Final Minutes

40th Meeting of the NECC
April 22nd, 2003
River Center – Davenport, Iowa

Nicole McVay
(CEMVR-PM-A)

NECC 40
April 22nd, 2003

8:11 - Welcome
Ken Barr welcomed everyone and had all attendees introduce themselves there were 33 people present; including 6 participates joining by phone (Attachment 1).

From 8 until 10 the Expert Panel was scheduled to make presentations to the NECC/ECC. **John Barko**, co-chair of the Expert Panel, briefed NECC/ECC members on the purposes of the expert panel as well as the progress that has been made during the 3 previous meetings of the expert panel. He discussed that during the next two days the expert panel will review writing responsibilities and develop a schedule to finalize the work. He mentioned that the panel values input from the NECC.

8:20 – Theiling – Review Resource Management Objectives
Chuck Theiling provided 3 handouts to participants: Management Action matrix (Attachment 2), Ranking of Management Actions (Attachment 3), Ranking of Objectives (Attachment 4). Chuck then presented a PowerPoint presentation and began by discussing the Management Action (MA) matrix (Attachment 5). He said the expert panel narrowed the environmental objectives down to 82 more general objectives. Those 82 objectives were placed into the MA matrix. Dan Wilcox rated each MA/objective combination with a 1, 2, or 3 as to ecological effectiveness (1= marginally effective, 2= effective, 3 = very effective). In the Excel spread sheet of the MA matrix there are red triangles. By clicking on these triangles Dan Wilcox's comments become visible. Dan Wilcox, the Expert Panel, and the Rock Island District Corps of Engineers have reviewed this ranked matrix. The electronic version of the matrix will be sent to the NECC for their review. Chuck then pointed to the one page, back-to-back handout (Attachment 4) that showed the 82 objective actions scored by the number of MA that would achieve the particular objective. Scores were figured from adding the 1,2, and 3 rankings from the matrix. He noted that the highest scoring objectives are all related to maintaining viable species. He found it interesting that this shows that we are concerned with protecting biota. Next he discussed the several page handout (Attachment 3) that sorted MA by rank of likelihood to achieve objectives. He noted that some MA weren't scored at all and said that was a good way to begin to pare the list down. He pointed out that "efforts to acquire new property" and "ways to manipulate flow" were scored highly. Again, he said this indicated what we are thinking. Water level management was in the middle of the ranking. He noted that the lower scored items are not less important, just more specific. Highly scored MA are more likely to achieve more objectives. He stated that there is still some editing to be done. Finally, he discussed the relational database that is being generated from the matrix. He demonstrated a few queries from the database and displayed several reports that were generated. He informed the participants that each report was being reviewed in an effort to edit the matrix and database.

Comments/Questions:
Hank DeHaan commented that it will be possible to query the database by looking at one particular objective and get a ranking of MA's applicable to that objective, or by grouping a set of objectives and obtaining a report that will rank the MA based on all of the objectives. It could be a tool useful in identifying objectives that a manager may not have considered.

Bernie Schonoff was concerned that there is a large difference in scale among the management actions. He was surprised at the low ranking that the Galloway report received. He was unsure of the usefulness of the tool with such differing MA. **Theiling** responded that this tool is used to identify MA that will be able to address individual objectives. He thought that the limited number of objectives that the Galloway Report addressed might have been the factor for the lower ranking. **Dan Wilcox** added that there is a disparity of scale because some MA are implemented daily and others only every few years. Additional information will be linked to the management actions to provide further detail on management action applicability by river reach, required frequency of application, and sequence of implementation. The study team is trying to identify alternatives for the Navigation Study and that this is one tool to help formulate different alternative plans.

Ken Lubinski commented that he saw the value of the worksheet when managers may have several different objectives that they will try to address at any one time. He wondered when the Navigation Study would have the different alternatives identified. **Barr** responded that much of the data for the alternatives is expected to come from the small working groups such as the fish passage and water level management groups. However, this matrix and resulting database would be useful in identifying other measures to include in the Alternatives.

Gretchen Benjamin stated that she was still concerned that this database was based upon the workshops. She felt that the database should be based more upon the HNA, pool plans and other tools that managers spent lots of work identifying goals and objectives for. She felt there was a need to look broader, not focus on the different types of dredging, for example. **Barr** responded by saying that the backbone for what went into the workshops was the HNA, pool plans and other studies. Therefore they are still part of this database, and have not been lost.

Lubinski expressed his concern that the expert panel has run out of time. The panel was supposed to review a set of objectives and link them to MA. However, they have spent a lot of time massaging the objectives into a set that can be reviewed. There isn't time to review and massage them anymore and there are only a few weeks left to link them to MA. **Theiling** commented that this process would be ongoing. There will be time to change the fine details for individual projects, but for Congress things need to be lumped together.

8:45 – Resource Management Teams

Davinroy – Dike Alteration and Side Channel Restoration

Rob Davinroy presented a PowerPoint presentation (Attachment 6) to the NECC. He discussed that the study began about 10 years ago and included micro modeling, numerical modeling, site visits and engineering design. MODOC, FWS, American Land Conservancy, RIAC, CEMVP, and ILDNR published a report in 1997. There has been some Congressional legislation drafted from this work, and **Davinroy** suggested that the study's recommendations could be part of the Navigation Study. He next discussed the Historical Morphology Study that has just been completed. The study looked at georeferenced 1817 Government Land Office photos and looked at the plan form changes that have taken place over time. By reviewing a succession of pictures taken over several years trends can be identified. Many people assume that removing a closing structure to a side channel will help it. However in some cases it may actually hurt it. Rob showed the Crawford Chute Restoration Area and showed some possibilities for project features.

Comments/Questions:

Chris Brescia mentioned that he was working with the Land Conservancy to get these recommendations added to WRDA 03, and that his organization will be supporting this.

Lubinski asked if there would be any monitoring performed in conjunction with any federal project. **Davinroy** responded that most monitoring tends to take a water quality focus, but he would like to see fish and wildlife monitoring added. He said there were some plans for monitoring any potential projects.

Wilcox – Fish Passage

Dan Wilcox passed out a hand out (Attachment 7) and presented some PowerPoint slides (Attachment 8). He discussed that the Fish Passage workgroup met in Feb of 2003. The group identified two main objectives related to fish passage: viable fish populations, and viable mussel populations. He used the Skip Jack Herring/ Ebony Shell mussel example. Skip Jack Herring is the only know host for the Ebony Shell mussel and it cannot pass through LD 19, therefore there is no Ebony Shell recruitment above 19. He discussed that there is some literature on the prolonged swimming speed of Paddlefish, blue catfish and others; and while they are strong, they are not as strong of swimmers as some invasive species. He discussed that the 1932 LD authorizing language mentioned that fish ways would be designed if necessary. He then began to discuss that the Corps understands hydraulic conditions at the navigation dams and that the lowest velocities usually occur during uncontrolled conditions and this allows some fish to pass through the system.

The spillways are usually impassable by fish, but the lock chambers are a way for some fish to up the river. However, the locks are not a pathway for the movement of whole communities of fish. Next, he showed an outline of the report and discussed that benefits will be calculated based upon the amount of habitat in each pool (benefits of fish passage for additional habitat). Then he showed different types of fishway and said that the technical fishways may not be the way to go because they tend to target specific species, but the Ottertail fishway in Minnesota has been effective. He concluded by saying that the final report should be to the Rock Island Corps in June.

Comments/Questions:
Davinroy asked how wide the fishways would have to be since the locks were not able to allow entire communities of fish to travel upstream. **Wilcox** responded that the bigger the better, and for the UMRS it should be as large as a given site will allow. He said the passages should try for 5% of the total discharge. He also pointed out that fish are attracted to flow. If they can find a path they can ascend, they will. The problem with the lock chambers is that there is little flow, and it is not in the direction that they fish are used to.

Gordon Farabee asked if any thought had been given to the movement of fish during drought years (when there isn't an open river condition). He said that is might be prudent to open a dam gate to allow for some fish passage. He suggested a MA that would allow for fish passage during drought years. **Wilcox** responded that the team had considered that, however that when there is a low river discharge there is maximum head difference at the dam. If a gate is opened there will be large velocities, and because of the structure of the dam there are set velocities that cannot be exceeded.

Landwehr – Water Level Control
Kevin Landwehr provided a read-ahead to the NECC (Attachment 9) and gave a PowerPoint presentation (Attachment 10). In his presentation he identified the goals of the workgroup. He discussed the prioritization process and discussed that this will be used not to exclude any pools, but to help choose which pools make the most sense and to focus the workgroups efforts. Prioritization was based upon Need, Natural Constrains, Major Constraints, and Impacts to other users. He pointed out that Navigation was previously the highest priority, but given the restructured study it could be analyzed with equal purpose to the environment. He then showed the anticipated success rate of a 60-day, 2-foot drawdown based upon flow regimes of the pools. He mentioned that for some pools there is substantial data to evaluate benefits while in other pools there is limited data. He said that the group would have a draft prioritization done by the end of the week, and a draft report would be ready in June.

Lubinski – Large scale floodplain restoration
Ken Lubinski passed out a handout detailing The Nature Conservancy's work on Emiquon (Attachment 11). He discussed that the objectives in the restoration project are similar to the Environmental objectives of the Navigation Study, but he wanted to point out some components in the vision statement. He said that the 3 secondary objectives are somewhat unique: evaluate potential of strong floodwaters, education programs, and demonstrate economic strategies. He said that he was making these points because the expert panel has been focused on ecological benefits. He pointed out that large-scale projects aren't done in a vacuum and will affect regional economics. The costs should not be just ecological, but should include non-ecological costs as well, especially with regional economical strategies and flood damage effects.

9:30 – Bain – Ecological/Environmental Endpoints
Mark Bain gave a PowerPoint presentation to the group (Attachment 12). Mark discussed the properties of endpoints (sense of a trend, driven by stakeholder values, practical, numerical, easily understandable). He said he wanted to be able to capture about a third of the Essential Ecosystem Characteristics (EEC). He next discussed the process of identifying endpoints. He started with the Environmental objectives from the workshops, Chuck's matrix, and the criteria for endpoint selection. First he removed redundant objective and then scored them based on: policy and management relevance, technical merits, and practicality. Any candidates that had all three criteria as yes were considered possibilities. Currently there are 24 endpoints:

5 for habitat, 6 for biota, 4 for geomorphology, 4 for water quality and 5 for H&H. For each endpoint a 1-page description of the endpoint including definition, policy and management relevance, technical merit, practicality and measures could be developed. He displayed an example of one of these pages. Mark discussed that some things to keep in mind are that big ideas and emerging issues dropped out of this process for endpoint selection. Also, there are currently too many endpoints. He said that this was the first time that anyone else has seen these endpoints and that he welcomes comments/suggestions.

Comments/Questions:
Barko commented that the expert panel would have a more in depth discussion regarding endpoints during their meeting.

9:45 – Nestler/Lubinski – Environmental sustainability/Integrating expert panel recommendations
John Nestler had a PowerPoint presentation for this section of the meeting (Attachment 13). He first discussed the definitions of sustainability and said the academicians and water resource managers tend to have separate ideas of what sustainability is. He said it is important to keep this in mind because the Navigation study is being formulated by mangers, but will be reviewed by academia. He said that the EEC's that have been developed work very well with both viewpoints. Next he discussed having a template to work towards and said that large projects should have some type of reference condition, whether it is a historic condition, an external condition such as a similar river/watershed, or even a created template to work toward. He discussed the historical information that is available and said that many processes are related to residence time in water. Why are certain processes different now than in the 1800's? He said another possible reference condition would be to have an internal reference of some healthy segments of the river system. For an external reference he suggested the Prana River in South America. It has similar watershed and flow regime to the Mississippi, but is still predominantly connected to its backwaters. He mentioned that the University of Iowa is currently pursuing this type of analysis. Finally, as to developing a strategy outside of existing reference conditions, he mentioned that both the Chesapeake Bay and the Everglades projects used this approach. He demonstrated the use of a virtual reference by combining historical, internal, and external references.

Comments/Questions:
Lubinski asked what was the primary difference in using a reference river approach then just following the goals and objectives? **Nestler** replied that there are 2 things. One there is a need to have a higher order concept that the team is marching towards. That way there is a good answer when someone asks what are will be achieved. He commented that this made him think of the Columbia River project where there is no embracing concept, so a lot of smart people have come up with nonproductive, expensive technical answers. Secondly, he said that this could give more details. When deciding where to construct new islands the decisions to have 1 500-acre island or 5 100-acres islands can be found in the reference, but not in the technical.

Wilcox mentioned that he liked the idea of a reference condition, but how could this capture the ideas of sustainability and resilience; possibility through modeling? **Nestler** responded that it should be considered on 2 different scales: a single project timeframe and as cumulative impacts timeframe. He noted that it has taken 150 years for the UMRS to get where it is now. He offered the suggestion that the use of regulatory efforts can help make small, natural fixes that can help the system border on self-maintaining, allowing the natural resilience of the system to take over.

Barko commented that there are 2 types of endpoints – "Process" types of endpoints that Nestler had been discussing, and "Thing" type endpoints that had been the focus of Bain's presentation. These two ideas should be linked together.

11:12 – Bluhm – Public Meetings
Kevin Bluhm presented PowerPoint slides for the meetings (Attachment 14). His presentation discussed the goals of the meetings, the objectives for the meetings, and displayed the draft faming statement for the questionnaire. He also showed the possible meeting locations as well as meeting formats. Definite locations would include 1 city in each state (St. Paul, La Crosse, Bettendorf, Peoria, and St. Louis) Additional possible locations included: Quincy, Dubuque, Des Moines, and Chicago. There has been some

discussion to allow a 30-minute time period in the meetings for participants to fill out their comment cards. Other areas under consideration were whether to have an afternoon session, whether to have a court stenographer present, and whether to have security present. He said he would appreciate any comments.

Comments/Questions:
Heather Hampton-Knodle asked how the question and answer periods would work. **Bluhm** responded that until he knew how the alternatives would shape up he was unsure. **Lundberg** said that tentative plans would be presented at the meetings. He hopes that states and agencies will be interested and will provide comments that can be utilized to formulate the finalized alternatives. The Corps will have to take all comments into consideration when determining the final plan. All of the Corps' decisions will be part of the draft report that will go out the first of April.

Beorkrem stated that he felt the workshops had 2 main points: 1 – regain public trust, and 2 – state the viability of the project. He felt that a court stenographer would be valuable because it adds a level of trust to the meeting. He also didn't think that had been any problems with security in the past so was unsure if security would be an issue. **Bluhm** said that one of the biggest issues to security was of a legal standpoint. What is the responsibility of a federal agency?

Schonoff said that he though an afternoon session is very important because many people work a late shift. He also supported meetings held in Quincy and Dubuque. **Hampton-Knodle** concurred that Quincy meeting would be important.

Brescia said he would offer comment once he saw the minutes.

Rick Moore supports meetings in Quincy and Dubuque. He also wondered if a pubic survey would be appropriate. **Bluhm** said that the team had discussed public surveys but decided it was too difficult to make them statistically defensible. He said that the public meetings get a pulse of the interested, concerned and affected public. The meetings may only get a sliver of the general public, but those that truly care will be there. He also said that the entire meeting will be on the website and in the newsletter.

11:45 – Lunch

12:30 – Manguno – Preliminary Economic Modeling Results
Rich Manguno gave a presentation with slides discussing the most current Economic modeling results (Attachment 15). Rich began his presentation by discussing the status of the study. Results from the traffic models are currently being analyzed. The results are beginning to be run through the alternatives models. The tow information from the traffic results will also be used in the environmental framework to determine mitigation requirements. The mitigation costs will be added to the final economic analysis.

Hampton-Knodle asked if mitigation was the appropriate term to be used. **Manguno** replied that is was correct. In this instance he was talking about direct construction impact, which is different than ecosystem needs.

Manguno continued his presentation on slide 2. He mentioned that Alternative 1 was no action, while Alternatives 2 and 3 were both non-structural alternatives. In slide 3 he noted that there had been a change from the Interim Report. Instead of having guide wall extension the alternatives now call for switch boats. He said the team reevaluated performance and cost, and switch boats show greater timesavings and are less costly. They will allow barges to re-make outside of the lock chamber. Costs were calculated for having 2 dedicated switch boats at each site (one for upstream and the other for downstream barges). Depending upon location, switch boats were about 5 min better than guide wall extensions and cost about $3.5 mil/boat/year, which was less than the annualized cost of the guide wall extensions. Costs were figured based on vessel output costs that the Corps maintains including the variable costs such as insurance, fuel, and administrative costs. It was assumed that switch boats would be contracted. For slide 3 he also mentioned that a progression was assumed, as larger improvements were made downstream, additional improvements were made upstream.

Moore asked if the costs used were the same as the initial navigation study. **Manguno** answered that the numbers were reviewed, but only a few changed. Lock extension costs did not change, but some of the new locks did, depending upon location. **Lundberg** added that $200 mill would be a general estimate for a new lock. He said he is planning on having as easily understandable format posted to the web soon.

Hampton-Knodle asked if at the new 1200ft locks, would the 600ft locks remain? **Manguno** replied that yes, there would be the existing 600ft lock and the new 1200ft lock. It is anticipated that recreation crafts would lock through the old 600' lock. **Hampton-Knodle** then asked where the new locks would be located. **Lundberg** replied that 25, Peoria, and La Grange would be landside, the others would be riverside.

Manguno continued his presentation on Slide 4. He mentioned that both the Tow Cost and Essence Models were being used, but the data presented was from the Tow Cost model because the Essence data was a little behind. This data needs to be viewed as preliminary information, because the input is still in the process of being reviewed, so numbers may change if the input is changed. He then showed the next several slides of results. He mentioned that under Less Favorable Incremental (Slide 10) Alt 4 added about 20 tows per year, and Alt 5 an6 added and additional tow per day (very little difference between the two). For the Most Favorable – Incremental slide he pointed out that Alternative 5 may change. Some input data for Lock 15 may need to be changed. Rich also emphasized that the graphs show traffic, whereas the economic modeling will use the benefits of the traffic. It is possible to see a modest change in traffic and a more significant change in benefits. By lessening delays traffic may only slightly increase, but the transportation savings is the metric that will be used, not the number of tows.

Comments/Questions:
Moore asked if the scenarios represented the amount of grain exported, and was it consistent across the alternatives? **Manguno** replied that traffic consisted of grain and other commodities. The scenarios represented unconstrained demand. Under the without project condition some proportion of that potential will be achieved. In alternative 4 a higher proportion of that potential will be achieved. The traffic associated with each scenario is not some homogeneous lump; it is a mixture of commodities that don't grow at the same rate. Don't think of the system's capacity in the physical sense, think of it in terms of economic capacity. Before physical capacity is reach, economic capacity kicks in. Economic capacity is governed by the cost of being on the waterway and the willingness of a commodity to be on the waterway. Different commodities have different willingness to pay. Because of this the same level of traffic is not achieved across the range of scenarios.

Moore then had a question about the Most Favorable Incremental Traffic Scenario – Looking at Alternative 6 there is a 3 boat increase. How does the data from the traffic of the Tow Cost differ from Essence? These seem like small numbers to me. **Manguno** replied that at this point it is fair to say that this is an artifact of all the numbers incorporated into the model. **Barr** added that the Central Scenario without traffic compared close to the old Faucet forecasts.

Manguno discussed some additional Economic Items. There was a 2-day meeting with Volpe (the contractor considering non-structural alternatives). The first meeting was with lockmasters, Corp Operations personnel, and industry people. Volpe wanted to solicit information of waterways operation. The second day focused on academic/planner types to solicit similar info, but with a focus on identifying other measures (scheduling, tradable use, small improvements to the operation (crew training, mechanical assist on winches etc.)). At the last NECC meeting there was some question as to whether there will be any RED (Regional Economic Development) with ecosystem measures. He said yes, there would be for the construction impacts of the measures. The general objective is to leverage the resources of the Navigation Study and the Comprehensive plan.

Hampton-Knodle – stated that a multi-purpose, rather than a dual- purpose authority might be appropriate. Instead of just navigation and the environment it should be navigation, the environment, and flood protection.

Beorkrem added that he was concerned that tourism and habitat impact won't be considered. **Manguno** replied that there is a lot of work to establish those relationships, outside of developing the model. He said that this study group does not have the resources to develop this data. **Barr** added that the National Academy of Science recommended that the study take this into consideration by using a Contingent Value Methodology (CVM). After consideration, it was decided that CVM would not be used. However, available information will be presented in the report in a qualitative assessment.

1:00 – Lundberg – Pathways Workgroup

Denny Lundberg presented a short PowerPoint presentation (Attachment 16). He said that he had just received a scope and would get it out to a small group for review. He hoped to have a straw man document put together in about 45 days. Hopefully that will be a good tool to engage the states. He presented the Study Schedule and pointed out the GLC meeting on May 13th. He also mentioned that there would be an initial meeting with the National Research Council. A scope has been approved, and they will be engaged throughout the study. There will be an initial briefing in the June-July timeframe. He said that a small subset, possibly the oval team, would be at the briefing.

Comments/Questions:

Beorkrem mentioned that he would like to meet with everyone. **Lundberg** replied that the NRC would probably want to do that, but not at the initial meeting. He then asked when the next NECC meetings would be. **Barr** responded sometime in July, after the impact and performance data was available. **Lundberg** added that another meeting in the September timeframe would be important.

The group decided that July 8th and 9th would be the next meeting dates. (Note, due to modeling delays this meeting will be rescheduled for late July, July 29th – 30th).

2:30 – DeHaan – Decision Model

Hank DeHaan gave a PowerPoint Presentation (Attachment 17). He began his presentation discussing the Formulation process and how it corresponds to the Corps' 6 step planning process. Hank then discussed Navigation Alternatives and displayed the Navigation Alternative Assessment Matrix. He discusses that each Alternative/Scenario combination would be rated based upon evaluation criteria possibly to include risk, robustness, adaptability, and acceptability. The next part of his talk focused on the environmental sustainability component of the study. He discussed the Essential Ecosystem Characteristics developed by the expert panel. He then reviewed the Ecosystem Objective/Management Action relational database that **Theiling** had presented before lunch. Next, he presented a list of potential evaluation criteria to be used to assess ecosystem Alternatives. The list of potential criteria included: completeness/robustness, effectiveness, efficiency, acceptability, risk, uncertainty, adaptability, compatibility. The next slide depicted possible criteria, tools and rating scores for each evaluation criteria. He then discussed how each ecosystem alternative would be assessed using a matrix similar to the Navigation Alternatives Matrix. He said that when the Navigation and Ecosystem alternatives are combined the team would be looking at where there may be conflicts and complements between the two. The team will refine alternatives and move to a selected multi-use plan. He concluded by showing the study schedule.

Comments/Questions:

Hampton-Knodle asked what the definition of robustness was. **DeHaan** replied that is was the ability to address multiple component needs of the UMR-IWW ecosystem (e.g., geomorphology, habitat, etc.).

Moore asked if the cost benefit would be dollar for dollar or more a ratio. **DeHaan** answered that for the Ecosystem Sustainability component it could be a ratio of cost to proportion of objectives.

Moore asked if there was a way to assign a dollar amount needed to be able to stabilize the system. **Barr** replied that the study would be able to identify the without project condition and attempt to evaluate the difference between that and stable conditions. The team will also try to measure the difference from the virtual reference and a given investment level (alternative).

Benjamin stated that some ecological measures may not contribute to many of the objectives but are very important to the overall health of the ecosystem as a whole. **DeHaan** replied that Environmental Quality

(included as one of the management actions evaluated on criteria) should capture the increased importance of these objectives and related management actions.

3:00 – Keevin- Fish Studies

Tom Keevin prepared a PowerPoint presentation, but due to time constraints he did not present the material. Rather, he gave a brief summary of the studies. He said that the fish entrainment study was finishing, Kilgore is finishing up his last sampling effort, and the last fish avoidance study will be done soon. By the next meeting Tom said he would have results to present.

Comments/Questions:

Attwood asked if any sampling had been done just outside of the lock in the lock mortality study. **Keevin** replied that they had not sampled outside of the lock. **Attwood** then asked if anyone had taken the fish killed per mile and multiplied it out of the entire river an applied the American Fisheries costs to that? **Barr** replied that the study has not done this for direct adult impacts, but has used a similar method for equivalent adult loss from larval entrainment. **Keevin** added that the Killgore study has found that not many fish are killed.

3:10 – Barr – Types of Authorities

Ken Barr was going to present mylars of different existing Corps' authorities. He did not present them at the meeting but said they would be included in the minutes (Attachment 18). He said it was important for NECC members to be thinking about existing authorities.

Comments/Questions:

Attwood asked if the Navigation Evaluation Zone was still and idea that was being discussed. **Barr** replied that this idea has been set aside. Instead, if there is some way to identify an area that has experience the effects of the navigation project then it can be addressed. The conceptual models can help with this. This is a Navigation Study, and all recommendations will be tied to the Navigation Project. The Comp Plan is on a different tract and there will not be a combined recommendation from these two studies.

3:20 - Adjourn

Attachment 1

Attendence List
NECC Meeting 22 April 2003
River Center, Davenport, IA

Present	Name	Affiliation	Address	Phone	E-mail	Second Email	Cell	Fax
X	Butch Atwood	ILDNR - Fisheries	1000 Killarney Dr Greenville, IL 62246	618.664.2330	eatwood@dnrmail.state.il.us			
X	Mark Bain	Cornell University	Center of the Env. 200 Rice Hall, Ithaca, NY 14853	607.255.7535	Mark.Bain@cornell.edu			
X	John Barko	CEERD-EV-E	3309 Halls Ferry Road Vicksburg, MS 39180-6199	601.634.3654	John.W.Barko@wes02.usace.army.mil			
X	Ken Barr	CEMVR-PM-A	P.O. Box 2004, Clock Tower Bldg. Rock Island, IL 61204-2004	309.794.5349	Kenneth.A.Barr@mvr02.usace.army.mil			
X	Steve Bartell	Cadmus Group	78A Mitchell Rd. Oak Ridge, TN 37830	865.425.0401	sbartell@cadmusgroup.com			
X	Clint Beckert	CEMVR-ED-HQ	P.O. Box 2004, Clock Tower Bldg. Rock Island, IL 61204-2004	309.794.5412	Clinton.A.Beckert@mvr02.usace.army.mil			
X	Gretchen Benjamin	WI DNR	3550 Mormon Coulee Rd. La Crosse, WI 54601	608.785.9982	Gretchen.Benjamin@dnr.state.wi.us			
X	Mark Beorkrem	IL Stewardship Alliance	P.O. Box 370 Morrisonville, IL 62546	217.498.9707	beorkrem@ctitech.com			217.526.4449
Phone	Chris Brescia	MARC 2000	906 Olive Street, Ste. 1010 St. Louis, MO 63101	314.436.7303	Bresh@aol.com		314.421.3374	
X	Ken Brummett	MO DOC	653 Clinic Rd. Hannibal MO 63401	573.248.2530	brummk@mdc.state.mo.us			
Phone	Julianna Cruz	U.S. Maratime Admin.	2860 S. River Rd., Suite 185, Des Plaines, IL 60018	847.298.4838	Julianna.Cruz@marad.dot.gov			
X	Rob Davinroy	CE-SLD	Applied River Engineering Center, Foot of Arsenal St, St. Louis, MO 63113	314.263.4714	Robert.D.Davinroy@mvs02.usace.army.mil			
X	Hank DeHaan	CEMVR-PM-M	P.O. Box 2004, Clock Tower Bldg. Rock Island, IL 61204-2004	309.794.5853	Henry.C.DeHaan@mvr02.usace.army.mil			
Phone	Jeffrey DeZellar	CEMVP-PM-A	190 Fifth Street East St. Paul, MN 55101-1638	651.290.5433	Jeffrey.T.DeZellar@mvp02.usace.army.mil			
X	Gordon Farabee	Contractor	7509 Conty Rd. 332, Palmyra MO 63461	573.769.2620	sfarabeeen@monet.com			
X	Heather Hampton Knodle	UMIMRA	Hillsdale, IL		ink@cillnet.com			
X	Donald Kathan	US EPA	Mailcode B-19J 77W. Jackson Blvd, Chicago, IL 60604	312.886.0448	Kathan.Donald@epa.gov			
X	Tom Keevin	CEMVS-PM-E	1222 Spruce Street St. Louis, MO 63103-2833	314.331.8462	Thomas.M.Keevin@mvs02.usace.army.mil			
X	Carl Korschgen	USGS-CERC	4200 New Haven Rd, Columbia MO 65201	573.876.1901	carl_korschgen@usgs.gov			

Present	Name	Affiliation	Address	Phone	E-mail	Second Email	Cell	Fax
X	Kevin Landwehr	CEMVR-ED-HH	P.O. Box 2004, Clock Tower Bldg. Rock Island, IL 61204-2004	309.794.5578	Kevin.J.Landwehr@mvr02.usace.army.mil			
X	Amy Lee	USACE-ERDC	3909 Halls Ferry Rd, Vickburg MS 39180	601.634.2238	Amy.A.Lee@erdc.usace.army.mil			
X	Ken Lubinski	USGS-UMESC	575 Lester Ave Onalaska, WI 54650	608.783.7550 x61	Ken_lubinski@usgs.gov			
X	Denny Lundberg	CEMVR-PM	P.O. Box 2004, Clock Tower Bldg. Rock Island, IL 61204-2004	309.794.5632	Denny.A.Lundberg@mvr02.usace.army.mil			
X	Richard Manguno	CEMVN-PM-A		504.862.1923	Richard.J.Manguno@mvn02.usace.army.mil			
Phone	Catherine McCalvin	TNC	PO Box 305 Trempealeau, WI 54661-0305	608.534.6514	CMcCalvin@tnc.org		.608.317.7588	.608.534.6514
X	Nicole McVay	CEMVR-PM-A	P.O. Box 2004, Clock Tower Bldg. Rock Island, IL 61204-2004	309.794.5547	Nicole.M.McVay@mvr02.usace.army.mil			
X	Rick Moore	Isaac Walton League	820 Brickl Rd, West Salem, WI 54669	651.649.1446	rxmoore@iwla.org	rxmoore@centurytel.net		
X	Tatsuaki Nakato	Univ of Iowa	IIHR - Hydroscience and Eng, Univsity of Iowa, Iowa City, IA 52242	563.288.2888	tatsuaki-nakato@uiowa,edu			
Phone	Barb Naramore	UMRBA	415 Hamm Bldg, 408 St. Peter St., St. Paul, MN 55116	651.224.2880	Bnaramore@umrba.org			
X	Rick Nelson	USFWS	4469 48th Ave. Ct. Rock Island, IL 61201	309.793.5800	Richard_Nelson@fws.gov			
X	John Nestler	CE ERRD EL	3909 Halls Ferry Rd, Vickburg MS 39180	601.634.3870	John.M.Nestlre@ERDC.usace.army.mil			
X	Jean O'Neil	CEERD-EE-E	3909 Halls Ferry Rd, Vickburg MS 39180		L.Jean.O'Neil@ERDC.usace.army.mil			
X	Bernard Schonoff	IA DNR	3390 Hwy. 22 Muscatine, IA 52761	563.263.5755	fishiowa@muscanet.com	bernard.Schonhoff@dnr.state.ia.us		
X	Dave Sobalee	USGS-UMESC		608.781.6200	dave_sobalee@usgs.gov			
X	Charles Theiling	CEMVR-PM-A	P.O. Box 2004, Clock Tower Bldg. Rock Island, IL 61204-2004	309.794.5636	Charles.H.Theiling@mvr02.usace.army.mil			
X	Dan Wilcox	CEMVP-PE-M	190 Fifth Street East St. Paul, MN 55101-1638	612.290.5276	Daniel.B.Wilcox@mvp02.usace.army.mil			

Present	Name	Affiliation	Address	Phone	E-mail	Second Email	Cell	Fax

Attachment 2

Ecological Objectives and Need Statements	Water Quality	Achieve USEPA and state full use standards to improve water quality	Reduce contaminant loadings to the river	Manage contaminated sediments	Achieve USEPA and state non-point TMDL standards to improve water quality	Reduce fine sediment loadings to the river	Reduce coarse sediment loadings to the river	Reduce nutrient loading from tributaries to the mainstem river and Gulf of Mexico	Increase nutrient processing (e.g., denitrification) in river habitats	Maintain DO concentrations >5 ppm during ice free periods for fish	During winter-ice covered periods maintain DO concentrations >3 ppm, temperature	Create thermal and velocity refugia (e.g., holes >3 m) in backwaters and channels	Maintain water clarity sufficient to support submersed aquatic vegetation, aquatic
River Regulation													
Water control decision-making													
Directions to lockmasters													
Mainstem dam gate operation											1		
Make frequent gate adjustments to minimize fluctuatior													
Automate dam operation:													
Use dam point control more - limit hinge point operatior										2	2		1
Acquire real estate rights, modify regulation of Pools 24,25,26									3	2	2		2
Growing season drawdowns to promote emergent vegetation								1	3				3
Spawning season drawdowns to strand fish eggs (carp)													
Drawdowns to consolidate sediment									2				1
Drawdowns to promote scour in tributaries													
System-scale or multiple pool drawdown		1											3
Build dam gates, naturalize hydrologic regime IL River										3			1
Operate pools on high side during winter		1											
Higher, slight pulsing of winter water levels		1									3		
Maintain minimum water gradier													
Dredging													
Dustpan hydraulic													
Cutterhead hydraulic													
Mechanical				2								3	
Shore pipe, boosters to reach target sites													
Use small dredges to expand placement options												3	
Bend width reductions where appropriate													
Overdepth dredging to reduce frequency, volume													
Limited depth dredging to reduce volume				1									
Sediment trap dredging to reduce frequency, volume							1						
As-needed dredging - close monitoring				1									
Dredge backwater areas, increase depth												3	
Dredging to restore and create secondary channels										2		3	
Use land based excavators to move material during drawdowns													
Dredged material placement													
Unconfined placement in floodplain													
Unconfined placement to raise areas for mast-producing trees													
Confined placement in floodplain		2		2			1						1
Unconfined placement in channel													
Semi-confined channel placement (chevrons)													
Placement out of floodplain - beneficial use		2		2									1
Placement behind levees - agricultural areas		2		2									1
Placement of contaminated material out of floodplain		2		3			1						
Mimimize dredge slurry return water		2		2						1			1
Minimize bankside dredged material placement		2		2									1
Stabilize dredged material with soil				1									
Island construction (impounded areas)													2
Islands to create secondary channels													
Seed islands													
Place dredged material to create wetland areas													
Placement on existing, construct new beaches													
Maintenance of channel structures													
Wing dams (dikes)												3	
Closing dams												3	
Bank revetments													
Maintain flow split between main and off-channel										3	3	3	2
Modify flow splits between main and off-channel areas										3	3	3	2
Notch wing dams to create hydraulic, depth diversity												3	
Notch closing dams to increase side channel flow										2	3	3	
Remove closing structures to divert flow into side channels										2	3	3	
Construct temporary structures to divert flow										2		3	
Use structures to manipulate flow to maintain backwater depth										2	3	3	
Use larger rock, make bank revetments irregular												3	

Ecological Objectives and Need Statements	Geomorphology	Reduce bank erosion	Restore secondary channels	Create secondary channels	Increase ridge and swale floodplain topography	Consolidate flocculent backwater sediment	Restore channelized tributaries in the mainstem river floodplains	Restore fluvial dynamics (e.g., channel avulsion, secondary channel, distributary channels)	Reduce sedimentation in tributary deltas	Alter aquatic and terrestrial habitat connectivity	Restore and maintain connectivity between contiguous backwater and channel areas	Increase extent of contiguous backwater areas	Increase extent of isolated floodplain areas	Increase extent of isolated floodplain lakes	Increase unleveed floodplain at tributary confluences
River Regulation															
Water control decision-making															
Directions to lockmasters															
Mainstem dam gate operation															
Make frequent gate adjustments to minimize fluctuatior		1													
Automate dam operation:															
Use dam point control more - limit hinge point operatior		1										3			
Acquire real estate rights, modify regulation of Pools 24,25,26		1								2		3			
Growing season drawdowns to promote emergent vegetation		1				3									
Spawning season drawdowns to strand fish eggs (carp)						3									
Drawdowns to consolidate sediment						2									
Drawdowns to promote scour in tributaries						2									
System-scale or multiple pool drawdown		1				3									
Build dam gates, naturalize hydrologic regime IL River		1								3		2			
Operate pools on high side during winter										1		1			
Higher, slight pulsing of winter water levels										1					
Maintain minimum water gradier												1			
Dredging															
Dustpan hydraulic					3										
Cutterhead hydraulic			3	3	3		3			3	3	3	3	3	3
Mechanical			3	3	3		3			3	3	3	3	3	3
Shore pipe, boosters to reach target sites			2	2	3		3			3	3	3	3	3	3
Use small dredges to expand placement options			3	3	3		3			3	3	3	3	3	3
Bend width reductions where appropriate															
Overdepth dredging to reduce frequency, volume															
Limited depth dredging to reduce volume															
Sediment trap dredging to reduce frequency, volume									3						
As-needed dredging - close monitoring															
Dredge backwater areas, increase depth										3		3			
Dredging to restore and create secondary channels			3	3			3			3	3				
Use land based excavators to move material during drawdowns										3	2	3		3	
Dredged material placement															
Unconfined placement in floodplain					3			2					3		
Unconfined placement to raise areas for mast-producing trees					3			2					3		
Confined placement in floodplain					2								3		
Unconfined placement in channel								3							
Semi-confined channel placement (chevrons)															
Placement out of floodplain - beneficial use															
Placement behind levees - agricultural areas															
Placement of contaminated material out of floodplain															
Mimimize dredge slurry return water															
Minimize bankside dredged material placement								2			2				
Stabilize dredged material with soil															
Island construction (impounded areas)										3					
Islands to create secondary channels			3	3						3	2				
Seed islands										3					
Place dredged material to create wetland areas										3					
Placement on existing, construct new beaches		2								3					
Maintenance of channel structures															
Wing dams (dikes)		2	3	3							2				
Closing dams											3				
Bank revetments		3									3				
Maintain flow split between main and off-channel		1	3	3					3		3	3			
Modify flow splits between main and off-channel areas		1	3	3		3		3	3	3	3	3			
Notch wing dams to create hydraulic, depth diversity			3	3											
Notch closing dams to increase side channel flow			3	3						3	3				
Remove closing structures to divert flow into side channels			3	3		2		3	3	3	3	3			
Construct temporary structures to divert flow			3	3		3		3	3	3	3	3			
Use structures to manipulate flow to maintain backwater depth						3		3	3	3	3	3			
Use larger rock, make bank revetments irregular		3									3				

Ecological Objectives and Need Statements	Hydrology/River Hydraulics	Naturalize hydrologic regime.	Reduce stage and discharge fluctuations caused by dam operation	Restore desirable stage discharge relationship	Provide for low water period during the growing season to restore aquatic vegetation	Restore or naturalize hydraulic interactions between the river and tributaries	Maintain minimum hydraulic gradient during very low flow periods	Minimize adverse flow fluctuations caused by hydropower operations on tributaries	Minimize adverse effects of elevated water table on soil moisture conditions	Maintain maximum controlled pool stage (or greater if possible) during the winter	Increase flexibility of dam operations (e.g., widen control limits)	Restore desirable hydraulic connections between the river and backwater or floodplain	Restore ecological benefits of the flood pulse (e.g., increase available flood flow storage)	Provide desirable pattern of hydraulic conditions in tailwaters (e.g., increase area of <0.3	Restore desirable longitudinal hydraulic connections across the dams to enhance	Reduce wind fetch in open water areas (e.g., backwaters and impounded areas)	Restore desirable current velocity and residence time in aquatic areas
River Regulation																	
Water control decision-making			3	3	3		3	3		3	3			3	3		3
Directions to lockmasters			3	3	3		3	3		3	3			3	3		3
Mainstem dam gate operation			3	3	3		3	3		3	3			3	3		3
Make frequent gate adjustments to minimize fluctuatior			3	3	3		3	3		3	3			2	2		2
Automate dam operation:			2	2	2		2	2		2	2			2	2		2
Use dam point control more - limit hinge point operatior			3	3	3		2	3		3	3	3					2
Acquire real estate rights, modify regulation of Pools 24,25,26			3	3	3		2	3		3	3	3					2
Growing season drawdowns to promote emergent vegetation				3	3		3		3		3						
Spawning season drawdowns to strand fish eggs (carp)				3	1		1		1		3						
Drawdowns to consolidate sediment				3	3		3		3		3						
Drawdowns to promote scour in tributaries				3	3	1	3		3		3	2					
System-scale or multiple pool drawdown				3	3		3		3		3						
Build dam gates, naturalize hydrologic regime IL River			3	3	2	2	2		2		3			3			3
Operate pools on high side during winter										3	3	2					3
Higher, slight pulsing of winter water levels										3	3	2					3
Maintain minimum water gradier				1			3		2		3	2					1
Dredging																	
Dustpan hydraulic																	
Cutterhead hydraulic						3						3				3	3
Mechanical						3						3				3	3
Shore pipe, boosters to reach target sites						3						3				3	3
Use small dredges to expand placement options						3						3				3	3
Bend width reductions where appropriate																	
Overdepth dredging to reduce frequency, volume																	
Limited depth dredging to reduce volume																	
Sediment trap dredging to reduce frequency, volume																	
As-needed dredging - close monitoring																	
Dredge backwater areas, increase depth												3					
Dredging to restore and create secondary channels												3					
Use land based excavators to move material during drawdowns												2				3	3
Dredged material placement																	
Unconfined placement in floodplain						2			3							1	
Unconfined placement to raise areas for mast-producing trees									3							3	
Confined placement in floodplain																	
Unconfined placement in channel																	
Semi-confined channel placement (chevrons)																2	
Placement out of floodplain - beneficial use																	
Placement behind levees - agricultural areas									1								
Placement of contaminated material out of floodplain																	
Mimimize dredge slurry return water																	
Minimize bankside dredged material placement																	
Stabilize dredged material with soil									2								
Island construction (impounded areas)									3			3				3	3
Islands to create secondary channels									3			3				3	3
Seed islands																2	2
Place dredged material to create wetland areas												3				3	
Placement on existing, construct new beaches									2								
Maintenance of channel structures																	
Wing dams (dikes)														3			2
Closing dams														3			2
Bank revetments														3			2
Maintain flow split between main and off-channel						3						3		3			3
Modify flow splits between main and off-channel areas						3						3		3			3
Notch wing dams to create hydraulic, depth diversity												2		3			3
Notch closing dams to increase side channel flow						2						3		3			3
Remove closing structures to divert flow into side channels						2						3		3			3
Construct temporary structures to divert flow						3						3					3
Use structures to manipulate flow to maintain backwater depth						2						3					3
Use larger rock, make bank revetments irregular														3			3

Ecological Objectives and Need Statements	Habitat	Restore and maintain a diverse mosaic of plant communities	Increase extent, abundance and diversity of submersed aquatic plants	Increase extent, abundance and diversity of emergent aquatic plants	Increase extent, abundance and diversity of floodplain grassland	Increase extent, abundance and diversity of floodplain shrub cover	Restore and maintain large contiguous grassland patches (>1,000 acres)	Restore and maintain large contiguous forest patches (>1,000 acres) with connected	Restore and maintain large contiguous wetland patches (>1,000 acres) every 30 - 40	Restore age and species diversity in floodplain forests	Maintain and restore geomorphic diversity in aquatic and floodplain areas	Restore physical habitat features in MMR	Restore or increase sand bar habitat	Maintain or increase depth of existing secondary channels	Increase topographic diversity (e.g., Increase elevation by two meters on 10% of all	Restore, create islands	Restore, create rapid and riffle habitat	Restore, create sand/mud flats	Restore, create, gravel bars	Restore and maintain substrate diversity in channels, (e.g., >2% of substrate area gravel	Restore and maintain backwater areas for sport and commercial fish	Provide for longitudinal fish passage in the mainstem and tributary rivers	Increase marsh habitat management opportunities in leveed areas	Maintain current areal abundance of crop land	Restore habitat corridors (eg riparian forests, contiguous prairie, etc.)	Create, maintain vegetated riparian buffer strips along tributaries and ditches basin-wide	Restore tributaries and floodplain streams	Create, restore floodplain terrestrial habitats.	Restore habitat on islands	Increase woody debris in secondary channels	Restore aquatic habitat every 10 miles in MMR (dike alteration)	Provide deepwater fish overwintering areas (e.g., depth range 0-3 m every 2 miles)
River Regulation																																
Water control decision-making			3	3					3									2			3	3										3
Directions to lockmasters			3	3					3									2			3	3										3
Mainstem dam gate operation			3	3					3									2			3	3										3
Make frequent gate adjustments to minimize fluctuatior			3	3					2									2			3											2
Automate dam operation:			2	2					2									1			2	1										
Use dam point control more - limit hinge point operatior			1	1					2												2											
Acquire real estate rights, modify regulation of Pools 24,25,26			1	1					3									2			3											
Growing season drawdowns to promote emergent vegetation			3	3					3									2			3											
Spawning season drawdowns to strand fish eggs (carp)			1	1					1									1			3											
Drawdowns to consolidate sediment			1	1					2		2							2			3											
Drawdowns to promote scour in tributaries			2	3					2		3						2	2	2	2	3						2					
System-scale or multiple pool drawdown			3	3					3		2							2			3											
Build dam gates, naturalize hydrologic regime IL River			1	1							2										3						2					
Operate pools on high side during winter																					3											3
Higher, slight pulsing of winter water levels																					3											3
Maintain minimum water gradier																																
Dredging																																
Dustpan hydraulic					3	3			1	3	3	3	3	3	3	3		3	3		3							3	3			
Cutterhead hydraulic				3	3	3			1	3	3	3	3	3	3	3	3	3	3	3	3						3	3	3			3
Mechanical				3	3	3			1	3	3	3	3	3	3	3	3	3	3	3	3							3	3			3
Shore pipe, boosters to reach target sites				3	3	3			1	3	3	3	3	3	3	3	3	3	3	3	3						3	3	3			3
Use small dredges to expand placement options				3	3	3			1	3	3	3	3	3	3	3	3	3	3	3	3						3	3	3			3
Bend width reductions where appropriate																																
Overdepth dredging to reduce frequency, volume																																
Limited depth dredging to reduce volume																																
Sediment trap dredging to reduce frequency, volume																											2					
As-needed dredging - close monitoring																																
Dredge backwater areas, increase depth											2	2									3											3
Dredging to restore and create secondary channels											2	3		3		3	3	2	3	3	3											3
Use land based excavators to move material during drawdowns													2	1			2	2	2	2	2								2			2
Dredged material placement																																
Unconfined placement in floodplain					3	3				3	3	3			3												2	3	3			
Unconfined placement to raise areas for mast-producing trees						2				3	3	3			3												2	3	3	1		
Confined placement in floodplain					2	2				1	1	1			2												1	2	2			
Unconfined placement in channel												3	3	3			3	3	3	3											3	
Semi-confined channel placement (chevrons)						2					2	2	3	3		3	2	3	2	2											3	
Placement out of floodplain - beneficial use																																
Placement behind levees - agricultural areas																																
Placement of contaminated material out of floodplain																																
Mimimize dredge slurry return water																					2											
Minimize bankside dredged material placement											1										2									2		
Stabilize dredged material with soil					3	3				3	3	3									1								3			
Island construction (impounded areas)			3	3	3	3			3	3	3				3	3	2	3	2	2	3							3	3			
Islands to create secondary channels				2	3	3				3	3	3	3	3	3	3	2	3	2	2								3	3		3	3
Seed islands			2	2	1	2			1		2	2	3	2		3	2	3	2	2								2			2	2
Place dredged material to create wetland areas			3	3		2			1		3	3				3		3			3								3			
Placement on existing, construct new beaches											3		3			1		1										2	2		2	
Maintenance of channel structures																																
Wing dams (dikes)											1	1		2			2		2	2											2	
Closing dams											1	1		2			2		2	2	3										2	
Bank revetments											1	1		2			1		1	1									2		2	
Maintain flow split between main and off-channel			3	3					2		3	3		3			3	3	3	3	3				3			3	3		3	3
Modify flow splits between main and off-channel areas			3	3					2		3	3		3			3	3	3	3	3				3			3	3	3	3	3
Notch wing dams to create hydraulic, depth diversity											3	3	2	2			2	2	2	2											3	3
Notch closing dams to increase side channel flow				3							3	3		3			2	2	2	2	3									2	3	3
Remove closing structures to divert flow into side channels				3							3	3		3			2	2	2	2	3							3		3	3	3
Construct temporary structures to divert flow				3							3	3	2	3		3	2	2	2	2	3							3		3	3	3
Use structures to manipulate flow to maintain backwater depth			3								3	3					2	2	2	2	3											3
Use larger rock, make bank revetments irregular											3	3	2	3			1			1									3		3	3

Ecological Objectives and Need Statements	Biota	Restore populations of endemic state and Federal protected species throughout their range	Maintain viable populations of native plant species and communities throughout their	Maintain viable populations of native invertebrate populations throughout their range in	Maintain viable populations of native mussel populations throughout their range in the	Maintain viable populations of native fish populations throughout their range in the Uppe	Maintain viable populations of native amphibian and reptile populations throughout their	Maintain viable populations of native bird populations throughout their range in the Uppe	Maintain viable populations of native mammal populations throughout their range in the	Control or eliminate exotic and invasive species throughout the Upper Mississippi River
River Regulation										
Water control decision-making			3			3	3	3	3	
Directions to lockmasters			3			3	3	3	3	
Mainstem dam gate operation			3			3	3	3	3	
Make frequent gate adjustments to minimize fluctuatior						2	3	3	3	
Automate dam operation:						1	1	1	1	
Use dam point control more - limit hinge point operatior			3			2	2	2	2	
Acquire real estate rights, modify regulation of Pools 24,25,26			3			3	3	3	3	
Growing season drawdowns to promote emergent vegetation			3	3		3	3	3	3	2
Spawning season drawdowns to strand fish eggs (carp)			1		2	3	1		1	2
Drawdowns to consolidate sediment			3	1		2	2		1	2
Drawdowns to promote scour in tributaries			3	1		2	2		1	2
System-scale or multiple pool drawdown			3	3		3	3	3	3	2
Build dam gates, naturalize hydrologic regime IL River			2	2	2	3	3	2	2	
Operate pools on high side during winter						3	1		2	
Higher, slight pulsing of winter water levels						3				
Maintain minimum water gradier										
Dredging										
Dustpan hydraulic										
Cutterhead hydraulic										
Mechanical										
Shore pipe, boosters to reach target sites										
Use small dredges to expand placement options										
Bend width reductions where appropriate										
Overdepth dredging to reduce frequency, volume										
Limited depth dredging to reduce volume										
Sediment trap dredging to reduce frequency, volume										
As-needed dredging - close monitoring										
Dredge backwater areas, increase depth						2				
Dredging to restore and create secondary channels					2	3			1	
Use land based excavators to move material during drawdowns						2				
Dredged material placement										
Unconfined placement in floodplain										
Unconfined placement to raise areas for mast-producing trees								2		
Confined placement in floodplain										
Unconfined placement in channel										
Semi-confined channel placement (chevrons)						2		2		
Placement out of floodplain - beneficial use										
Placement behind levees - agricultural areas										
Placement of contaminated material out of floodplain				1			1			
Mimimize dredge slurry return water				2	1	2	1			
Minimize bankside dredged material placement				2	2	2	2	2	2	
Stabilize dredged material with soil			2				1		1	
Island construction (impounded areas)			2	2		3	3	3	2	
Islands to create secondary channels			2	2		3	2	3	2	
Seed islands			1	2		2	1	2	1	
Place dredged material to create wetland areas			3	3		2	3	3	3	
Placement on existing, construct new beaches							3	1		
Maintenance of channel structures										
Wing dams (dikes)				1		2				
Closing dams				1		2				
Bank revetments				1		2				
Maintain flow split between main and off-channel			3	3	2	3	3	3	3	
Modify flow splits between main and off-channel areas			3	3	2	3	3	3	3	
Notch wing dams to create hydraulic, depth diversity				2	1	2				
Notch closing dams to increase side channel flow				2	1	2				
Remove closing structures to divert flow into side channels				1	1	2	1			
Construct temporary structures to divert flow				1	1	2	1			
Use structures to manipulate flow to maintain backwater depth				2	1	3	2		1	
Use larger rock, make bank revetments irregular				3	1	3				

Ecological Objectives and Need Statements

	Water Quality: Achieve USEPA and state full use standards to improve water quality	Reduce contaminant loadings to the river	Manage contaminated sediments	Achieve USEPA and state non-point TMDL standards to improve water quality	Reduce fine sediment loadings to the river	Reduce coarse sediment loadings to the river	Reduce nutrient loading from tributaries to the mainstem river and Gulf of Mexico	Increase nutrient processing (e.g., denitrification) in river habitats	Maintain DO concentrations >5 ppm during ice free periods for fish	During winter-ice covered periods maintain DO concentrations >3 ppm, temperature	Create thermal and velocity refugia (e.g., holes >3 m) in backwaters and channels	Maintain water clarity sufficient to support submersed aquatic vegetation, aquatic	Geomorphology: Reduce bank erosion	Restore secondary channels	Create secondary channels	Increase ridge and swale floodplain topography	Consolidate flocculent backwater sediment	Restore channelized tributaries in the mainstem river floodplains	Restore fluvial dynamics (e.g., channel avulsion, secondary channel, distributary channels	Reduce sedimentation in tributary deltas	Alter aquatic and terrestrial habitat connectivity	Restore and maintain connectivity between contiguous backwater and channel areas	Increase extent of contiguous backwater areas	Increase extent of isolated floodplain areas	Increase extent of isolated floodplain lakes	Increase unleveed floodplain at trubutary confluences	Hydrology/River Hydraulics: Naturalize hydrologic regime.	Reduce stage and discharge fluctuations caused by dam operation	Restore desirable stage discharge relationship	Provide for low water period during the growing season to restore aquatic vegetation	Restore or naturalize hydraulic interactions between the river and tributaries	Maintain minimum hydraulic gradient during very low flow periods	Minimize adverse flow fluctuations caused by hydropower operations on tributaries	Minimize adverse effects of elevated water table on soil moisture conditions	Maintain maximum controlled pool stage (or greater if possible) during the winter	Increase flexibility of dam operations (e.g., widen control limits)	Restore desirable hydraulic connections between the river and backwater or floodplain	Restore ecological benefits of the flood pulse (e.g., increase available flood flow storage	Provide desirable pattern of hydraulic conditions in tailwaters (e.g., increase area of <0.3	Restore desirable longitudinal hydraulic connections across the dams to enhance	Reduce wind fetch in open water areas (e.g., backwaters and impounded areas)	Restore desirable current velocity and residence time in aquatic areas	Habitat: Restore and maintain a diverse mosaic of plant communities	Increase extent, abundance and diversity of submersed aquatic plants	Increase extent, abundance and diversity of emergent aquatic plants	Increase extent, abundance and diversity of floodplain grassland	Increase extent, abundance and diversity of floodplain shrub cover	Restore and maintain large contiguous grassland patches (>1,000 acres)	Restore and maintain large contiguous forest patches (>1,000 acres) with connected	Restore and maintain large contiguous wetland patches (>1,000 acres) every 30 - 40	Restore age and species diversity in floodplain forests	Maintain and restore geomorphic diversity in aquatic and floodplain areas	Restore physical habitat features in MMR	Restore or increase sand bar habitat	Maintain or increase depth of existing secondary channels	Increase topographic diversity (e.g., Increase elevation by two meters on 10% of all	Restore, create islands	Restore, create rapid and riffle habitat	Restore, create sand/mud flats	Restore, create, gravel bars	Restore and maintain substrate diversity in channels, (e.g., >2% of substrate area gravel	Restore and maintain backwater areas for sport and commercial fish	Provide for longitudinal fish passage in the mainstem and tributary rivers	Increase marsh habitat management opportunities in leveed areas	Maintain current areal abundance of crop land	Restore habitat corridors (eg riparian forests, contiguous prairie, etc.)	Create, maintain vegetated riparian buffer strips along tributaries and ditches basin-wide	Restore tributaries and floodplain streams	Create, restore floodplain terrestrial habitats.	Restore habitat on islands	Increase woody debris in secondary channels	Restore aquatic habitat every 10 miles in MMR (dike alteration)	Provide deepwater fish overwintering areas (e.g., depth range 0-3 m every 2 miles)	Biota: Restore populations of endemic state and Federal protected species throughout their range	Maintain viable populations of native plant species and communities throughout their	Maintain viable populations of native invertebrate populations throughout their range in	Maintain viable populations of native mussel populations throughout their range in the	Maintain viable populations of native fish populations throughout their range in the Uppe	Maintain viable populations of native amphibian and reptile populations throughout their	Maintain viable populations of native bird populations throughout their range in the Uppe	Maintain viable populations of native mammal populations throughout their range in the	Control or eliminate exotic and invasive species throughout the Upper Mississippi River
Incorporate woody debris into channel structures													3									3																		3													3	3		3															3	2	3	3			3		3	3	2	2	
Construct hard points, groins for shoreline stabilization													3									3																		3													2	2	1	3															2		2	3			2	1	2	1			
Construct off-shore revetments												2	3																													3		3	2		3	3							2	2	1				2		2	2									3		1				3	1	2	1	2	1	
Construct seed islands												2																															2	2		2	2	1				1		2	2	3	3		3	2	3	2	2								2	2		2	2		1	2		2	2	2	1	
Construct bendway weirs											1																																	2										2	2		3			2		2	2											2	2			2		2				
Construct chevrons																																										2										2	2	3	3		3	2	3	2	2								2			3	2		1	2		2	1	2		
Construct island wave breaks												2	3									3																			2				1							2	1				2		2			2														2		2	1	2		
Stabilize existing islands												2	3									3															2														2	2		2		3					3							2	2				2	1		2	1	2		
Remove bank stabilization structures																					3	3																															2	2		2		3		2											2							1	1			
Maintenance, adjustment of channel alignment																																																																																	
Modify alignment to reduce dredging requirements			1																																																																														
Modify alignment to improve navigation safety																																																																																	
Bend width reductions to reduce dredging																																																																											1					
Bendway weirs													2																																									2																			2	2			2						
Realign channel to reduce navigation impacts													1																													1																																				1	1				
Increase water depth to reduce sediment resuspension	2											1																																																																							
Aids to and restrictions on navigation																																																																																	
Buoys																																																																																	
Day marks																																																																																	
Lights																																																																																	
Signs																																																																																	
Navigation charts																																																																																	
Navigation notices, restrictions on commercial navigation																																																																																	
Draft restrictions																																																																																	
Cargo and tow configuration requirements																																																																																	
Licensing of commercial vessels, pilots																																																																																	
Navigation area restrictions - recreational boats												1	3																														3	3																2																			
Speed and wake restrictions													3																														3	3																																					
Schedule commercial traffic to minimize stops																																																																													1				
Modify towboat propulsion system																																																																													1				
Modify design of towboat hull																																																																																	
Improve lock approaches																																																																																	
Modify tow size/configuration																																																																																	
Establish and enforce safety zone for tow boat																																																																																	
Limit draft of commercial tows to 9 feet																																																																																	
Establish a permit system for tows over 9 foot dra																																																																																	
Industry resource alerts																																																																																	
River closure due to floods, security concerns, etc.																																																																																	
Set buoys before navigation season opens																																																																																	
Reset buoys as channel conditions require																																																																																	
Restrict speed of commercial tows to reduce fish entrainment																																																																																	
Restrict daily time of tow traffic to reduce fish entrainment																																																																													1				
Restrict seasonal timing of tow traffic to reduce fish entrainment																																																																													2				
Restrict opening, closing of navigation season																																																																							2						1				
Restrict navigation season to accommodate pool drawdowns																													3	3		3				3								3	3																3														3	3		3	3		3	
Prohibit commercial navigation outside designated channel areas																																											1	1																													2		2	1	2	2	1			
Install bouys to keep tows away from sensitive habitats													1																													1	1																													2		2	1	2	2	1	1		
Minimize impacts of barge fleeting and mooring												1	1																																																																1	1	1	1	1	1		
Prohibit barge fleeting outside designated areas													1																													1	1																													2		1	1	1	1	1	1		1
Restrict navigation during high river flow to improve safety																																																																																	
Require use of helper boats to improve safety																																																																																	
Require lock waiting area use, mooring cells (commercial)																																																																																	
Require lock waiting area use, designated beaches (rec boat)																																																																																	
Licensing of recreational boats																																																																																	
Restrict recreational boat wakes to protect shorelines												2	3																														3	3																2												2	2		2	3	2	1	
Restrict recreational boat beaching to protect habitats												1	1																														1	1																2												1	1		2	3	2	1	
Restrict recreational boat navigated areas to protect habitats												1	2																														3	3																2												1	1		2	3	2	1	
Restrict recreational boat noise to protect habitats																																																													2																	2	1	
Experiment with management actions during scheduled closures																																											2	2																1																2	2			2
Operation and Maintenance of Locks and Dams																																																																																	

Ecological Objectives and Need Statements

Water Quality	Achieve USEPA and state full use standards to improve water quality	Reduce contaminant loadings to the river	Manage contaminated sediments	Achieve USEPA and state non-point TMDL standards to improve water quality	Reduce fine sediment loadings to the river	Reduce coarse sediment loadings to the river	Reduce nutrient loading from tributaries to the mainstem river and Gulf of Mexico	Increase nutrient processing (e.g., denitrification) in river habitats	Maintain DO concentrations >5 ppm during ice free periods for fish	During winter-ice covered periods maintain DO concentrations >3 ppm, temperature	Create thermal and velocity refugia (e.g., holes >3 m) in backwaters and channels	Maintain water clarity sufficient to support submersed aquatic vegetation, aquatic
Operate locks												
Operate dam gates												
Ensure navigation safety near locks and dams												
Perform rescues												
Maintain dam structures, machinery and controls												
Maintain grounds at dams												
Maintain visitor areas												
Maintain earthen embankments												
Brush removal												
Replace riprap												
Operate water control structures in embankments										3		
Maintain signs and lights												
Catch and properly dispose of old paint												
Limit fertilizer use	1						1					
Plant native prairie on grounds							1					
Use non-toxic paint under water	1	1										
Limit extent and use of toxic herbicides in brush removal	1											
Place shades on lights to limit skyward lighting												
Recreational Use Management												
Operate and maintain recreation areas												
Operate and maintain boating access sites												
Improve angler access												
Provide, maintain boating access to backwater areas												
Provide interpretive, educational information to public												
Create and maintain beaches												
Limit public use, behavior, impacts (people management)												
Limit density of use and impacts												
Encourage non-motorized recreation												
Protect special habitat areas (see rec boat restrictions above)												
River clean-up days with volunteer effort	1											
Designate camping areas												
Designate boat beaching areas												
Provide sanitary facilities for campers on island	1	1					1					
Provide interpretive displays												
Maintain the visual aesthetics of the riverscap					3							3
Regulation of Work in Water, Wetlands												
Review, permitting of work in rivers	1		1		1	1	1					
Review, permitting of work in wetlands	1		1		1		1					
Review, permitting of barge fleeting areas	1											
Review, permitting of work in floodplains	1						1					
Water Quality Management Along Mainstem Rivers												
Assess water quality conditions	1	1	1	1	1	1	1		1	1	1	1
Reduce loadings of sediment, N, P from tributaries (TMDLs)	3				3	3	3		3	1		3
Introduce flows to backwater areas, improve DO	2								3	3		
Modify habitat to improve water quality (e.g., sediment consolidation)	1		1				1		2			2
Regulate discharge of pollutants from point sources (NPDES)	3	3					3		2	1		3
Upgrade municipal waste treatment systems	3	3					3		2	1		2
Re-use industrial wastes into products	3	3					3		1			
Upgrade industrial waste pre-treatment systems	3	3					3		1			
Improve safety of potential spill sources	3	3					1					
Develop effective spill response, river defense network	1	1										
Increase aquatic plant density	2						2		3			3
Increase plant distribution	2						2		3			3
Reduce algae production	1						2		3	1		3
Remove bottom feeding fish (carp)	1								2			2
Reduce phosphate discharge from sewage treatment plants	2	1					3		3	1		3
Implement stormwater treatment	2						2		2			2
Use aerators to improve backwater DO	1								3	2		
Divert tributaries into backwaters to deliver DO during winter	2									3		
Open springs in isolated backwaters	1								3	2		

Geomorphology	Reduce bank erosion	Restore secondary channels	Create secondary channels	Increase ridge and swale floodplain topography	Consolidate flocculent backwater sediment	Restore channelized tributaries in the mainstem river floodplains	Restore fluvial dynamics (e.g., channel avulsion, secondary channel, distributary channels	Reduce sedimentation in tributary deltas	Alter aquatic and terrestrial habitat connectivity	Restore and maintain connectivity between contiguous backwater and channel areas	Increase extent of contiguous backwater areas	Increase extent of isolated floodplain areas	Increase extent of isolated floodplain lakes	Increase unleveed floodplain at trubutary confluences
Operate locks														
Operate dam gates														
Ensure navigation safety near locks and dams														
Perform rescues														
Maintain dam structures, machinery and controls														
Maintain grounds at dams														
Maintain visitor areas														
Maintain earthen embankments														
Brush removal														
Replace riprap	3													
Operate water control structures in embankments														
Maintain signs and lights														
Catch and properly dispose of old paint														
Limit fertilizer use														
Plant native prairie on grounds														
Use non-toxic paint under water														
Limit extent and use of toxic herbicides in brush removal														
Place shades on lights to limit skyward lighting														
Recreational Use Management														
Operate and maintain recreation areas														
Operate and maintain boating access sites														
Improve angler access														
Provide, maintain boating access to backwater areas									2	1				
Provide interpretive, educational information to public														
Create and maintain beaches	2													
Limit public use, behavior, impacts (people management)														
Limit density of use and impacts														
Encourage non-motorized recreation														
Protect special habitat areas (see rec boat restrictions above)														
River clean-up days with volunteer effort														
Designate camping areas														
Designate boat beaching areas														
Provide sanitary facilities for campers on island														
Provide interpretive displays														
Maintain the visual aesthetics of the riverscap	2	2	2	2		2				2	2	2	2	2
Regulation of Work in Water, Wetlands														
Review, permitting of work in rivers	2							2		2				2
Review, permitting of work in wetlands								2						
Review, permitting of barge fleeting areas	2													
Review, permitting of work in floodplains														2
Water Quality Management Along Mainstem Rivers														
Assess water quality conditions														
Reduce loadings of sediment, N, P from tributaries (TMDLs)								3						
Introduce flows to backwater areas, improve DO									3					
Modify habitat to improve water quality (e.g., sediment consolidation)					3				2					
Regulate discharge of pollutants from point sources (NPDES)														
Upgrade municipal waste treatment systems														
Re-use industrial wastes into products														
Upgrade industrial waste pre-treatment systems														
Improve safety of potential spill sources														
Develop effective spill response, river defense network														
Increase aquatic plant density														
Increase plant distribution														
Reduce algae production														
Remove bottom feeding fish (carp)														
Reduce phosphate discharge from sewage treatment plants														
Implement stormwater treatment														
Use aerators to improve backwater DO														
Divert tributaries into backwaters to deliver DO during winter														
Open springs in isolated backwaters													1	

Hydrology/River Hydraulics	Naturalize hydrologic regime.	Reduce stage and discharge fluctuations caused by dam operation	Restore desirable stage:discharge relationship	Provide for low water period during the growing season to restore aquatic vegetation	Restore or naturalize hydraulic interactions between the river and tributaries	Maintain minimum hydraulic gradient during very low flow periods	Minimize adverse flow fluctuations cayused by hydropower operations on tributaries	Minimize adverse effects of elevated water table on soil moisture conditions	Maintain maximum controlled pool stage (or greater if possible) during the winter	Increase flexibility of dam operations (e.g., widen control limits)	Restore desirable hydraulic connections between the river and backwater or floodplain	Restore ecological benefits of the flood pulse (e.g., increase available flood flow storage	Provide desirable pattern of hydraulic conditions in tailwaters (e.g., increase area of <0.3	Restore desirable longitudinal hydraulic connections across the dams to enhance	Reduce wind fetch in open water areas (e.g., backwaters and impounded areas)	Restore desirable current velocity and residence time in aquatic areas
Operate locks																
Operate dam gates		3	3	3	3	3	3		3	3			3			3
Ensure navigation safety near locks and dams																
Perform rescues																
Maintain dam structures, machinery and controls																
Maintain grounds at dams																
Maintain visitor areas																
Maintain earthen embankments																
Brush removal																
Replace riprap																
Operate water control structures in embankments		1			2	3					2					3
Maintain signs and lights																
Catch and properly dispose of old paint																
Limit fertilizer use																
Plant native prairie on grounds								2								
Use non-toxic paint under water																
Limit extent and use of toxic herbicides in brush removal																
Place shades on lights to limit skyward lighting																
Recreational Use Management																
Operate and maintain recreation areas																
Operate and maintain boating access sites																
Improve angler access																
Provide, maintain boating access to backwater areas											1					
Provide interpretive, educational information to public																
Create and maintain beaches								2								
Limit public use, behavior, impacts (people management)																
Limit density of use and impacts																
Encourage non-motorized recreation																
Protect special habitat areas (see rec boat restrictions above)																
River clean-up days with volunteer effort																
Designate camping areas																
Designate boat beaching areas																
Provide sanitary facilities for campers on island																
Provide interpretive displays																
Maintain the visual aesthetics of the riverscap			2	3											3	
Regulation of Work in Water, Wetlands																
Review, permitting of work in rivers		3					3	2			1	3				
Review, permitting of work in wetlands											1					
Review, permitting of barge fleeting areas																
Review, permitting of work in floodplains								2			1	3				
Water Quality Management Along Mainstem Rivers																
Assess water quality conditions						2										
Reduce loadings of sediment, N, P from tributaries (TMDLs)																
Introduce flows to backwater areas, improve DO											3					
Modify habitat to improve water quality (e.g., sediment consolidation)																
Regulate discharge of pollutants from point sources (NPDES)																
Upgrade municipal waste treatment systems																
Re-use industrial wastes into products																
Upgrade industrial waste pre-treatment systems																
Improve safety of potential spill sources																
Develop effective spill response, river defense network																
Increase aquatic plant density																
Increase plant distribution																
Reduce algae production																
Remove bottom feeding fish (carp)																
Reduce phosphate discharge from sewage treatment plants																
Implement stormwater treatment																
Use aerators to improve backwater DO																
Divert tributaries into backwaters to deliver DO during winter					3											
Open springs in isolated backwaters					3						3					

Habitat	Restore and maintain a diverse mosaic of plant communities	Increase extent, abundance and diversity of submersed aquatic plants	Increase extent, abundance and diversity of emergent aquatic plants	Increase extent, abundance and diversity of floodplain grassland	Increase extent, abundance and diversity of floodplain shrub cover	Restore and maintain large contiguous grassland patches (>1,000 acres)	Restore and maintain large contiguous forest patches (>1,000 acres) with connected	Restore and maintain large contiguous wetland patches (>1,000 acres) every 30 - 40	Restore age and species diversity in floodplain forests	Maintain and restore geomorphic diversity in aquatic and floodplain areas	Restore physical habitat features in MMR	Restore or increase sand bar habitat	Maintain or increase depth of existing secondary channels	Increase topographic diversity (e.g., Increase elevation by two meters on 10% of all	Restore, create islands	Restore, create rapid and riffle habitat	Restore, create sand/mud flats	Restore, create, gravel bars	Restore and maintain substrate diversity in channels, (e.g., >2% of substrate area gravel	Restore and maintain backwater areas for sport and commercial fish	Provide for longitudinal fish passage in the mainstem and tributary rivers	Increase marsh habitat management opportunities in leveed areas	Maintain current areal abundance of crop land	Restore habitat corridors (eg riparian forests, contiguous prairie, etc.)	Create, maintain vegetated riparian buffer strips along tributaries and ditches basin-wide	Restore tributaries and floodplain streams	Create, restore floodplain terrestrial habitats.	Restore habitat on islands	Increase woody debris in secondary channels	Restore aquatic habitat every 10 miles in MMR (dike alteration)	Provide deepwater fish overwintering areas (e.g., depth range 0-3 m every 2 miles)
Operate locks																					1										
Operate dam gates		3	3					3													2										3
Ensure navigation safety near locks and dams																															
Perform rescues																															
Maintain dam structures, machinery and controls																															
Maintain grounds at dams																															
Maintain visitor areas																															
Maintain earthen embankments																															
Brush removal																															
Replace riprap																															
Operate water control structures in embankments																															
Maintain signs and lights																															
Catch and properly dispose of old paint																															
Limit fertilizer use																															
Plant native prairie on grounds				2																				1							
Use non-toxic paint under water																															
Limit extent and use of toxic herbicides in brush removal																															
Place shades on lights to limit skyward lighting																															
Recreational Use Management																															
Operate and maintain recreation areas				2																											
Operate and maintain boating access sites																															
Improve angler access																															
Provide, maintain boating access to backwater areas																				1											
Provide interpretive, educational information to public																															
Create and maintain beaches												1			1		1											1			
Limit public use, behavior, impacts (people management)																				1											
Limit density of use and impacts																				2											
Encourage non-motorized recreation																				2											
Protect special habitat areas (see rec boat restrictions above)																				2											
River clean-up days with volunteer effort																				1											
Designate camping areas																															
Designate boat beaching areas																				2											
Provide sanitary facilities for campers on island																															
Provide interpretive displays																															
Maintain the visual aesthetics of the riverscap		3	3	3	3	3	3	3	3	3	3	3		3	3	3	3	3	3						2		3	3			
Regulation of Work in Water, Wetlands																															
Review, permitting of work in rivers										1	1	1	1		1	1	1	1	1	1					1	1	1	1	1		1
Review, permitting of work in wetlands										1	1									1								1			
Review, permitting of barge fleeting areas																															1
Review, permitting of work in floodplains									2	1	1			1								1			1	1	1	1	1		
Water Quality Management Along Mainstem Rivers																															
Assess water quality conditions																				1											
Reduce loadings of sediment, N, P from tributaries (TMDLs)		3						2			3									3											
Introduce flows to backwater areas, improve DO											2									3											
Modify habitat to improve water quality (e.g., sediment consolidation)		2						2			1									2											
Regulate discharge of pollutants from point sources (NPDES)		3																		3											
Upgrade municipal waste treatment systems																				2											
Re-use industrial wastes into products																				2											
Upgrade industrial waste pre-treatment systems																				2											
Improve safety of potential spill sources																				2											
Develop effective spill response, river defense network																				1											
Increase aquatic plant density		3	3																	3		3									
Increase plant distribution		3	3																	3		3									
Reduce algae production		3																		3											
Remove bottom feeding fish (carp)		3	3					1												3		1									
Reduce phosphate discharge from sewage treatment plants		2						2												3											
Implement stormwater treatment		2						1												2											
Use aerators to improve backwater DO																				2											
Divert tributaries into backwaters to deliver DO during winter																				3											
Open springs in isolated backwaters																				2											3

Biota	Restore populations of endemic state and Federal protected species throughout their range	Maintain viable populations of native plant species and communities throughout their	Maintain viable populations of native invertebrate populations throughout their range in	Maintain viable populations of native mussel populations throughout their range in the	Maintain viable populations of native fish populations throughout their range in the Uppe	Maintain viable populations of native amphibian and reptile populations throughout their	Maintain viable populations of native bird populations throughout their range in the Uppe	Maintain viable populations of native mammal populations throughout their range in the	Control or eliminate exotic and invasive species throughout the Upper Mississippi River
Operate locks									
Operate dam gates		3	1		3	3	3	3	
Ensure navigation safety near locks and dams									
Perform rescues									
Maintain dam structures, machinery and controls									
Maintain grounds at dams									
Maintain visitor areas									
Maintain earthen embankments									
Brush removal									
Replace riprap			1						
Operate water control structures in embankments					3				
Maintain signs and lights									
Catch and properly dispose of old paint									
Limit fertilizer use									
Plant native prairie on grounds		2				1	1	1	
Use non-toxic paint under water			1	1	1	1			
Limit extent and use of toxic herbicides in brush removal			1		1	1			
Place shades on lights to limit skyward lighting									
Recreational Use Management									
Operate and maintain recreation areas									
Operate and maintain boating access sites									
Improve angler access									
Provide, maintain boating access to backwater areas									
Provide interpretive, educational information to public									
Create and maintain beaches						2			
Limit public use, behavior, impacts (people management)						3	3		
Limit density of use and impacts						3	3	3	
Encourage non-motorized recreation						3	3	3	
Protect special habitat areas (see rec boat restrictions above)			1		1	3	3	3	
River clean-up days with volunteer effort								1	
Designate camping areas								1	
Designate boat beaching areas						3		1	
Provide sanitary facilities for campers on island									
Provide interpretive displays									
Maintain the visual aesthetics of the riverscap		3					3	3	
Regulation of Work in Water, Wetlands									
Review, permitting of work in rivers			1	1	1	1	1	1	
Review, permitting of work in wetlands		1	1		1	1	1	1	
Review, permitting of barge fleeting areas		1	1	1	1	1	1	1	
Review, permitting of work in floodplains		1				1	1	1	
Water Quality Management Along Mainstem Rivers									
Assess water quality conditions			1	1	1	1			
Reduce loadings of sediment, N, P from tributaries (TMDLs)		3	3	3	3	3			
Introduce flows to backwater areas, improve DO			3	1	3	2			
Modify habitat to improve water quality (e.g., sediment consolidation)		3	2		2	1			
Regulate discharge of pollutants from point sources (NPDES)			3	3	3	3			
Upgrade municipal waste treatment systems			2	1	1	1			
Re-use industrial wastes into products			1	1	1	1			
Upgrade industrial waste pre-treatment systems			1	1	1	1			
Improve safety of potential spill sources			1	1	1	1			
Develop effective spill response, river defense network									
Increase aquatic plant density			3	1	3	3		3	
Increase plant distribution		3	3	1	3	3		3	
Reduce algae production		3	1	1	2	2			
Remove bottom feeding fish (carp)		3	3	3	3	3			
Reduce phosphate discharge from sewage treatment plants		2	2	1	1	1			
Implement stormwater treatment		2	2	1	1	1			
Use aerators to improve backwater DO			1		2				
Divert tributaries into backwaters to deliver DO during winter			2		3				
Open springs in isolated backwaters			1		2				

Ecological Objectives and Need Statements

Water Quality

Ecological Objectives and Need Statements	Achieve USEPA and state full use standards to improve water quality	Reduce contaminant loadings to the river	Manage contaminated sediments	Achieve USEPA and state non-point TMDL standards to improve water quality	Reduce fine sediment loadings to the river	Reduce coarse sediment loadings to the river	Reduce nutrient loading from tributaries to the mainstem river and Gulf of Mexico	Increase nutrient processing (e.g., denitrification) in river habitats	Maintain DO concentrations >5 ppm during ice free periods for fish	During winter-ice covered periods maintain DO concentrations >3 ppm, temperature	Create thermal and velocity refugia (e.g., holes >3 m) in backwaters and channels	Maintain water clarity sufficient to support submersed aquatic vegetation, aquatic
Reduce bank erosion	1					1						2
Reduce sediment resuspensio	1											3
Refuge Management												
Assess condition of fish populations												
Assess condition of wildlife populations												
Manage vegetation cover												2
Manage water levels									3	2		2
Modify habitat structure in floodplain and backwaters												
Manage fish and wildlife populations on federal refuges												
Protect or provide special spawning, nesting, nursery areas									2			
Install bird nesting structures												
Enforce hunting regulations												
Enforce fishing regulations												
Enforce trapping regulations												
Control invasive exotic species												
Control selected predator populations												
Reintroduce native species												
Protect special habitat areas required by fish and wildlife									2			
Recreational use management (see recreation above)												
Purchase land												
Encourage land trusts and individuals to conserve grasslands blufflands,open space in perpetuity along the watershed (encourgae all means of land conservation)				2								
Conservation easements to protect blufflands & grasslands in floodplain ar beyond (local, state, NGO, Feds)	1			1								
Acquire tributary floodplain areas	1			1								
Manage Vegetation												
Assess condition of floodplain vegetation												
Protect and manage floodplain forests												
Restore and maintain floodplain prairie												
Control invasive exotic species												
Create mix of successional stages												
Create mix of forest and prairie												
Plant, encourage expansion of mast-producing trees												
Promote emergent plant growth							2		2			
Develop moist soil plant communities							1					
Plant vegetation on dredged material deposits												
Deposit sand, cap with fines, plant tree												
Reestablish disease resistant elms in floodplai												
Modify drainage district operation												
Plant agricultural crops to maintain open areas, control undesirable species												
Plant agricultural crops as food for wildlif												
Timber stand improvemen												
Fisheries Management												
Assess condition of fish populations												
Adjust angling, commercial fishing regulations as needed												
Sportsman education and outreach												
Enforce fishing regulations												
Stock fish												
Conduct biomanipulation of fish community (various actions)												3
Protect, increase populations of threatened, endangered species												
Modify habitat (see below)									2			
Use predator control where appropriat												
Focus Federal aid on Miss. F												
Monitor and test for diseases												
Wildlife Management												
Assess condition of wildlife populations												
Adjust hunting and trapping regulations as needed												
Modify hunter attitudes about expoitation												

Geomorphology

Ecological Objectives and Need Statements	Reduce bank erosion	Restore secondary channels	Create secondary channels	Increase ridge and swale floodplain topography	Consolidate flocculent backwater sediment	Restore channelized tributaries in the mainstem river floodplains	Restore fluvial dynamics (e.g., channel avulsion, secondary channel, distributary channels)	Reduce sedimentation in tributary deltas	Alter aquatic and terrestrial habitat connectivity	Restore and maintain connectivity between contiguous backwater and channel areas	Increase extent of contiguous backwater areas	Increase extent of isolated floodplain areas	Increase extent of isolated floodplain lakes	Increase unleveed floodplain at trubutary confluences
Reduce bank erosion	X									1				
Reduce sediment resuspensio														
Refuge Management														
Assess condition of fish populations														
Assess condition of wildlife populations													1	
Manage vegetation cover														
Manage water levels					2								3	
Modify habitat structure in floodplain and backwaters													3	
Manage fish and wildlife populations on federal refuges														
Protect or provide special spawning, nesting, nursery areas													3	
Install bird nesting structures														
Enforce hunting regulations														
Enforce fishing regulations														
Enforce trapping regulations												3	3	
Control invasive exotic species														
Control selected predator populations												3	3	
Reintroduce native species												3	3	
Protect special habitat areas required by fish and wildlife												3	3	
Recreational use management (see recreation above)														
Purchase land						3								3
Encourage land trusts and individuals to conserve grasslands blufflands,open space in perpetuity along the watershed (encourgae all means of land conservation)														
Conservation easements to protect blufflands & grasslands in floodplain ar beyond (local, state, NGO, Feds)														
Acquire tributary floodplain areas												3	3	
Manage Vegetation														
Assess condition of floodplain vegetation														
Protect and manage floodplain forests														
Restore and maintain floodplain prairie														
Control invasive exotic species														
Create mix of successional stages														
Create mix of forest and prairie														
Plant, encourage expansion of mast-producing trees														
Promote emergent plant growth														
Develop moist soil plant communities														
Plant vegetation on dredged material deposits	1													
Deposit sand, cap with fines, plant tree				3								3		
Reestablish disease resistant elms in floodplai														
Modify drainage district operation												3		
Plant agricultural crops to maintain open areas, control undesirable species														
Plant agricultural crops as food for wildlif														
Timber stand improvemen														
Fisheries Management														
Assess condition of fish populations														
Adjust angling, commercial fishing regulations as needed														
Sportsman education and outreach														
Enforce fishing regulations														
Stock fish														
Conduct biomanipulation of fish community (various actions)														
Protect, increase populations of threatened, endangered species														
Modify habitat (see below)														
Use predator control where appropriat														
Focus Federal aid on Miss. F														
Monitor and test for diseases														
Wildlife Management														
Assess condition of wildlife populations												1	1	
Adjust hunting and trapping regulations as needed														
Modify hunter attitudes about expoitation														

Hydrology/River Hydraulics

Ecological Objectives and Need Statements	Naturalize hydrologic regime.	Reduce stage and discharge fluctuations caused by dam operation	Restore desirable stage:discharge relationship	Provide for low water period during the growing season to restore aquatic vegetation	Restore or naturalize hydraulic interactions between the river and tributaries	Maintain minimum hydraulic gradient during very low flow periods	Minimize adverse flow fluctuations cayused by hydropower operations on tributaries	Minimize adverse effects of elevated water table on soil moisture conditions	Maintain maximum controlled pool stage (or greater if possible) during the winter	Increase flexibility of dam operations (e.g., widen control limits)	Restore desirable hydraulic connections between the river and backwater or floodplain	Restore ecological benefits of the flood pulse (e.g., increase available flood flow storage	Provide desirable pattern of hydraulic conditions in tailwaters (e.g., increase area of <0.3	Restore desirable longitudinal hydraulic connections across the dams to enhance	Reduce wind fetch in open water areas (e.g., backwaters and impounded areas)	Restore desirable current velocity and residence time in aquatic areas
Reduce bank erosion																
Reduce sediment resuspensio																
Refuge Management																
Assess condition of fish populations																
Assess condition of wildlife populations																
Manage vegetation cover								2								
Manage water levels																
Modify habitat structure in floodplain and backwaters								2								
Manage fish and wildlife populations on federal refuges																
Protect or provide special spawning, nesting, nursery areas																
Install bird nesting structures																
Enforce hunting regulations																
Enforce fishing regulations																
Enforce trapping regulations																
Control invasive exotic species																
Control selected predator populations																
Reintroduce native species																
Protect special habitat areas required by fish and wildlife																
Recreational use management (see recreation above)																
Purchase land										3	2					
Encourage land trusts and individuals to conserve grasslands blufflands,open space in perpetuity along the watershed (encourgae all means of land conservation)																
Conservation easements to protect blufflands & grasslands in floodplain ar beyond (local, state, NGO, Feds)					3			3		3	3	3				
Acquire tributary floodplain areas					2			3		3	3	3				
Manage Vegetation																
Assess condition of floodplain vegetation								1								
Protect and manage floodplain forests								3							2	
Restore and maintain floodplain prairie								3								
Control invasive exotic species																
Create mix of successional stages								3								
Create mix of forest and prairie								3								
Plant, encourage expansion of mast-producing trees								3							2	
Promote emergent plant growth				3											3	
Develop moist soil plant communities				3												
Plant vegetation on dredged material deposits								3							2	
Deposit sand, cap with fines, plant tree								3							3	
Reestablish disease resistant elms in floodplai								3							1	
Modify drainage district operation				2				2		3	2					
Plant agricultural crops to maintain open areas, control undesirable species								1								
Plant agricultural crops as food for wildlif								1								
Timber stand improvemen								3								
Fisheries Management																
Assess condition of fish populations																
Adjust angling, commercial fishing regulations as needed																
Sportsman education and outreach																
Enforce fishing regulations																
Stock fish																
Conduct biomanipulation of fish community (various actions)																
Protect, increase populations of threatened, endangered species																
Modify habitat (see below)																
Use predator control where appropriat																
Focus Federal aid on Miss. F																
Monitor and test for diseases																
Wildlife Management																
Assess condition of wildlife populations								1								
Adjust hunting and trapping regulations as needed																
Modify hunter attitudes about expoitation																

Habitat

Ecological Objectives and Need Statements	Restore and maintain a diverse mosaic of plant communities	Increase extent, abundance and diversity of submersed aquatic plants	Increase extent, abundance and diversity of emergent aquatic plants	Increase extent, abundance and diversity of floodplain grassland	Increase extent, abundance and diversity of floodplain shrub cover	Restore and maintain large contiguous grassland patches (>1,000 acres)	Restore and maintain large contiguous forest patches (>1,000 acres) with connected	Restore and maintain large contiguous wetland patches (>1,000 acres) every 30 - 40	Restore age and species diversity in floodplain forests	Maintain and restore geomorphic diversity in aquatic and floodplain areas	Restore physical habitat features in MMR	Restore or increase sand bar habitat	Maintain or increase depth of existing secondary channels	Increase topographic diversity (e.g., Increase elevation by two meters on 10% of all	Restore, create islands	Restore, create rapid and riffle habitat
Reduce bank erosion		1									1					
Reduce sediment resuspensio		3						2								
Refuge Management																
Assess condition of fish populations																
Assess condition of wildlife populations																
Manage vegetation cover				3	3	3	3	2	3							
Manage water levels								3								
Modify habitat structure in floodplain and backwaters																
Manage fish and wildlife populations on federal refuges																
Protect or provide special spawning, nesting, nursery areas																
Install bird nesting structures																
Enforce hunting regulations																
Enforce fishing regulations																
Enforce trapping regulations																
Control invasive exotic species																
Control selected predator populations																
Reintroduce native species																
Protect special habitat areas required by fish and wildlife			1													
Recreational use management (see recreation above)																
Purchase land				3	3	3	3	3							3	
Encourage land trusts and individuals to conserve grasslands blufflands,open space in perpetuity along the watershed (encourgae all means of land conservation)				3												
Conservation easements to protect blufflands & grasslands in floodplain ar beyond (local, state, NGO, Feds)				3	3	3	3	3	3	3	3					
Acquire tributary floodplain areas					3	3	3	3	3	3	3					
Manage Vegetation																
Assess condition of floodplain vegetation				1	1	1	1		1							
Protect and manage floodplain forests					3	3	3		3							
Restore and maintain floodplain prairie				3		3										
Control invasive exotic species				1		2										
Create mix of successional stages					3		3		3							
Create mix of forest and prairie				3		3	3		3							
Plant, encourage expansion of mast-producing trees							3		3							
Promote emergent plant growth		3						3								
Develop moist soil plant communities			3					2			2					
Plant vegetation on dredged material deposits		1	2	2	2						3			3	3	
Deposit sand, cap with fines, plant tree					2		2			3	3			3	3	
Reestablish disease resistant elms in floodplai									1							
Modify drainage district operation		1				2	3				2					
Plant agricultural crops to maintain open areas, control undesirable species																
Plant agricultural crops as food for wildlif																
Timber stand improvemen							3		3							
Fisheries Management																
Assess condition of fish populations																
Adjust angling, commercial fishing regulations as needed								3								
Sportsman education and outreach																
Enforce fishing regulations																
Stock fish																
Conduct biomanipulation of fish community (various actions)		3														
Protect, increase populations of threatened, endangered species																
Modify habitat (see below)																
Use predator control where appropriat																
Focus Federal aid on Miss. F																
Monitor and test for diseases																
Wildlife Management																
Assess condition of wildlife populations																
Adjust hunting and trapping regulations as needed																
Modify hunter attitudes about expoitation																

Ecological Objectives and Need Statements	Restore, create sand/mud flats	Restore, create, gravel bars	Restore and maintain substrate diversity in channels, (e.g., >2% of substrate area gravel)	Restore and maintain backwater areas for sport and commercial fish	Provide for longitudinal fish passage in the mainstem and tributary rivers	Increase marsh habitat management opportunities in leveed areas	Maintain current areal abundance of crop land	Restore habitat corridors (eg riparian forests, contiguous prairie, etc.)	Create, maintain vegetated riparian buffer strips along tributaries and ditches basin-wide	Restore tributaries and floodplain streams	Create, restore floodplain terrestrial habitats.	Restore habitat on islands	Increase woody debris in secondary channels	Restore aquatic habitat every 10 miles in MMR (dike alteration)	Provide deepwater fish overwintering areas (e.g., depth range 0-3 m every 2 miles)
Reduce bank erosion				2											
Reduce sediment resuspensio				2											
Refuge Management															
Assess condition of fish populations				1											1
Assess condition of wildlife populations															
Manage vegetation cover				2				3	3			3			
Manage water levels				2									2		3
Modify habitat structure in floodplain and backwaters															
Manage fish and wildlife populations on federal refuges				2		2									
Protect or provide special spawning, nesting, nursery areas				3		3									
Install bird nesting structures															
Enforce hunting regulations															
Enforce fishing regulations															
Enforce trapping regulations															
Control invasive exotic species															
Control selected predator populations															
Reintroduce native species															
Protect special habitat areas required by fish and wildlife				3		3									3
Recreational use management (see recreation above)															
Purchase land					3	3		3	3	3	3				
Encourage land trusts and individuals to conserve grasslands blufflands,open space in perpetuity along the watershed (encourgae all means of land conservation)								3			3				
Conservation easements to protect blufflands & grasslands in floodplain ar beyond (local, state, NGO, Feds)						3		3	3	3	3				
Acquire tributary floodplain areas				3		3		3	3	3	3				
Manage Vegetation															
Assess condition of floodplain vegetation				1		1		1	1		1	1	1		
Protect and manage floodplain forests								3	3		3	3	3		
Restore and maintain floodplain prairie									3		3	3			
Control invasive exotic species				1							1	1			
Create mix of successional stages								3	3		3	3	3		
Create mix of forest and prairie								3	3		3	3			
Plant, encourage expansion of mast-producing trees								3	3		3	3	2		
Promote emergent plant growth				2					3			2			
Develop moist soil plant communities	2			2					1			2			
Plant vegetation on dredged material deposits									3		3	3			
Deposit sand, cap with fines, plant tree									3		3	3	2		
Reestablish disease resistant elms in floodplai									1		1	1	1		
Modify drainage district operation				1		3	3	2	3		2				
Plant agricultural crops to maintain open areas, control undesirable species							2					1			
Plant agricultural crops as food for wildlif							2					1			
Timber stand improvemen									3		2	2	2		
Fisheries Management															
Assess condition of fish populations				1	1										1
Adjust angling, commercial fishing regulations as needed															2
Sportsman education and outreach					2										2
Enforce fishing regulations					1										2
Stock fish															
Conduct biomanipulation of fish community (various actions)															
Protect, increase populations of threatened, endangered species					3										
Modify habitat (see below)															
Use predator control where appropriat															
Focus Federal aid on Miss. F															
Monitor and test for diseases															
Wildlife Management															
Assess condition of wildlife populations															
Adjust hunting and trapping regulations as needed															
Modify hunter attitudes about expoitation															

Biota

Ecological Objectives and Need Statements	Restore populations of endemic state and Federal protected species throughout their range	Maintain viable populations of native plant species and communities throughout their	Maintain viable populations of native invertebrate populations throughout their range in	Maintain viable populations of native mussel populations throughout their range in the	Maintain viable populations of native fish populations throughout their range in the Upper	Maintain viable populations of native amphibian and reptile populations throughout their	Maintain viable populations of native bird populations throughout their range in the Upper	Maintain viable populations of native mammal populations throughout their range in the	Control or eliminate exotic and invasive species throughout the Upper Mississippi River
Reduce bank erosion		1	1	1	1				
Reduce sediment resuspensio		2	2	2	2	1			
Refuge Management									
Assess condition of fish populations				1	1				
Assess condition of wildlife populations						1	1	1	
Manage vegetation cover		3			2	2	3	3	
Manage water levels		3			3	3	3	3	
Modify habitat structure in floodplain and backwaters									
Manage fish and wildlife populations on federal refuges				1	2	2	3	3	
Protect or provide special spawning, nesting, nursery areas					1	2	3	3	
Install bird nesting structures							2		
Enforce hunting regulations							3	3	
Enforce fishing regulations					2				
Enforce trapping regulations						3			
Control invasive exotic species					2				
Control selected predator populations					2		3		
Reintroduce native species		3		2			2		
Protect special habitat areas required by fish and wildlife		2	2	3	1	3	3	3	
Recreational use management (see recreation above)									
Purchase land		3				3	3	3	
Encourage land trusts and individuals to conserve grasslands blufflands,open space in perpetuity along the watershed (encourgae all means of land conservation)		3				3	3	3	
Conservation easements to protect blufflands & grasslands in floodplain ar beyond (local, state, NGO, Feds)		3				3	3	3	
Acquire tributary floodplain areas		3	2	1	2	3			
Manage Vegetation									
Assess condition of floodplain vegetation		1				1	1	1	
Protect and manage floodplain forests		3				2	3	3	
Restore and maintain floodplain prairie		3				2	3	3	
Control invasive exotic species		2				2	1	2	1
Create mix of successional stages		3				3	3	3	
Create mix of forest and prairie		3				3	3	3	
Plant, encourage expansion of mast-producing trees		3					2	3	
Promote emergent plant growth		3	3	2	3	3	3	3	
Develop moist soil plant communities		3	1		2	3	3	2	
Plant vegetation on dredged material deposits		2				1	1	1	
Deposit sand, cap with fines, plant tree		2					1	1	
Reestablish disease resistant elms in floodplai		2							
Modify drainage district operation		2	1		1	2	2	2	
Plant agricultural crops to maintain open areas, control undesirable species		1					1	1	
Plant agricultural crops as food for wildlif							2	2	
Timber stand improvemen		3					2	2	
Fisheries Management									
Assess condition of fish populations				1	1				
Adjust angling, commercial fishing regulations as needed				2	3	3			
Sportsman education and outreach					2				
Enforce fishing regulations				2	3	3			
Stock fish					1				
Conduct biomanipulation of fish community (various actions)			2	3	3	2			3
Protect, increase populations of threatened, endangered species				3	3	2			2
Modify habitat (see below)									
Use predator control where appropriat					2				2
Focus Federal aid on Miss. F									
Monitor and test for diseases					1				
Wildlife Management									
Assess condition of wildlife populations						1	1	1	
Adjust hunting and trapping regulations as needed						3	3	3	
Modify hunter attitudes about expoitation							3	3	

Ecological Objectives and Need Statements	Water Quality	Achieve USEPA and state full use standards to improve water quality	Reduce contaminant loadings to the river	Manage contaminated sediments	Achieve USEPA and state non-point TMDL standards to improve water quality	Reduce fine sediment loadings to the river	Reduce coarse sediment loadings to the river	Reduce nutrient loading from tributaries to the mainstem river and Gulf of Mexico	Increase nutrient processing (e.g., denitrification) in river habitats	Maintain DO concentrations >5 ppm during ice free periods for fish	During winter-ice covered periods maintain DO concentrations >3 ppm, temperature	Create thermal and velocity refugia (e.g., holes >3 m) in backwaters and channels	Maintain water clarity sufficient to support submersed aquatic vegetation, aquatic
Enforce hunting regulations													
Conduct biomanipulation of wildlife community (various actions)													
Modify habitat (see below)													
Predator management where appropriate or neede													
Management for protection of neotropical migrants and other species (concern													
Protect, restore, and increase grassland, forest, wetland habitats for areas sensitive sp - large habitat blocks for acquisition/easement programs													
Monitor and test for diseases													
Mitigate wildlife diseases related to habitat e.g. botulism													
Better management of game sp. (deer) so populations do not negative impact other biodiversity													
Exotic Species Management													
Control invasive exotic species										1			
Construct, operate, maintain barrier on Illinois River													
Require treatment of Great Lakes freighter ballast water													
Regulate use of exotic species for fishing bait										1			
Regulate biota transfer by fishing boats										1			
Apply species-specific toxicants										1			
Kill zebra mussels on vessels in lock chambers										1			
Restrict and enforce use of exotic species in aquaculture													
Promote utilization of exotic biomas													
Encourage commercial harvest of invasive species													
Bioengineered - control of exotics/problem specie													
T&E Species Management													
Reintroduction of extirpated species to the are													
Restore populations of T&E species													
Restore and improve T&E species habitats													
Protect, increase populations of threatened, endangered species													
Reintroduce/expand species of concern to avoid listir													
Naturalize hydrologic regime													
Growing season pool drawdowns to reestablish vegetation		2								2			3
Small scale drawdown of floodplain lakes for vegetation		1						1		2			3
Build dam gates, naturalize hydrologic regime IL River										3			2
Introduce flow to isolated backwater areas		1								3	3	3	
Restore flow to secondary channels		1								2		3	
Restore flow to floodplain areas isolated by levees		1						1		2	3	3	
Establish hydrologic objectives for tributarie						2	2	1					
Modify river-floodplain geometry													
Construct islands in impounded areas													3
Seed islands													3
Chevron islands													3
Rock islands													3
Islands with varied top elevation, fine material													3
Low islands - mud flats and sand bars													3
Construct islands to restore and create secondary channe													3
Stabilize and protect landforms so we can protect what we hav													3
Increase shoreline dynamics/complexit													3
Construct rock barbs													
Increase channel border widtl													
Divert flow into backwater areas to cause scour, deepening										2		3	
Open barrier islands - create channel, induce delta formation into open BV areas													
Temporarily isolate and draw down contiguous backwaters								1		2			3
Construct wind breaks													3
Construct wave breaks													3
Notch levees											2	2	
Set back levees											2	2	
Remove levees											3	2	

Ecological Objectives and Need Statements	Geomorphology	Reduce bank erosion	Restore secondary channels	Create secondary channels	Increase ridge and swale floodplain topography	Consolidate flocculent backwater sediment	Restore channelized tributaries in the mainstem river floodplains	Restore fluvial dynamics (e.g., channel avulsion, secondary channel, distributary channels	Reduce sedimentation in tributary deltas	Alter aquatic and terrestrial habitat connectivity	Restore and maintain connectivity between contiguous backwater and channel areas	Increase extent of contiguous backwater areas	Increase extent of isolated floodplain areas	Increase extent of isolated floodplain lakes	Increase unleveed floodplain at tributary confluences
Enforce hunting regulations															
Conduct biomanipulation of wildlife community (various actions)														3	
Modify habitat (see below)															
Predator management where appropriate or neede														3	
Management for protection of neotropical migrants and other species (concern															
Protect, restore, and increase grassland, forest, wetland habitats for areas sensitive sp - large habitat blocks for acquisition/easement programs										3		3			3
Monitor and test for diseases															
Mitigate wildlife diseases related to habitat e.g. botulism															
Better management of game sp. (deer) so populations do not negative impact other biodiversity															
Exotic Species Management															
Control invasive exotic species															
Construct, operate, maintain barrier on Illinois River															
Require treatment of Great Lakes freighter ballast water															
Regulate use of exotic species for fishing bait															
Regulate biota transfer by fishing boats															
Apply species-specific toxicants															
Kill zebra mussels on vessels in lock chambers															
Restrict and enforce use of exotic species in aquaculture															
Promote utilization of exotic biomas															
Encourage commercial harvest of invasive species															
Bioengineered - control of exotics/problem specie															
T&E Species Management															
Reintroduction of extirpated species to the are															
Restore populations of T&E species															
Restore and improve T&E species habitats															
Protect, increase populations of threatened, endangered species															
Reintroduce/expand species of concern to avoid listir															
Naturalize hydrologic regime															
Growing season pool drawdowns to reestablish vegetation						3									
Small scale drawdown of floodplain lakes for vegetation						3									
Build dam gates, naturalize hydrologic regime IL River		1								3	3				
Introduce flow to isolated backwater areas					1	3		3		3	3		1	1	
Restore flow to secondary channels					1	2		3		3	3				
Restore flow to floodplain areas isolated by levees					3			3		3	3				3
Establish hydrologic objectives for tributarie							2	2	2	2					2
Modify river-floodplain geometry															
Construct islands in impounded areas			3	3						3	3				
Seed islands			1	1						3					
Chevron islands			1	1						3					
Rock islands			2	2						3					
Islands with varied top elevation, fine material			1	1						3	3		3	3	
Low islands - mud flats and sand bars										3	3				
Construct islands to restore and create secondary channe			3	3						3	3				
Stabilize and protect landforms so we can protect what we hav											3				
Increase shoreline dynamics/complexit										3	3				
Construct rock barbs		1	1	1											
Increase channel border widtl															
Divert flow into backwater areas to cause scour, deepening						3		3	3	3	3				
Open barrier islands - create channel, induce delta formation into open BV areas										3	3				
Temporarily isolate and draw down contiguous backwaters						3				3					
Construct wind breaks		3													
Construct wave breaks		3													
Notch levees			2	2	3			3		3	3	3			
Set back levees			2	2	3			3		3	3	3			
Remove levees			2	2	3			3		3	3	3			

Ecological Objectives and Need Statements	Hydrology/River Hydraulics	Naturalize hydrologic regime.	Reduce stage and discharge fluctuations caused by dam operation	Restore desirable stage discharge relationship	Provide for low water period during the growing season to restore aquatic vegetation	Restore or naturalize hydraulic interactions between the river and tributaries	Maintain minimum hydraulic gradient during very low flow periods	Minimize adverse flow fluctuations caused by hydropower operations on tributaries	Minimize adverse effects of elevated water table on soil moisture conditions	Maintain maximum controlled pool stage (or greater if possible) during the winter	Increase flexibility of dam operations (e.g., widen control limits)	Restore desirable hydraulic connections between the river and backwater or floodplain	Restore ecological benefits of the flood pulse (e.g., increase available flood flow storage	Provide desirable pattern of hydraulic conditions in tailwaters (e.g., increase area of <0.3	Restore desirable longitudinal hydraulic connections across the dams to enhance	Reduce wind fetch in open water areas (e.g., backwaters and impounded areas)	Restore desirable current velocity and residence time in aquatic areas
Enforce hunting regulations																	
Conduct biomanipulation of wildlife community (various actions)									2								
Modify habitat (see below)																	
Predator management where appropriate or neede																	
Management for protection of neotropical migrants and other species (concern																	
Protect, restore, and increase grassland, forest, wetland habitats for areas sensitive sp - large habitat blocks for acquisition/easement programs				3					3			3					
Monitor and test for diseases																	
Mitigate wildlife diseases related to habitat e.g. botulism																	
Better management of game sp. (deer) so populations do not negative impact other biodiversity																	
Exotic Species Management																	
Control invasive exotic species																	
Construct, operate, maintain barrier on Illinois River																	
Require treatment of Great Lakes freighter ballast water																	
Regulate use of exotic species for fishing bait																	
Regulate biota transfer by fishing boats																	
Apply species-specific toxicants																	
Kill zebra mussels on vessels in lock chambers																	
Restrict and enforce use of exotic species in aquaculture																	
Promote utilization of exotic biomas																	
Encourage commercial harvest of invasive species																	
Bioengineered - control of exotics/problem specie																	
T&E Species Management																	
Reintroduction of extirpated species to the are																	
Restore populations of T&E species																	
Restore and improve T&E species habitats																	
Protect, increase populations of threatened, endangered species																	
Reintroduce/expand species of concern to avoid listir																	
Naturalize hydrologic regime																	
Growing season pool drawdowns to reestablish vegetation				3	3		3		3		3						
Small scale drawdown of floodplain lakes for vegetation				3	3				3								
Build dam gates, naturalize hydrologic regime IL River			3	3	2	2	2		2		3	3		2			3
Introduce flow to isolated backwater areas												3					3
Restore flow to secondary channels												3					3
Restore flow to floodplain areas isolated by levees				3								3	3				3
Establish hydrologic objectives for tributarie			2	2	1	2		3			3	1					2
Modify river-floodplain geometry																	
Construct islands in impounded areas									3			3				3	3
Seed islands									3			2				2	2
Chevron islands									3			2				2	2
Rock islands																3	2
Islands with varied top elevation, fine material																3	3
Low islands - mud flats and sand bars																2	3
Construct islands to restore and create secondary channe									3			3				3	3
Stabilize and protect landforms so we can protect what we hav																	
Increase shoreline dynamics/complexit						2								3			2
Construct rock barbs														2			1
Increase channel border widtl																	
Divert flow into backwater areas to cause scour, deepening												3					3
Open barrier islands - create channel, induce delta formation into open BV areas												3					3
Temporarily isolate and draw down contiguous backwaters					3				3								
Construct wind breaks																2	
Construct wave breaks																3	
Notch levees						3						3	3				3
Set back levees												3	3				2
Remove levees						3						3	3				3

Ecological Objectives and Need Statements	Habitat	Restore and maintain a diverse mosaic of plant communities	Increase extent, abundance and diversity of submersed aquatic plants	Increase extent, abundance and diversity of emergent aquatic plants	Increase extent, abundance and diversity of floodplain grassland	Increase extent, abundance and diversity of floodplain shrub cover	Restore and maintain large contiguous grassland patches (>1,000 acres)	Restore and maintain large contiguous forest patches (>1,000 acres) with connected	Restore and maintain large contiguous wetland patches (>1,000 acres) every 30 - 40	Restore age and species diversity in floodplain forests	Maintain and restore geomorphic diversity in aquatic and floodplain areas	Restore physical habitat features in MMR	Restore or increase sand bar habitat	Maintain or increase depth of existing secondary channels	Increase topographic diversity (e.g., Increase elevation by two meters on 10% of all	Restore, create islands	Restore, create rapid and riffle habitat	Restore, create sand/mud flats	Restore, create, gravel bars	Restore and maintain substrate diversity in channels, (e.g., >2% of substrate area gravel	Restore and maintain backwater areas for sport and commercial fish	Provide for longitudinal fish passage in the mainstem and tributary rivers	Increase marsh habitat management opportunities in leveed areas	Maintain current areal abundance of crop land	Restore habitat corridors (eg riparian forests, contiguous prairie, etc.)	Create, maintain vegetated riparian buffer strips along tributaries and ditches basin-wide	Restore tributaries and floodplain streams	Create, restore floodplain terrestrial habitats.	Restore habitat on islands	Increase woody debris in secondary channels	Restore aquatic habitat every 10 miles in MMR (dike alteration)	Provide deepwater fish overwintering areas (e.g., depth range 0-3 m every 2 miles)
Enforce hunting regulations																																
Conduct biomanipulation of wildlife community (various actions)				3																												
Modify habitat (see below)																																
Predator management where appropriate or neede																																
Management for protection of neotropical migrants and other species (concern																																
Protect, restore, and increase grassland, forest, wetland habitats for areas sensitive sp - large habitat blocks for acquisition/easement programs					3		3	3	3														3		3	3	3	3				
Monitor and test for diseases																																
Mitigate wildlife diseases related to habitat e.g. botulism																																
Better management of game sp. (deer) so populations do not negative impact other biodiversity																												2				
Exotic Species Management																																
Control invasive exotic species																						3										
Construct, operate, maintain barrier on Illinois River																						3										
Require treatment of Great Lakes freighter ballast water																																
Regulate use of exotic species for fishing bait																																
Regulate biota transfer by fishing boats																																
Apply species-specific toxicants																																
Kill zebra mussels on vessels in lock chambers																																
Restrict and enforce use of exotic species in aquaculture																																
Promote utilization of exotic biomas																																
Encourage commercial harvest of invasive species																																
Bioengineered - control of exotics/problem specie																																
T&E Species Management																																
Reintroduction of extirpated species to the are																						3										
Restore populations of T&E species																						2										
Restore and improve T&E species habitats																						2										
Protect, increase populations of threatened, endangered species																						2										
Reintroduce/expand species of concern to avoid listir																						2										
Naturalize hydrologic regime																																
Growing season pool drawdowns to reestablish vegetation			3	3					3									2			3											
Small scale drawdown of floodplain lakes for vegetation			3	3					3									2			3											
Build dam gates, naturalize hydrologic regime IL River				1					1												3											
Introduce flow to isolated backwater areas																					3		3									3
Restore flow to secondary channels												3					3	2	3	3												3
Restore flow to floodplain areas isolated by levees			3	3								3					2	2	2	2	3		3				3					3
Establish hydrologic objectives for tributarie			2	2								2					2	2	2	2	2		2				2					2
Modify river-floodplain geometry																																
Construct islands in impounded areas			3	3	3	3			3	2	3				3	3	3	3	3	3	3											3
Seed islands			2	2	1	1			1		2	2	3	3		3	2	3	2	2												2
Chevron islands			1	1		1					2	2	3	3		3	2	3	2	2												2
Rock islands			2	2					2		2	2		1		2	2	1	2	2												2
Islands with varied top elevation, fine material			3	3	3	3			3	3	3	3	2		3	3	2	3	1	2	3							3	3			2
Low islands - mud flats and sand bars			3	3		2			2		3	3	3		3	3	1	3	1	1	3								3			1
Construct islands to restore and create secondary channe			1	1		3					3	3	2	3	3	3	3	3	3	3								3				3
Stabilize and protect landforms so we can protect what we hav																																
Increase shoreline dynamics/complexit				1							3	3	2	3		3		3			3								3			3
Construct rock barbs											2	2	1	2		2	2	1	2	2	2								1			2
Increase channel border widtl				1									2					2														
Divert flow into backwater areas to cause scour, deepening			2								3	3					3	2	3	3	3						3					3
Open barrier islands - create channel, induce delta formation into open BV areas				1					2		3		3			3	2	2	2	2	3											
Temporarily isolate and draw down contiguous backwaters			3	3					3									2			3											
Construct wind breaks			2	1					1		1					2		1			1								1			
Construct wave breaks			3	2					2		2					3		2			2								2			
Notch levees			1	1					2		2	2									2		2					2				2
Set back levees			1	1					2		2	2									2		2					2				2
Remove levees			2	2							3	3									3		3					3				3

Ecological Objectives and Need Statements	Biota	Restore populations of endemic state and Federal protected species throughout their range	Maintain viable populations of native plant species and communities throughout their	Maintain viable populations of native invertebrate populations throughout their range in	Maintain viable populations of native mussel populations throughout their range in the	Maintain viable populations of native fish populations throughout their range in the Uppe	Maintain viable populations of native amphibian and reptile populations throughout their	Maintain viable populations of native bird populations throughout their range in the Uppe	Maintain viable populations of native mammal populations throughout their range in the	Control or eliminate exotic and invasive species throughout the Upper Mississippi River
Enforce hunting regulations								3	3	
Conduct biomanipulation of wildlife community (various actions)							2	2	2	3
Modify habitat (see below)										
Predator management where appropriate or neede								2	2	2
Management for protection of neotropical migrants and other species (concern								2		
Protect, restore, and increase grassland, forest, wetland habitats for areas sensitive sp - large habitat blocks for acquisition/easement programs							3	3	3	3
Monitor and test for diseases								2	2	2
Mitigate wildlife diseases related to habitat e.g. botulism								2	2	
Better management of game sp. (deer) so populations do not negative impact other biodiversity			2					1	2	
Exotic Species Management										
Control invasive exotic species				1	2	2		1	2	1
Construct, operate, maintain barrier on Illinois River					2	3				2
Require treatment of Great Lakes freighter ballast water				1	2	3				3
Regulate use of exotic species for fishing bait				1	2	2				2
Regulate biota transfer by fishing boats				1	2	2				2
Apply species-specific toxicants				1	1	1				1
Kill zebra mussels on vessels in lock chambers				1	1	1				1
Restrict and enforce use of exotic species in aquaculture				2	3	3				3
Promote utilization of exotic biomas					2	2				1
Encourage commercial harvest of invasive species					2	2				2
Bioengineered - control of exotics/problem specie				1	2	2				2
T&E Species Management										
Reintroduction of extirpated species to the are			3		2	1	2	2	2	
Restore populations of T&E species			3		2	2	2	2	2	
Restore and improve T&E species habitats			3		2	2	2	2	2	
Protect, increase populations of threatened, endangered species			3		2	2	2	2	2	
Reintroduce/expand species of concern to avoid listir			3		2	2	3	2	2	
Naturalize hydrologic regime										
Growing season pool drawdowns to reestablish vegetation			3	3	2	3	3	3	3	
Small scale drawdown of floodplain lakes for vegetation			3	3	2	2	3	3	3	
Build dam gates, naturalize hydrologic regime IL River			2	2	2	3	3	2	2	
Introduce flow to isolated backwater areas				3		3	1	2	1	
Restore flow to secondary channels				3	3	3	2	2	2	
Restore flow to floodplain areas isolated by levees				3		3	3	3	3	
Establish hydrologic objectives for tributarie				2	2	2	2	2	2	
Modify river-floodplain geometry										
Construct islands in impounded areas			2	3	2	3	3	3	2	
Seed islands			1	2		2	2	2	1	
Chevron islands			1	2		2	2	2		
Rock islands			1	2		2	1	1		
Islands with varied top elevation, fine material			2	2		2	3	3	2	
Low islands - mud flats and sand bars				2		2	3	3	2	
Construct islands to restore and create secondary channe			2	3	3	3	3	3	2	
Stabilize and protect landforms so we can protect what we hav										
Increase shoreline dynamics/complexit				3	2	3	3	2	2	
Construct rock barbs				2	1	2	1			
Increase channel border widtl										
Divert flow into backwater areas to cause scour, deepening				3	2	3	1		1	
Open barrier islands - create channel, induce delta formation into open BV areas			2	2	2	3	3	3	3	
Temporarily isolate and draw down contiguous backwaters			3	2	3	3	3	3	3	
Construct wind breaks			1	1		1	1	1	1	
Construct wave breaks			2	2		2	2	2	2	
Notch levees			2	2		2	2	2	2	
Set back levees			2	2		2	2	2	2	
Remove levees			3	3		3	3	3	3	

Ecological Objectives and Need Statements

Water Quality

Ecological Objectives and Need Statements	Achieve USEPA and state full use standards to improve water quality	Reduce contaminant loadings to the river	Manage contaminated sediments	Achieve USEPA and state non-point TMDL standards to improve water quality	Reduce fine sediment loadings to the river	Reduce coarse sediment loadings to the river	Reduce nutrient loading from tributaries to the mainstem river and Gulf of Mexico	Increase nutrient processing (e.g., denitrification) in river habitats	Maintain DO concentrations >5 ppm during ice free periods for fish	During winter-ice covered periods maintain DO concentrations >3 ppm, temperature	Create thermal and velocity refugia (e.g., holes >3 m) in backwaters and channels	Maintain water clarity sufficient to support submersed aquatic vegetation, aquatic
Dredge backwater areas										2	3	
Increase water levels									1	2	2	
Increase terrestrial area												
Encourage natural land formation - delta												
Restore lost physical structure in the floodplai												
Construct hard point in floodplain (scour points)												
Excavate floodplain pothole												
Blast floodplain potholes												
Excavate wetland scrapes												
Berm and construct moist soil area with water level contr												
Create ridge and swale topography with dredged mater												
Restore natural tributary channels through delta areas									2		2	
Divert more tributary delta flow into open impounded areas									2			
Construct temporary flow diversions to enlarge delta areas												
Shoreline stabilization (aquatic habitat)												
Rip rap												
Grading, vegetation planting												
Rock groins, hard points											3	
Anchored woody debris												
Off-shore rock revetments												3
Submerged rock vanes											3	
Modify aquatic habitat - hydraulic conditions												
Create rock and gravel substrate areas												
Create shallow rock and gravel riffle areas												
Remove/modify/knock down wingdams											3	
Break low spots in dam embankments - riffle type aquatic habit												
Incorporate woody debris into bank protection											3	
Incorporate woody debris into secondary and small channels											3	
Modify flow distribution from dam gates - tailwater habitat											3	
Modify flow in channe												
Construct islands to increase flow												
Restore flow and geometry of secondary channels											3	
Restrict flow to secondary channels											2	
Adjust introduced flow into overwinter area	1									3	3	
Restrict flow to contiguous backwaters	1									3	3	2
Divert flow of sediment laden water away from backwate	1										2	3
Sediment traps on tributaries to protect backwater												2
Prevent/manage sediment from tributaries in sensitive area									2			2
Submerged sills into backwaters	1											
Pool scale drawdown	2		1						2			3
Drawdown management units												3
Drawdown isolated backwaters												3
Isolate and drawdown contiguous backwaters									1			3
Temporarily isolate and drawdown contiguous backwate									1			3
Create and maintain fishless aquatic areas (e.g., potholes, ephemeral pond)												3
Increase connectivity between channels and floodplain												
Acquire real estate rights, restore water to leveed floodplain areas							2		2	3	3	
Notch levees									2		2	
Set back levees							1		2		2	
Remove levees									2		3	
Reconfigure, restore flow to secondary channels (see above)									2		3	
Restore flow to isolated backwater areas (see above)							2		3	3	3	
Create habitat corridors for floodplain terrestrial wildlife												
Restore natural tributary channels through delta areas (see above)							1		2			
Establish fish-friendly wetland units									2			
Install flow structures (pipes) through earthen dams to connect to isolate backwaters									3	3	3	
Increase longitudinal connectivity of rivers												
Build fishways at mainstem dams												

Geomorphology

Ecological Objectives and Need Statements	Reduce bank erosion	Restore secondary channels	Create secondary channels	Increase ridge and swale floodplain topography	Consolidate flocculent backwater sediment	Restore channelized tributaries in the mainstem river floodplains	Restore fluvial dynamics (e.g., channel avulsion, secondary channel, distributary channels	Reduce sedimentation in tributary deltas	Alter aquatic and terrestrial habitat connectivity	Restore and maintain connectivity between contiguous backwater and channel areas	Increase extent of contiguous backwater areas	Increase extent of isolated floodplain areas	Increase extent of isolated floodplain lakes	Increase unleveed floodplain at trubutary confluences
Dredge backwater areas									3	3	3		3	
Increase water levels									3	3	3		3	
Increase terrestrial area									3	3		3		
Encourage natural land formation - delta				2			3		3				3	3
Restore lost physical structure in the floodplai				3					3					
Construct hard point in floodplain (scour points)				2									3	
Excavate floodplain pothole													3	
Blast floodplain potholes													3	
Excavate wetland scrapes													3	
Berm and construct moist soil area with water level contr									3			3	2	
Create ridge and swale topography with dredged mater				3					3				3	
Restore natural tributary channels through delta areas				3	2	3	3	3	3	3			3	3
Divert more tributary delta flow into open impounded areas							3	3	3	3			3	3
Construct temporary flow diversions to enlarge delta areas				3			3		3	3			3	3
Shoreline stabilization (aquatic habitat)														
Rip rap	3					1				3				
Grading, vegetation planting	2					2				3				
Rock groins, hard points	3	2	2			2				3				
Anchored woody debris	2					3				3				
Off-shore rock revetments	3									3				
Submerged rock vanes	2	2	2			2				3				
Modify aquatic habitat - hydraulic conditions														
Create rock and gravel substrate areas						3								
Create shallow rock and gravel riffle areas						3								
Remove/modify/knock down wingdams							3			3				
Break low spots in dam embankments - riffle type aquatic habit										3				
Incorporate woody debris into bank protection	2	2	2			3				3				
Incorporate woody debris into secondary and small channels	2	2	2			3				3				
Modify flow distribution from dam gates - tailwater habitat														
Modify flow in channe														
Construct islands to increase flow														
Restore flow and geometry of secondary channels		3	3		2		2			3				
Restrict flow to secondary channels		1	1							3				
Adjust introduced flow into overwinter area										3				
Restrict flow to contiguous backwaters										3	1			
Divert flow of sediment laden water away from backwate								3		3	1			
Sediment traps on tributaries to protect backwater						2		3		3	1			
Prevent/manage sediment from tributaries in sensitive area				1		2		3		3	1			3
Submerged sills into backwaters										3	1			
Pool scale drawdown					3									
Drawdown management units					3					3				
Drawdown isolated backwaters					3									
Isolate and drawdown contiguous backwaters					3									
Temporarily isolate and drawdown contiguous backwate					3									
Create and maintain fishless aquatic areas (e.g., potholes, ephemeral pond)									3					
Increase connectivity between channels and floodplain														
Acquire real estate rights, restore water to leveed floodplain areas						3	3		3	3	3		3	3
Notch levees		2	2	3			3		3	3	3		3	3
Set back levees		2	2	3			3		3	3	3		3	3
Remove levees		2	2	3					3	3	3		3	3
Reconfigure, restore flow to secondary channels (see above)		3	3						3	3				
Restore flow to isolated backwater areas (see above)									3	3			3	
Create habitat corridors for floodplain terrestrial wildlife									3					
Restore natural tributary channels through delta areas (see above)				2				3	3	3			3	3
Establish fish-friendly wetland units									3					
Install flow structures (pipes) through earthen dams to connect to isolate backwaters									3					
Increase longitudinal connectivity of rivers														
Build fishways at mainstem dams									3					

Hydrology/River Hydraulics

Ecological Objectives and Need Statements	Naturalize hydrologic regime.	Reduce stage and discharge fluctuations caused by dam operation	Restore desirable stage:discharge relationship	Provide for low water period during the growing season to restore aquatic vegetation	Restore or naturalize hydraulic interactions between the river and tributaries	Maintain minimum hydraulic gradient during very low flow periods	Minimize adverse flow fluctuations cayused by hydropower operations on tributaries	Minimize adverse effects of elevated water table on soil moisture conditions	Maintain maximum controlled pool stage (or greater if possible) during the winter	Increase flexibility of dam operations (e.g., widen control limits)	Restore desirable hydraulic connections between the river and backwater or floodplain	Restore ecological benefits of the flood pulse (e.g., increase available flood flow storage	Provide desirable pattern of hydraulic conditions in tailwaters (e.g., increase area of <0.3	Restore desirable longitudinal hydraulic connections across the dams to enhance	Reduce wind fetch in open water areas (e.g., backwaters and impounded areas)	Restore desirable current velocity and residence time in aquatic areas
Dredge backwater areas					3						3					2
Increase water levels											2					2
Increase terrestrial area								3								
Encourage natural land formation - delta					3			2			3				2	2
Restore lost physical structure in the floodplai																
Construct hard point in floodplain (scour points)																
Excavate floodplain pothole																
Blast floodplain potholes																
Excavate wetland scrapes																
Berm and construct moist soil area with water level contr																
Create ridge and swale topography with dredged mater								3			3					
Restore natural tributary channels through delta areas					3			3			3					3
Divert more tributary delta flow into open impounded areas					3			2			3				2	2
Construct temporary flow diversions to enlarge delta areas					3			2			3				2	3
Shoreline stabilization (aquatic habitat)																
Rip rap					2											
Grading, vegetation planting					2			2								
Rock groins, hard points					2								2			
Anchored woody debris					3								3			
Off-shore rock revetments													3		2	
Submerged rock vanes					2						2		2			
Modify aquatic habitat - hydraulic conditions																
Create rock and gravel substrate areas													3			
Create shallow rock and gravel riffle areas													3		3	3
Remove/modify/knock down wingdams													3			3
Break low spots in dam embankments - riffle type aquatic habit					3						3		3			3
Incorporate woody debris into bank protection					3								3			3
Incorporate woody debris into secondary and small channels					3											3
Modify flow distribution from dam gates - tailwater habitat						2							3			3
Modify flow in channe																
Construct islands to increase flow															3	3
Restore flow and geometry of secondary channels											3					3
Restrict flow to secondary channels											3					3
Adjust introduced flow into overwinter area											3					3
Restrict flow to contiguous backwaters											3					3
Divert flow of sediment laden water away from backwate					3						3					3
Sediment traps on tributaries to protect backwater					3						3					3
Prevent/manage sediment from tributaries in sensitive area					3			3			3					3
Submerged sills into backwaters											3					3
Pool scale drawdown			3	3		3		3		3						
Drawdown management units			3	3				3								
Drawdown isolated backwaters			3	3				3								
Isolate and drawdown contiguous backwaters			3	3				3								
Temporarily isolate and drawdown contiguous backwate			3	3				3								
Create and maintain fishless aquatic areas (e.g., potholes, ephemeral pond)			3					3			3					
Increase connectivity between channels and floodplain																
Acquire real estate rights, restore water to leveed floodplain areas			3					3		3	3	3				3
Notch levees			3		3			3			3	3				3
Set back levees			3					3			3	3				2
Remove levees			3		3			3			3	3				3
Reconfigure, restore flow to secondary channels (see above)					3						3					3
Restore flow to isolated backwater areas (see above)											3					3
Create habitat corridors for floodplain terrestrial wildlife																
Restore natural tributary channels through delta areas (see above)					3		2	3			3					3
Establish fish-friendly wetland units																
Install flow structures (pipes) through earthen dams to connect to isolate backwaters						3					2		3			3
Increase longitudinal connectivity of rivers																
Build fishways at mainstem dams													1	3		1

Habitat

Ecological Objectives and Need Statements	Restore and maintain a diverse mosaic of plant communities	Increase extent, abundance and diversity of submersed aquatic plants	Increase extent, abundance and diversity of emergent aquatic plants	Increase extent, abundance and diversity of floodplain grassland	Increase extent, abundance and diversity of floodplain shrub cover	Restore and maintain large contiguous grassland patches (>1,000 acres)	Restore and maintain large contiguous forest patches (>1,000 acres) with connected	Restore and maintain large contiguous wetland patches (>1,000 acres) every 30 - 40	Restore age and species diversity in floodplain forests	Maintain and restore geomorphic diversity in aquatic and floodplain areas	Restore physical habitat features in MMR	Restore or increase sand bar habitat	Maintain or increase depth of existing secondary channels	Increase topographic diversity (e.g., Increase elevation by two meters on 10% of all	Restore, create islands	Restore, create rapid and riffle habitat	Restore, create sand/mud flats	Restore, create, gravel bars	Restore and maintain substrate diversity in channels, (e.g., >2% of substrate area gravel	Restore and maintain backwater areas for sport and commercial fish	Provide for longitudinal fish passage in the mainstem and tributary rivers	Increase marsh habitat management opportunities in leveed areas	Maintain current areal abundance of crop land	Restore habitat corridors (eg riparian forests, contiguous prairie, etc.)	Create, maintain vegetated riparian buffer strips along tributaries and ditches basin-wide	Restore tributaries and floodplain streams	Create, restore floodplain terrestrial habitats.	Restore habitat on islands	Increase woody debris in secondary channels	Restore aquatic habitat every 10 miles in MMR (dike alteration)	Provide deepwater fish overwintering areas (e.g., depth range 0-3 m every 2 miles)
Dredge backwater areas										2	2					1		1	1	3											3
Increase water levels								2												1		1									3
Increase terrestrial area					2					1																	1				
Encourage natural land formation - delta		2	2	3	3			3	2	3	1	2		3	3	1	3	1	1	3		2			3	3	3				
Restore lost physical structure in the floodplai																															
Construct hard point in floodplain (scour points)										2	2			3								1					2				
Excavate floodplain pothole										1	1			2								1									
Blast floodplain potholes										1	1			2								1									
Excavate wetland scrapes		1	1							1	1			2								2									
Berm and construct moist soil area with water level contr			2					2			2						2			1		2									
Create ridge and swale topography with dredged mater				2	3		2		3	3	3			3			2					2					3		2		
Restore natural tributary channels through delta areas			1		2			2	2	3	3	3		3		2	3	2	2	3		3		3	3	3	2				3
Divert more tributary delta flow into open impounded areas		2	2		2			3	2	3		2		3	3	2	3	2	2	3		3		3		3	2				
Construct temporary flow diversions to enlarge delta areas		2	2	2	2			3	2	3	2	2		3	3	2	3	2	2	3		3		3	3	3	2				
Shoreline stabilization (aquatic habitat)																															
Rip rap										1	1		2							1						2		2			
Grading, vegetation planting					2					2	2		2		3											2		3			
Rock groins, hard points										1	2		2		2	2		2	2	2						2		2			2
Anchored woody debris										3	3		3		3					3						3		3	2		3
Off-shore rock revetments					2					2	2		2		3	2		2	2	3								3			
Submerged rock vanes										2	2		2							2						2		2			2
Modify aquatic habitat - hydraulic conditions																															
Create rock and gravel substrate areas										3	3		3			3		3	3	3						3					3
Create shallow rock and gravel riffle areas		2								3	3		3			3		3	3	3						3					1
Remove/modify/knock down wingdams										3	3		3			3		3	3												3
Break low spots in dam embankments - riffle type aquatic habit		1								3			3			3		3	3	3	3					3					2
Incorporate woody debris into bank protection										3	3		3							3						3			2		3
Incorporate woody debris into secondary and small channels										3	3		3							3						3			2		3
Modify flow distribution from dam gates - tailwater habitat																2		2	2		3										3
Modify flow in channe																															
Construct islands to increase flow			1							2		2	2			2	2	2	2	2											3
Restore flow and geometry of secondary channels										3	3	2	3			3	3	3	3												3
Restrict flow to secondary channels											1	2	3			2	3	2	2												3
Adjust introduced flow into overwinter area											3									3											3
Restrict flow to contiguous backwaters		2	1								2									3											3
Divert flow of sediment laden water away from backwate		3	1							2	2									3											2
Sediment traps on tributaries to protect backwater		2	1					2		2	1									2											2
Prevent/manage sediment from tributaries in sensitive area		2	1					2		2	2									2					3						2
Submerged sills into backwaters								2		2	2					2		2	2	2											2
Pool scale drawdown		3	3					3												3											
Drawdown management units		2	2					3												2											
Drawdown isolated backwaters		3	3					3												2											
Isolate and drawdown contiguous backwaters		3	3					3									2			3											
Temporarily isolate and drawdown contiguous backwate		3	3					3									2			3											
Create and maintain fishless aquatic areas (e.g., potholes, ephemeral pond)		3	3					3		3	3																				
Increase connectivity between channels and floodplain																															
Acquire real estate rights, restore water to leveed floodplain areas		2	2		3	3	3	3	3	3	3			3			3			3		3		3	3	3	3				3
Notch levees		1	1		2	2	2	2	2	2	2			2			2			2		2		2	2	2	2				2
Set back levees		1	1		2	2	2	2	2	2	2			2			2			2		2		2	2	2	2				2
Remove levees		2	2		3	3	3	3	3	3	3			3			3			3		3		3	3	3	3				3
Reconfigure, restore flow to secondary channels (see above)		1	1							3	3	2	3			2	2	2	2					3					2		3
Restore flow to isolated backwater areas (see above)		1	1																	3		3		3							3
Create habitat corridors for floodplain terrestrial wildlife						3	3		3															3	3		3				
Restore natural tributary channels through delta areas (see above)		1	1					3	2	3	3			3						3		3		3	3	3	2				3
Establish fish-friendly wetland units		1	1					1			2						2			2		2		2							
Install flow structures (pipes) through earthen dams to connect to isolate backwaters																				2		2		2		2					3
Increase longitudinal connectivity of rivers																															
Build fishways at mainstem dams																3		3	3		3										

Biota

Ecological Objectives and Need Statements	Restore populations of endemic state and Federal protected species throughout their range	Maintain viable populations of native plant species and communities throughout their	Maintain viable populations of native invertebrate populations throughout their range in	Maintain viable populations of native mussel populations throughout their range in the	Maintain viable populations of native fish populations throughout their range in the Uppe	Maintain viable populations of native amphibian and reptile populations throughout their	Maintain viable populations of native bird populations throughout their range in the Uppe	Maintain viable populations of native mammal populations throughout their range in the	Control or eliminate exotic and invasive species throughout the Upper Mississippi River
Dredge backwater areas					2				
Increase water levels					1				
Increase terrestrial area									
Encourage natural land formation - delta		3	3	3	3	3	3	3	
Restore lost physical structure in the floodplai									
Construct hard point in floodplain (scour points)			1			1	1	1	
Excavate floodplain pothole			1			1	1	1	
Blast floodplain potholes			1			1	1	1	
Excavate wetland scrapes			1			2	1	1	
Berm and construct moist soil area with water level contr		2	2		1	2	2	2	
Create ridge and swale topography with dredged mater		3				3	3	3	
Restore natural tributary channels through delta areas		3	3	3	3	3	3	3	
Divert more tributary delta flow into open impounded areas		3	2	2	3	3	3	3	
Construct temporary flow diversions to enlarge delta areas		3	2	2	3	3	3	3	
Shoreline stabilization (aquatic habitat)									
Rip rap			1	1	2				
Grading, vegetation planting						2			
Rock groins, hard points			2	2	2				
Anchored woody debris			3		3	3			
Off-shore rock revetments			3		3	2	2	2	
Submerged rock vanes			2	2	2				
Modify aquatic habitat - hydraulic conditions									
Create rock and gravel substrate areas			3	3	3	1			
Create shallow rock and gravel riffle areas			3	3	3	1			
Remove/modify/knock down wingdams				2	2	1			
Break low spots in dam embankments - riffle type aquatic habit			3	3	3	1			
Incorporate woody debris into bank protection			3		3	3			
Incorporate woody debris into secondary and small channels			3		3	3		2	
Modify flow distribution from dam gates - tailwater habitat			2	1	2				
Modify flow in channe									
Construct islands to increase flow			2	2	2	2	2	2	
Restore flow and geometry of secondary channels			3	3	3	3	2	2	
Restrict flow to secondary channels			2	2	2	1	1	1	
Adjust introduced flow into overwinter area			2		3				
Restrict flow to contiguous backwaters			2	1	3				
Divert flow of sediment laden water away from backwate		2	2	2	3	2			
Sediment traps on tributaries to protect backwater		2	2	2	2	1			
Prevent/manage sediment from tributaries in sensitive area		2	2	2	2	2			
Submerged sills into backwaters			2	2	2	2			
Pool scale drawdown			3	3	3	3	3	3	
Drawdown management units		2	2		1	2	2	2	
Drawdown isolated backwaters		2	2		1	2	2	3	
Isolate and drawdown contiguous backwaters		2	2	3	3	3	3	3	
Temporarily isolate and drawdown contiguous backwate		3	2	3	3	3	3	3	
Create and maintain fishless aquatic areas (e.g., potholes, ephemeral pond)		3	3			3	2		
Increase connectivity between channels and floodplain									
Acquire real estate rights, restore water to leveed floodplain areas		3	3		3	3	3	3	
Notch levees		2	2		2	2	2	2	
Set back levees		2	2		2	2	2	2	
Remove levees		3	3		3	3	3	3	
Reconfigure, restore flow to secondary channels (see above)			3	3	3	3	3	3	
Restore flow to isolated backwater areas (see above)			2		3				
Create habitat corridors for floodplain terrestrial wildlife		3					3	3	
Restore natural tributary channels through delta areas (see above)		3	3	3	3	3	3	3	
Establish fish-friendly wetland units		2	2		2	2	2	2	
Install flow structures (pipes) through earthen dams to connect to isolate backwaters			2		3				
Increase longitudinal connectivity of rivers									
Build fishways at mainstem dams			2	3	3				

Ecological Objectives and Need Statements

Water Quality

	Achieve USEPA and state full use standards to improve water quality	Reduce contaminant loadings to the river	Manage contaminated sediments	Achieve USEPA and state non-point TMDL standards to improve water quality	Reduce fine sediment loadings to the river	Reduce coarse sediment loadings to the river	Reduce nutrient loading from tributaries to the mainstem river and Gulf of Mexico	Increase nutrient processing (e.g., denitrification) in river habitats	Maintain DO concentrations >5 ppm during ice free periods for fish	During winter-ice covered periods maintain DO concentrations >3 ppm, temperature	Create thermal and velocity refugia (e.g., holes >3 m) in backwaters and channels	Maintain water clarity sufficient to support submersed aquatic vegetation, aquatic
Remove dams on tributaries												
Modify dam gate settings												
Build fishways on tributary dams												
Lower embankments and spillway												
Remove dams (mainstem and tribs												
Build barriers to restrict exotic species movement												
Sever Great Lakes IWW connectior												
Flood Damage Reduction, Floodplain Management												
Construct levees												
Maintain levees												
Construct flood walls												
Maintain flood walls												
Construct pump stations												
Maintain pump stations												
Use floodplain areas for floodwater storage	1								2			
Set back levees to reduce flood stages											2	
Remove levees to reduce flood stages											3	
Controlled floodways												
Gated levees - controlled flow into hydrograph												
Floodproof essential floodplain infrastructure												
Move vulnerable infrastructure to high ground												
Prohibit further development in structurally protected floodplain												
Restrict development in floodways												
Acquire real estate rights, restore water to leveed floodplain areas												
Grow perennial flood tolerant crops in floodplain												
Do not subsidize any floodplain land use (100% local cost)												
No government bailouts for repetative flood damag												
Implement Galloway Report recommendatior												
Watershed and Water Quality Management in UMR Basin Apply BMPs												
Assess water quality and watershed conditions	1	1		1	1	1	1		2			1
Conservation tillage	2			2	2	1	2		1			1
Contour farming, terraces	2			1	1	1	1		1			1
Grassed waterways	2	1		1	2	2	2		1			1
Riparian buffer strips	3	1		1	2	2	2		1			1
Establish perennial cover, crops	3	2		3	2	3	3		2			2
Conservation set-aside	3	2		2	3	3	3		2			2
Construct, maintain small impoundments						1			2			1
Restore drained lakes, wetland areas	2	1	1	2	2	2	2		2			2
Water and sediment control basins	1		1	1	1	1			1			1
Construct tributary reservoirs						3						
Wetland restoration to increase infiltratio	2	1	1	2	2	2	1		2			1
Stabilize eroding ravines	1			1	1	2						1
Erosion control structures along intermittent streams	1			1	1	2						1
Restore stream channels, floodplain areas	1			1		2	2					1
Restore hydrologic regime in tributaries				2	2	2						1
Use tributary dams to mimic natural patterns				1	1							
Run of the river tributaries												
Urban stormwater management practices	2	2	2	2	2	1	1		1	1		1
Construction site erosion prevention practices	1	1	1	1	1	1	1		1	1		1
Increase pervious surface in developed areas	1		1	1	1	1	1		1	1		1
Increase water onto floodplains, denitrification	1			1			2		1	1		
Upgrade municipal waste treatment systems	3	3					3		2	1		1
Re-use industrial wastes into products	3	3					3		1			
Upgrade industrial waste pre-treatment systems	3	3					3		1			
Create wetlands to treat storm water	2	2	2	2	2	1	2		2	1		1
Eliminate phosphorus in lawn fertilizer	1	1					2		2	1		1
Dechannelize tributaries					1	1	1		1	2		
Regulate discharge of pollutants from point sources (NPDES)	3	3					3		3	2		2
Regulate implementation of BMPs (non-point TMDLs)	3	3	2	3	3	3	3		3	2		2
Implement zoning regulations on runoff and erosion control	2	2	2	2	2	1	1		1			1

Geomorphology

	Reduce bank erosion	Restore secondary channels	Create secondary channels	Increase ridge and swale floodplain topography	Consolidate flocculent backwater sediment	Restore channelized tributaries in the mainstem river floodplains	Restore fluvial dynamics (e.g. channel avulsion, secondary channel, distributary channels)	Reduce sedimentation in tributary deltas	Alter aquatic and terrestrial habitat connectivity	Restore and maintain connectivity between contiguous backwater and channel areas	Increase extent of contiguous backwater areas	Increase extent of isolated floodplain areas	Increase extent of isolated floodplain lakes	Increase unleveed floodplain at tributary confluences
Remove dams on tributaries									3					
Modify dam gate settings									3					
Build fishways on tributary dams									3					
Lower embankments and spillway									3	3				
Remove dams (mainstem and tribs									3					
Build barriers to restrict exotic species movement									3					
Sever Great Lakes IWW connectior									3					
Flood Damage Reduction, Floodplain Management														
Construct levees									3			3		
Maintain levees												3		
Construct flood walls									3			3		
Maintain flood walls												3		
Construct pump stations									3			3		
Maintain pump stations												3		
Use floodplain areas for floodwater storage									3		3			
Set back levees to reduce flood stages		2	2	3					3	3	3		3	3
Remove levees to reduce flood stages		2	2	3					3	3	3		3	3
Controlled floodways									3					
Gated levees - controlled flow into hydrograph									3					
Floodproof essential floodplain infrastructure														
Move vulnerable infrastructure to high ground														
Prohibit further development in structurally protected floodplain														
Restrict development in floodways														
Acquire real estate rights, restore water to leveed floodplain areas									3					3
Grow perennial flood tolerant crops in floodplain														
Do not subsidize any floodplain land use (100% local cost)														
No government bailouts for repetative flood damag														
Implement Galloway Report recommendatior														
Watershed and Water Quality Management in UMR Basin Apply BMPs														
Assess water quality and watershed conditions								1						
Conservation tillage								1						
Contour farming, terraces								1						
Grassed waterways								1						
Riparian buffer strips								2						
Establish perennial cover, crops								3						
Conservation set-aside								3						
Construct, maintain small impoundments														
Restore drained lakes, wetland areas														
Water and sediment control basins								1	3					
Construct tributary reservoirs								1	3					
Wetland restoration to increase infiltratio									3					
Stabilize eroding ravines								1						
Erosion control structures along intermittent streams								1						
Restore stream channels, floodplain areas								3	3					
Restore hydrologic regime in tributaries								2	3					
Use tributary dams to mimic natural patterns									3					
Run of the river tributaries									3					
Urban stormwater management practices								1						
Construction site erosion prevention practices								1						
Increase pervious surface in developed areas														
Increase water onto floodplains, denitrification														
Upgrade municipal waste treatment systems														
Re-use industrial wastes into products														
Upgrade industrial waste pre-treatment systems														
Create wetlands to treat storm water														
Eliminate phosphorus in lawn fertilizer														
Dechannelize tributaries								3						
Regulate discharge of pollutants from point sources (NPDES)														
Regulate implementation of BMPs (non-point TMDLs)								3						
Implement zoning regulations on runoff and erosion control								1						

Hydrology/River Hydraulics

	Naturalize hydrologic regime.	Reduce stage and discharge fluctuations caused by dam operation	Restore desirable stage discharge relationship	Provide for low water period during the growing season to restore aquatic vegetation	Restore or naturalize hydraulic interactions between the river and tributaries	Maintain minimum hydraulic gradient during very low flow periods	Minimize adverse flow fluctuations caused by hydropower operations on tributaries	Minimize adverse effects of elevated water table on soil moisture conditions	Maintain maximum controlled pool stage (or greater if possible) during the winter	Increase flexibility of dam operations (e.g., widen control limits)	Restore desirable hydraulic connections between the river and backwater or floodplain	Restore ecological benefits of the flood pulse (e.g., increase available flood flow storage	Provide desirable pattern of hydraulic conditions in tailwaters (e.g., increase area of <0.3	Restore desirable longitudinal hydraulic connections across the dams to enhance	Reduce wind fetch in open water areas (e.g., backwaters and impounded areas)	Restore desirable current velocity and residence time in aquatic areas
Remove dams on tributaries		1	1				3							3		3
Modify dam gate settings													3	2		3
Build fishways on tributary dams														3		1
Lower embankments and spillway					2	3					3			2		2
Remove dams (mainstem and tribs		3	1		2	3	3				3			3		3
Build barriers to restrict exotic species movement																
Sever Great Lakes IWW connectior																
Flood Damage Reduction, Floodplain Management																
Construct levees								1								
Maintain levees								1								
Construct flood walls																
Maintain flood walls																
Construct pump stations								1								
Maintain pump stations								1								
Use floodplain areas for floodwater storage			3		1						1	3				
Set back levees to reduce flood stages			3								3	3				2
Remove levees to reduce flood stages			3								3	3				3
Controlled floodways												3				
Gated levees - controlled flow into hydrograph			2					1				2				
Floodproof essential floodplain infrastructure																
Move vulnerable infrastructure to high ground																
Prohibit further development in structurally protected floodplain																
Restrict development in floodways																
Acquire real estate rights, restore water to leveed floodplain areas			3					3				3				
Grow perennial flood tolerant crops in floodplain								3				3				
Do not subsidize any floodplain land use (100% local cost)												2				
No government bailouts for repetative flood damag												2				
Implement Galloway Report recommendatior												2				
Watershed and Water Quality Management in UMR Basin Apply BMPs																
Assess water quality and watershed conditions					1											
Conservation tillage					2											
Contour farming, terraces					2											
Grassed waterways					2											
Riparian buffer strips					2											
Establish perennial cover, crops					3											
Conservation set-aside					3											
Construct, maintain small impoundments				1	2											
Restore drained lakes, wetland areas				2	3											
Water and sediment control basins				1	2											
Construct tributary reservoirs																
Wetland restoration to increase infiltratio					2											
Stabilize eroding ravines					2											
Erosion control structures along intermittent streams					2											
Restore stream channels, floodplain areas					2											
Restore hydrologic regime in tributaries		2	2		2		3									
Use tributary dams to mimic natural patterns		2	2	2	1		3									
Run of the river tributaries		3	3		2											
Urban stormwater management practices					2											
Construction site erosion prevention practices					2											
Increase pervious surface in developed areas					2											
Increase water onto floodplains, denitrification																
Upgrade municipal waste treatment systems																
Re-use industrial wastes into products																
Upgrade industrial waste pre-treatment systems																
Create wetlands to treat storm water					2											
Eliminate phosphorus in lawn fertilizer																
Dechannelize tributaries					3											
Regulate discharge of pollutants from point sources (NPDES)																
Regulate implementation of BMPs (non-point TMDLs)					3											
Implement zoning regulations on runoff and erosion control																

Habitat

	Restore and maintain a diverse mosaic of plant communities	Increase extent, abundance and diversity of submersed aquatic plants	Increase extent, abundance and diversity of emergent aquatic plants	Increase extent, abundance and diversity of floodplain grassland	Increase extent, abundance and diversity of floodplain shrub cover	Restore and maintain large contiguous grassland patches (>1,000 acres)	Restore and maintain large contiguous forest patches (>1,000 acres) with connected	Restore and maintain large contiguous wetland patches (>1,000 acres) every 30 - 40	Restore age and species diversity in floodplain forests	Maintain and restore geomorphic diversity in aquatic and floodplain areas	Restore physical habitat features in MMR	Restore or increase sand bar habitat	Maintain or increase depth of existing secondary channels	Increase topographic diversity (e.g., Increase elevation by two meters on 10% of all	Restore, create islands	Restore, create rapid and riffle habitat	Restore, create sand/mud flats	Restore, create, gravel bars	Restore and maintain substrate diversity in channels, (e.g., >2% of substrate area gravel	Restore and maintain backwater areas for sport and commercial fish	Provide for longitudinal fish passage in the mainstem and tributary rivers	Increase marsh habitat management opportunities in leveed areas	Maintain current areal abundance of crop land	Restore habitat corridors (eg riparian forests, contiguous prairie, etc.)	Create, maintain vegetated riparian buffer strips along tributaries and ditches basin-wide	Restore tributaries and floodplain streams	Create, restore floodplain terrestrial habitats.	Restore habitat on islands	Increase woody debris in secondary channels	Restore aquatic habitat every 10 miles in MMR (dike alteration)	Provide deepwater fish overwintering areas (e.g., depth range 0-3 m every 2 miles)
Remove dams on tributaries																3		3	3		3										3
Modify dam gate settings																					2										
Build fishways on tributary dams																3		3	3		3										
Lower embankments and spillway																3		3	3	3	2			3		3					
Remove dams (mainstem and tribs								3		3				3		3		3	3	3	3			3		3					
Build barriers to restrict exotic species movement																					3										
Sever Great Lakes IWW connectior																					3										
Flood Damage Reduction, Floodplain Management																															
Construct levees																						2									
Maintain levees																						2	3								
Construct flood walls																															
Maintain flood walls																															
Construct pump stations																						2									
Maintain pump stations																						2	3								
Use floodplain areas for floodwater storage						2	3	3	3	3	3									2		2		2	2	2					
Set back levees to reduce flood stages		1	1		2	2	2	2	2	2	2			2			2					2		2	2	2	2				2
Remove levees to reduce flood stages		2	2		3	3	3	3	3	3	3			3			3					3		3	3	3	3				3
Controlled floodways					2	2	3	3	3	2	2			2			2					2		2	2	2	2				
Gated levees - controlled flow into hydrograph																															
Floodproof essential floodplain infrastructure																															
Move vulnerable infrastructure to high ground																							2	1							
Prohibit further development in structurally protected floodplain																							2	2							
Restrict development in floodways																							2	2			3				
Acquire real estate rights, restore water to leveed floodplain areas				3				3	3		3									3		3		3	3	3	3				
Grow perennial flood tolerant crops in floodplain				3		3	3		3													1	3	2	3		2				
Do not subsidize any floodplain land use (100% local cost)																															
No government bailouts for repetative flood damag																															
Implement Galloway Report recommendatior																															
Watershed and Water Quality Management in UMR Basin Apply BMPs																															
Assess water quality and watershed conditions		1								1										1											
Conservation tillage		1																		1											
Contour farming, terraces		1																		1											
Grassed waterways		2																		2					3						
Riparian buffer strips		2																		3					3						
Establish perennial cover, crops		3		3																3					3						
Conservation set-aside		3																		3					3						
Construct, maintain small impoundments		1	1																	1											
Restore drained lakes, wetland areas		2	2																	2					3						
Water and sediment control basins		1	1																	1											
Construct tributary reservoirs																															
Wetland restoration to increase infiltratio		1	2																	3					3						
Stabilize eroding ravines		1																		2											
Erosion control structures along intermittent streams		1																		2											
Restore stream channels, floodplain areas		2																		3					3						
Restore hydrologic regime in tributaries		2								2										3											
Use tributary dams to mimic natural patterns										1										1											
Run of the river tributaries										1										1											
Urban stormwater management practices		1																		2											
Construction site erosion prevention practices		1																		2											
Increase pervious surface in developed areas		1																		1											
Increase water onto floodplains, denitrification			2																	2											
Upgrade municipal waste treatment systems		1																		1											
Re-use industrial wastes into products																				1											
Upgrade industrial waste pre-treatment systems																				1											
Create wetlands to treat storm water		2	2																	2					3						
Eliminate phosphorus in lawn fertilizer		1																		1											
Dechannelize tributaries		1	1						2											3											
Regulate discharge of pollutants from point sources (NPDES)		2	1																	3											
Regulate implementation of BMPs (non-point TMDLs)		2	1							2										3											
Implement zoning regulations on runoff and erosion control		1																													

Biota

	Restore populations of endemic state and Federal protected species throughout their range	Maintain viable populations of native plant species and communities throughout their	Maintain viable populations of native invertebrate populations throughout their range in	Maintain viable populations of native mussel populations throughout their range in the	Maintain viable populations of native fish populations throughout their range in the Uppe	Maintain viable populations of native amphibian and reptile populations throughout their	Maintain viable populations of native bird populations throughout their range in the Uppe	Maintain viable populations of native mammal populations throughout their range in the	Control or eliminate exotic and invasive species throughout the Upper Mississippi River
Remove dams on tributaries			3	3	3	2	1	1	
Modify dam gate settings				1	2				
Build fishways on tributary dams			2	3	3				
Lower embankments and spillway			2	2	2	1		1	
Remove dams (mainstem and tribs			3	3	3	3	1	2	
Build barriers to restrict exotic species movement			2	2	2				
Sever Great Lakes IWW connectior			3	3	3				
Flood Damage Reduction, Floodplain Management									
Construct levees									
Maintain levees									
Construct flood walls									
Maintain flood walls									
Construct pump stations									
Maintain pump stations									
Use floodplain areas for floodwater storage		2	2		2	2	2	2	
Set back levees to reduce flood stages		2	2		2	2	2	2	
Remove levees to reduce flood stages		3	3		3	3	3	3	
Controlled floodways		2			1				
Gated levees - controlled flow into hydrograph									
Floodproof essential floodplain infrastructure									
Move vulnerable infrastructure to high ground									
Prohibit further development in structurally protected floodplain									
Restrict development in floodways		1							
Acquire real estate rights, restore water to leveed floodplain areas		3	3		3	3	3	3	
Grow perennial flood tolerant crops in floodplain		1					2	2	
Do not subsidize any floodplain land use (100% local cost)									
No government bailouts for repetative flood damag									
Implement Galloway Report recommendatior									
Watershed and Water Quality Management in UMR Basin Apply BMPs									
Assess water quality and watershed conditions			1	1	1	1			
Conservation tillage			1	1	1	1			
Contour farming, terraces			1	1	1	1			
Grassed waterways			2	2	2	2	1	1	
Riparian buffer strips		3	3	2	2	2	2	3	
Establish perennial cover, crops			3	3	3	3	2	3	
Conservation set-aside		3	3	3	3	3	3	3	
Construct, maintain small impoundments									
Restore drained lakes, wetland areas		3	3	3	3	3	3	3	
Water and sediment control basins				1	1	1	1		
Construct tributary reservoirs									
Wetland restoration to increase infiltratio		3	3	2	2	2	2	2	
Stabilize eroding ravines			1	1	1	1			
Erosion control structures along intermittent streams			1	1	1	1			
Restore stream channels, floodplain areas		3	3	3	3	3	3	3	
Restore hydrologic regime in tributaries		2	2	3	3	3	2	2	
Use tributary dams to mimic natural patterns			1	1	1	1	1		
Run of the river tributaries			2	2	2	2	2		
Urban stormwater management practices			1	1	1	1			
Construction site erosion prevention practices			1	1	1	1			
Increase pervious surface in developed areas			1	1	1	1			
Increase water onto floodplains, denitrification			1	1	1	1			
Upgrade municipal waste treatment systems			1	1	1	1			
Re-use industrial wastes into products			1	1	1	1			
Upgrade industrial waste pre-treatment systems			1	1	1	1			
Create wetlands to treat storm water		1	1	1	1	1	1	1	
Eliminate phosphorus in lawn fertilizer			1	1	1	1			
Dechannelize tributaries			3	3	3	3			
Regulate discharge of pollutants from point sources (NPDES)			3	3	3	3			
Regulate implementation of BMPs (non-point TMDLs)			3	3	3	3			
Implement zoning regulations on runoff and erosion control			1	1	1	1			

Attachment 3

Management actions sorted by sum of rank of likelihood to achieve objectives

Limited depth dredging to reduce volume	1
As-needed dredging - close monitoring	1
Modify alignment to reduce dredging requirements	1
Bend width reductions to reduce dredging	1
Schedule commercial traffic to minimize stops	1
Modify towboat propulsion system	1
Restrict daily time of tow traffic to reduce fish entrainment	1
Operate locks	1
Designate camping areas	1
Stock fish	1
Monitor and test for diseases	1
Restrict seasonal timing of tow traffic to reduce fish entrainment	2
Limit fertilizer use	2
Operate and maintain recreation areas	2
Install bird nesting structures	2
Enforce fishing regulations	2
Control invasive exotic species	2
Modify habitat (see below)	2
Management for protection of neotropical migrants and other species of concern	2
Do not subsidize any floodplain land use (100% local cost)	2
No government bailouts for repetative flood damage	2
Implement Galloway Report recommendations	2
Increase water depth to reduce sediment resuspension	3
Restrict opening, closing of navigation season	3
River clean-up days with volunteer effort	3
Provide sanitary facilities for campers on islands	3
Develop effective spill response, river defense network	3
Maintain flood walls	3
Move vulnerable infrastructure to high ground	3
Realign channel to reduce navigation impacts	4
Replace riprap	4
Limit extent and use of toxic herbicides in brush removal	4
Assess condition of fish populations	4
Assess condition of wildlife populations	4
Use predator control where appropriate	4
Mitigate wildlife diseases related to habitat e.g. botulism	4
Prohibit further development in structurally protected floodplain	4
Placement out of floodplain - beneficial use	5
Restrict recreational boat noise to protect habitats	5
Provide, maintain boating access to backwater areas	5
Modify habitat structure in floodplain and backwaters	5
Assess condition of fish populations	5
Apply species-specific toxicants	5
Kill zebra mussels on vessels in lock chambers	5
Promote utilization of exotic biomass	5
Increase channel border width	5
Sediment trap dredging to reduce frequency, volume	6
Placement behind levees - agricultural areas	6

Use non-toxic paint under water	6
Designate boat beaching areas	6
Enforce hunting regulations	6
Sportsman education and outreach	6
Assess condition of wildlife populations	6
Modify hunter attitudes about expoitation	6
Enforce hunting regulations	6
Monitor and test for diseases	6
Encourage commercial harvest of invasive species	6
Stabilize and protect landforms so we can protect what we have	6
Restore lost physical structure in the floodplain	6
Construct flood walls	6
Limit public use, behavior, impacts (people management)	7
Plant agricultural crops to maintain open areas, control undesirable species	7
Better management of game sp. (deer) so populations do not negatively impact other biodiversity	7
Bioengineered - control of exotics/problem species	7
Construct tributary reservoirs	7
Placement of contaminated material out of floodplain	8
Minimize impacts of barge fleeting and mooring	8
Plant agricultural crops as food for wildlife	8
Regulate use of exotic species for fishing bait	8
Regulate biota transfer by fishing boats	8
Gated levees - controlled flow into hydrograph	8
Restrict development in floodways	8
Speed and wake restrictions	9
Enforce trapping regulations	9
Adjust hunting and trapping regulations as needed	9
Predator management where appropriate or needed	9
Require treatment of Great Lakes freighter ballast water	9
Construct levees	9
Maintain levees	9
Construct pump stations	9
Maintain pump stations	9
Bendway weirs	10
Create and maintain beaches	10
Construct, operate, maintain barrier on Illinois River	10
Construct, maintain small impoundments	10
Experiment with management actions during scheduled closures	11
Plant native prairie on grounds	11
Limit density of use and impacts	11
Encourage non-motorized recreation	11
Review, permitting of barge fleeting areas	11
Use aerators to improve backwater DO	11
Control selected predator populations	11
Reestablish disease resistant elms in floodplain	11
Enforce fishing regulations	11
Restrict and enforce use of exotic species in aquaculture	11
Navigation area restrictions - recreational boats	12
Prohibit commercial navigation outside designated channel areas	12
Prohibit barge fleeting outside designated areas	12

Excavate floodplain potholes	12
Blast floodplain potholes	12
Build barriers to restrict exotic species movements	12
Maintain minimum water gradient	13
Protect special habitat areas (see rec boat restrictions above)	13
Improve safety of potential spill sources	13
Reduce bank erosion	13
Reintroduce native species	13
Adjust angling, commercial fishing regulations as needed	13
Protect, increase populations of threatened, endangered species	13
Control invasive exotic species	13
Mimimize dredge slurry return water	14
Install bouys to keep tows away from sensitive habitats	14
Control invasive exotic species	14
Increase water onto floodplains, denitrification	14
Eliminate phosphorus in lawn fertilizer	14
Manage fish and wildife populations on federal refuges	15
Reintroduction of extirpated species to the area	15
Restore populations of T&E species.	15
Restore and improve T&E species habitats	15
Protect, increase populations of threatened, endangered species	15
Sever Great Lakes IWW connection	15
Re-use industrial wastes into products	15
Upgrade industrial waste pre-treatment systems	15
Restrict recreational boat beaching to protect habitats	16
Re-use industrial wastes into products	16
Upgrade industrial waste pre-treatment systems	16
Divert tributaries into backwaters to deliver DO during winter	16
Reintroduce/expand species of concern to avoid listing	16
Increase terrestrial area	16
Excavate wetland scrapes	16
Modify dam gate settings	16
Stabilize eroding ravines	16
Erosion control structures along intermittent streams	16
Operate water control structures in embankments	17
Review, permitting of work in wetlands	17
Assess condition of floodplain vegetation	17
Conduct biomanipulation of wildlife community (various actions)	17
Contour farming, terraces	17
Increase pervious surface in developed areas	17
Assess water quality conditions	18
Assess water quality and watershed conditions	18
Conduct biomanipulation of fish community (various actions)	19
Construct hard point in floodplain (scour points)	19
Upgrade municipal waste treatment systems	19
Implement stormwater treatment	20
Reduce sediment resuspension	20
Protect or provide special spawning, nesting, nursery areas	20
Conservation tillage	20
Construction site erosion prevention practices	20

Implement zoning regulations on runoff and erosion control	20
Remove bank stabilization structures	21
Restrict recreational boat navigated areas to protect habitats	21
Upgrade municipal waste treatment systems	21
Open springs in isolated backwaters	21
Water and sediment control basins	21
Rip rap	22
Use tributary dams to mimic natural patterns	22
watershed (encourgae all means of land conservation)	23
Run of the river tributaries	23
Dredge backwater areas, increase depth	24
Construct bendway weirs	24
Construct wind breaks	24
Higher, slight pulsing of winter water levels	25
Confined placement in floodplain	25
Placement on existing, construct new beaches	25
Bank revetments	25
Restrict recreational boat wakes to protect shorelines	25
Review, permitting of work in floodplains	25
Reduce algae production	25
Timber stand improvement	25
Urban stormwater management practices	25
Operate pools on high side during winter	26
Minimize bankside dredged material placement	26
Stabilize dredged material with soil	26
Unconfined placement in channel	27
Construct island wave breaks	27
Modify habitat to improve water quality (e.g., sediment consolidation)	27
Reduce phosphate discharge from sewage treatment plants	27
Build fishways on tributary dams	27
Introduce flows to backwater areas, improve DO	28
Modify flow distribution from dam gates - tailwater habitat	28
Build fishways at mainstem dams	28
Spawning season drawdowns to strand fish eggs (carp)	29
Closing dams	29
Restore and maintain floodplain prairie	29
Increase water levels	29
Grading, vegetation planting	29
Construct hard points, groins for shoreline stabilization	30
Berm and construct moist soil area with water level control	30
Adjust introduced flow into overwinter areas	30
Create habitat corridors for floodplain terrestrial wildlife	30
Establish fish-friendly wetland units	30
Remove bottom feeding fish (carp)	31
Dechannelize tributaries	31
Develop moist soil plant communities	32
Grassed waterways	32
Semi-confined channel placement (chevrons)	33
Wing dams (dikes)	33
Regulate discharge of pollutants from point sources (NPDES)	33

Plant, encourage expansion of mast-producing trees	33
Construct rock barbs	33
Automate dam operations	34
Stabilize existing islands	34
Grow perennial flood tolerant crops in floodplain	34
Regulate discharge of pollutants from point sources (NPDES)	34
Increase aquatic plant density	35
Protect special habitat areas required by fish and wildlife	35
Submerged sills into backwaters	35
Create wetlands to treat storm water	35
Restrict navigation season to accommodate pool drawdowns	36
Plant vegetation on dredged material deposits	36
Restrict flow to contiguous backwaters	36
Manage water levels	37
Use land based excavators to move material during drawdowns	38
Increase plant distribution	38
Construct islands to increase flow	38
Drawdown management units	38
Drawdown isolated backwaters	38
Unconfined placement to raise areas for mast-producing trees	39
Construct chevrons	39
Create mix of successional stages	39
Create mix of forest and prairie	39
Construct wave breaks	39
Install flow structures (pipes) through earthen dams to connect to isolated backwaters	39
Unconfined placement in floodplain	40
Dredge backwater areas	40
Submerged rock vanes	40
Restrict flow to secondary channels	40
Controlled floodways	40
Remove/modify/knock down wingdams	41
Sediment traps on tributaries to protect backwaters	41
Create and maintain fishless aquatic areas (e.g., potholes, ephemeral pond)	41
Drawdowns to consolidate sediment	42
Incorporate woody debris into channel structures	42
Remove dams on tributaries	42
Riparian buffer strips	42
Protect and manage floodplain forests	43
Promote emergent plant growth	43
Deposit sand, cap with fines, plant trees	43
Create rock and gravel substrate areas	43
Use larger rock, make bank revetments irregular	44
Construct off-shore revetments	44
Modify drainage district operations	44
Rock islands	44
Wetland restoration to increase infiltration	44
Restore stream channels, floodplain areas	44
Manage vegetation cover	45
Restore flow to isolated backwater areas (see above)	45
Restore hydrologic regime in tributaries	45

Dustpan hydraulic	46
Notch wing dams to create hydraulic, depth diversity	46
Rock groins, hard points	46
Divert flow of sediment laden water away from backwaters	46
Lower embankments and spillways	46
Review, permitting of work in rivers	47
Reduce loadings of sediment, N, P from tributaries (TMDLs)	48
Anchored woody debris	49
Off-shore rock revetments	49
Create shallow rock and gravel riffle areas	49
Isolate and drawdown contiguous backwaters	49
Introduce flow to isolated backwater areas	50
Temporarily isolate and drawdown contiguous backwaters	50
Use dam point control more - limit hinge point operations	51
Seed islands	51
Restore drained lakes, wetland areas	51
Construct seed islands	52
Small scale drawdown of floodplain lakes for vegetation	52
Temporarily isolate and draw down contiguous backwaters	52
Break low spots in dam embankments - riffle type aquatic habitat	52
Incorporate woody debris into secondary and small channels	52
Place dredged material to create wetland areas	53
Chevron islands	53
Open barrier islands - create channel, induce delta formation into open BW areas	53
Incorporate woody debris into bank protection	53
Regulate implementation of BMPs (non-point TMDLs)	53
Make frequent gate adjustments to minimize fluctuations	54
Drawdowns to promote scour in tributaries	54
Create ridge and swale topography with dredged material	55
Prevent/manage sediment from tributaries in sensitive areas	55
Establish perennial cover, crops	55
Restore flow to secondary channels	56
Pool scale drawdown	56
Use floodplain areas for floodwater storage	56
Conservation set-aside	56
Dredging to restore and create secondary channels	57
acquisition/easement programs	57
Build dam gates, naturalize hydrologic regime IL River	58
Build dam gates, naturalize hydrologic regime IL River	58
Seed islands	58
Increase shoreline dynamics/complexity	58
System-scale or multiple pool drawdowns	59
Purchase land	59
Growing season pool drawdowns to reestablish vegetation	59
Set back levees	59
Growing season drawdowns to promote emergent vegetation	60
Operate dam gates	60
Notch levees	63
Acquire real estate rights, restore water to leveed floodplain areas	63
Low islands - mud flats and sand bars	64

Divert flow into backwater areas to cause scour, deepening	64
Restore flow and geometry of secondary channels	64
Water control decision-making	65
Directions to lockmasters	65
Acquire real estate rights, modify regulation of Pools 24,25,26	65
Establish hydrologic objectives for tributaries	65
Mainstem dam gate operation	66
Use structures to manipulate flow to maintain backwater depth	66
Notch closing dams to increase side channel flow	67
Conservation easements to protect blufflands & grasslands in floodplain and beyond (local, state, NGO, Feds)	68
Remove dams (mainstem and tribs)	69
Acquire tributary floodplain areas	72
Reconfigure, restore flow to secondary channels (see above)	73
Remove levees	76
Island construction (impounded areas)	77
Set back levees to reduce flood stages	79
Restore flow to floodplain areas isolated by levees	81
Remove closing structures to divert flow into side channels	82
Construct temporary structures to divert flow	83
Construct islands to restore and create secondary channels	86
Islands to create secondary channels	87
Islands with varied top elevation, fine material	88
Construct islands in impounded areas	89
Set back levees	90
Restore natural tributary channels through delta areas (see above)	91
Notch levees	93
Encourage natural land formation - deltas	94
Divert more tributary delta flow into open impounded areas	96
Shore pipe, boosters to reach target sites	98
Cutterhead hydraulic	100
Mechanical	102
Maintain the visual aesthetics of the riverscape	102
Construct temporary flow diversions to enlarge delta areas	102
Use small dredges to expand placement options	103
Remove levees to reduce flood stages	104
Maintain flow split between main and off-channel	106
Restore natural tributary channels through delta areas	111
Remove levees	115
Modify flow splits between main and off-channel areas	118
Acquire real estate rights, restore water to leveed floodplain areas	119
Bend width reductions where appropriate	
Overdepth dredging to reduce frequency, volume	
Modify alignment to improve navigation safety	
Buoys	
Day marks	
Lights	
Signs	
Navigation charts	
Navigation notices, restrictions on commercial navigation	
Draft restrictions	

Cargo and tow configuration requirements	
Licensing of commercial vessels, pilots	
Modify design of towboat hull	
Improve lock approaches	
Modify tow size/configuration	
Establish and enforce safety zone for tow boats	
Limit draft of commercial tows to 9 feet	
Establish a permit system for tows over 9 foot draft	
Industry resource alerts	
River closure due to floods, security concerns, etc.	
Set buoys before navigation season opens	
Reset buoys as channel conditions require	
Restrict speed of commercial tows to reduce fish entrainment	
Restrict navigation during high river flow to improve safety	
Require use of helper boats to improve safety	
Require lock waiting area use, mooring cells (commercial)	
Require lock waiting area use, designated beaches (rec boat)	
Licensing of recreational boats	
Ensure navigation safety near locks and dams	
Perform rescues	
Maintain dam structures, machinery and controls	
Maintain grounds at dams	
Maintain visitor areas	
Maintain earthen embankments	
Brush removal	
Maintain signs and lights	
Catch and properly dispose of old paint	
Place shades on lights to limit skyward lighting	
Operate and maintain boating access sites	
Improve angler access	
Provide interpretive, educational information to public	
Provide interpretive displays	
Recreational use management (see recreation above)	
Focus Federal aid on Miss. R	
Modify habitat (see below)	
Modify flow in channel	
Floodproof essential floodplain infrastructure	

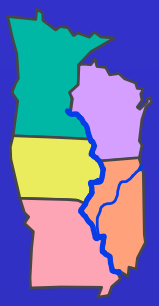
Attachment 4

Objectives sorted by sum of rank of likelihood to achieve objectives (Need, option to achieve objective??)

Increase nutrient processing (e.g., denitrification) in river habitats	8
Maintain current areal abundance of crop land	22
Maintain maximum controlled pool stage (or greater if possible) during the winter	29
Restore desirable longitudinal hydraulic connections across the dams to enhance opportunities for animal migrations	29
Manage contaminated sediments	37
Achieve USEPA and state non-point TMDL standards to improve water quality	39
Minimize adverse flow fluctuations cayused by hydropower operations on tributaries	43
Reduce fine sediment loadings to the river	46
Reduce stage and discharge fluctuations caused by dam operation	46
Increase woody debris in secondary channels	46
Reduce coarse sediment loadings to the river	50
Control or eliminate exotic and invasive species throughout the Upper Mississippi River Basin	51
Reduce contaminant loadings to the river	52
Restore channelized tributaries in the mainstem river floodplains	54
Restore aquatic habitat every 10 miles in MMR (dike alteration)	55
Restore and maintain large contiguous grassland patches (>1,000 acres)	57
Restore ecological benefits of the flood pulse (e.g., increase available flood flow storage and conveyance area in the floodplain; controlled levee overtopping)	62
Consolidate flocculent backwater sediment	65
Maintain minimum hydraulic gradient during very low flow periods	66
Increase unleveed floodplain at trubutary confluences	68
Restore and maintain large contiguous forest patches (>1,000 acres) with connected corridors	68
Provide for longitudinal fish passage in the mainstem and tributary rivers	68
Restore fluvial dynamics (e.g., channel avulsion, secondary channel, distributary channels, etc.)	70
Increase extent of isolated floodplain areas	73
Increase ridge and swale floodplain topography	76
Reduce sedimentation in tributary deltas	78
Increase flexibility of dam operations (e.g., widen control limits)	80
Restore secondary channels	83
Create secondary channels	83
Provide for low water period during the growing season to restore aquatic vegetation	85
Increase extent, abundance and diversity of floodplain grassland	86
During winter-ice covered periods maintain DO concentrations >3 ppm, temperature >0.5 C, and current velocity <0.01 m/sec in fish overwintering areas	89
Increase extent of contiguous backwater areas	89
Restore or increase sand bar habitat	89
Reduce bank erosion	90
Reduce wind fetch in open water areas (e.g., backwaters and impounded areas)	92
Reduce nutrient loading from tributaries to the mainstem river and Gulf of Mexico	94
Provide desirable pattern of hydraulic conditions in tailwaters (e.g., increase area of <0.3 m/sec current velocity by changing distribution of flow through dam gates)	97
Increase topographic diversity (e.g., Increase elevation by two meters on 10% of all floodplain and island terrestrial habitats)	98
Restore habitat corridors (eg riparian forests, contiguous prairie, etc.)	100
Increase marsh habitat management opportunities in leveed areas	109
Increase extent, abundance and diversity of floodplain shrub cover	111
Restore age and species diversity in floodplain forests	112
Increase extent of isolated floodplain lakes	113
Restore tributaries and floodplain streams	113
Restore desirable stage:discharge relationship	117
Restore, create islands	118
Create, maintain vegetated riparian buffer strips along tributaries and ditches basin-wide (e.g., 200-ft wide strips)	119
Create thermal and velocity refugia (e.g., holes >3 m) in backwaters and channels	124
Achieve USEPA and state full use standards to improve water quality	129
Restore habitat on islands	132
Maintain or increase depth of existing secondary channels	133
Restore, create rapid and riffle habitat	145
Restore and maintain substrate diversity in channels, (e.g., >2% of substrate area gravel and rock	145
Restore, create, gravel bars	146
Create, restore floodplain terrestrial habitats.	159
Maintain DO concentrations >5 ppm during ice free periods for fish	165
Restore or naturalize hydraulic interactions between the river and tributaries	170
Minimize adverse effects of elevated water table on soil moisture conditions	177
Maintain water clarity sufficient to support submersed aquatic vegetation, aquatic invertebrates and sight feeding fishes	182
Restore, create sand/mud flats	184
Restore and maintain large contiguous wetland patches (>1,000 acres) every 30 - 40 miles	185
Increase extent, abundance and diversity of emergent aquatic plants	214
Restore desirable hydraulic connections between the river and backwater or floodplain areas	216
Restore and maintain connectivity between contiguous backwater and channel areas	221
Increase extent, abundance and diversity of submersed aquatic plants	238

Provide deepwater fish overwintering areas (e.g., depth range 0-3 m every 2 miles)	238
Restore desirable current velocity and residence time in aquatic areas	244
Restore physical habitat features in MMR	252
Maintain and restore geomorphic diversity in aquatic and floodplain areas	259
Maintain viable populations of native mussel populations throughout their range in the Upper Mississippi River Syste	260
Alter aquatic and terrestrial habitat connectivity	262
Maintain viable populations of native plant species and communities throughout their range in the Upper Mississippi River System	289
Maintain viable populations of native mammal populations throughout their range in the Upper Mississippi River System	331
Maintain viable populations of native bird populations throughout their range in the Upper Mississippi River System	350
Maintain viable populations of native invertebrate populations throughout their range in the Upper Mississippi River System	372
Restore and maintain backwater areas for sport and commercial fish	412
Maintain viable populations of native amphibian and reptile populations throughout their range in the Upper Mississippi River System	430
Maintain viable populations of native fish populations throughout their range in the Upper Mississippi River System	500

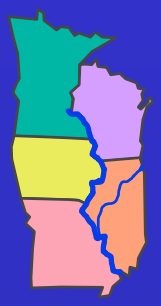
Attachment 5



Upper Mississippi River – Illinois Waterway Restructured System Navigation Feasibility Study

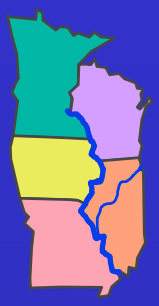
NECC/ECC Meeting
April 2003

Environmental Objectives
&
Environmental Management Actions



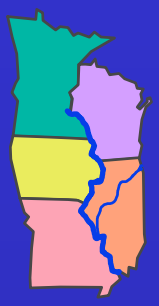
Environmental Objectives

- ~2,600 site-specific Objectives identified by stakeholders during workshops
- Reviewed, categorized, and sorted (Theiling, DeHaan, McVay, Farabee, Wilcox, Experts)
- 82 general objectives (or needs, or super-objectives)
- More lumping and splitting could be done
- Wilcox annotated worksheet



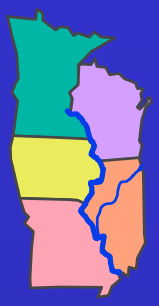
Management Actions

- Actions taken by the Corps, USFWS, USDA, States, Counties, Municipalities, NGO's, landowners
- Actions that are intended to change the condition of the river ecosystem



Environmental Management Actions

- Wilcox master list (Interim Report)
- Reviewed by Corps Nav. Study
  Environmental and O&M workgroups
  (i.e., District Review)
- Reviewed, discussed, and enhanced at
  Objectives Workshops
- Scored by ecological effectiveness
  (high, med, low) by Wilcox
- Ready for review



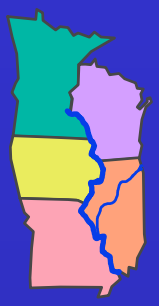
Ranking Ecological Effectiveness of Management Actions

1 = Marginally Effective

2 = Effective

3 = Very Effective

Environmental Objectives & Environmental Management Actions Relational Database



- Needed an easy mechanism to associate objectives with management actions
- Help identify robust management actions
- Help identify cost effective management actions
- Help evaluate restoration costs
- Help prioritize management actions
- Help develop and evaluate alternatives

Environmental Objectives & Environmental Management Actions Relational Database

(continued)

- Objectives addressed by selected MA
- Objectives addressed by selected MA – grouped by MA
- Objectives addressed by selected MA – grouped by EEC

- Management actions for selected objectives
- Management actions for selected objectives – grouped by objective
- Management actions for selected objectives – grouped by EEC

- MAs for multiple objectives – scores summed and averaged to evaluate robustness

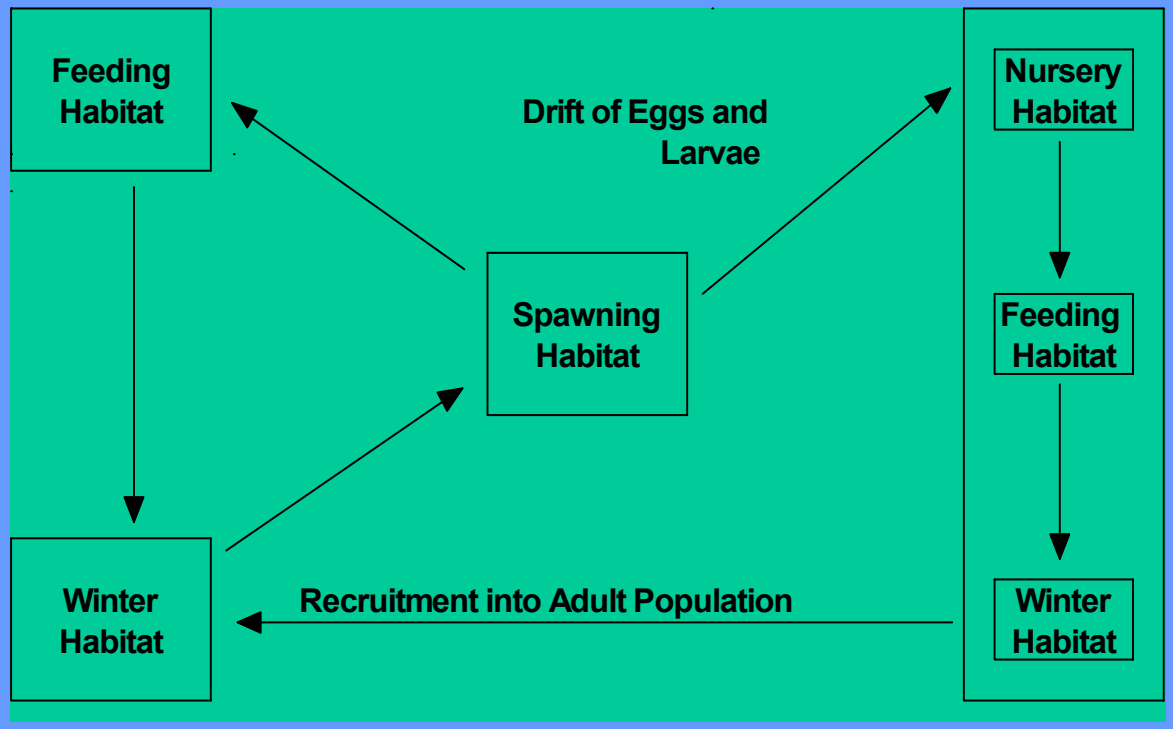
Fish Passage Through Dams on the Upper Mississippi River System

Ecosystem Objectives

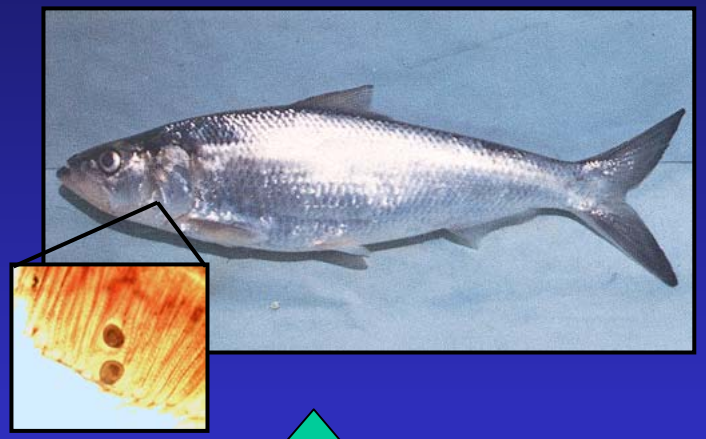
- Maintain viable native fish populations throughout their range in the Upper Mississippi River System

- Maintain viable native mussel populations throughout their range in the Upper Mississippi River System

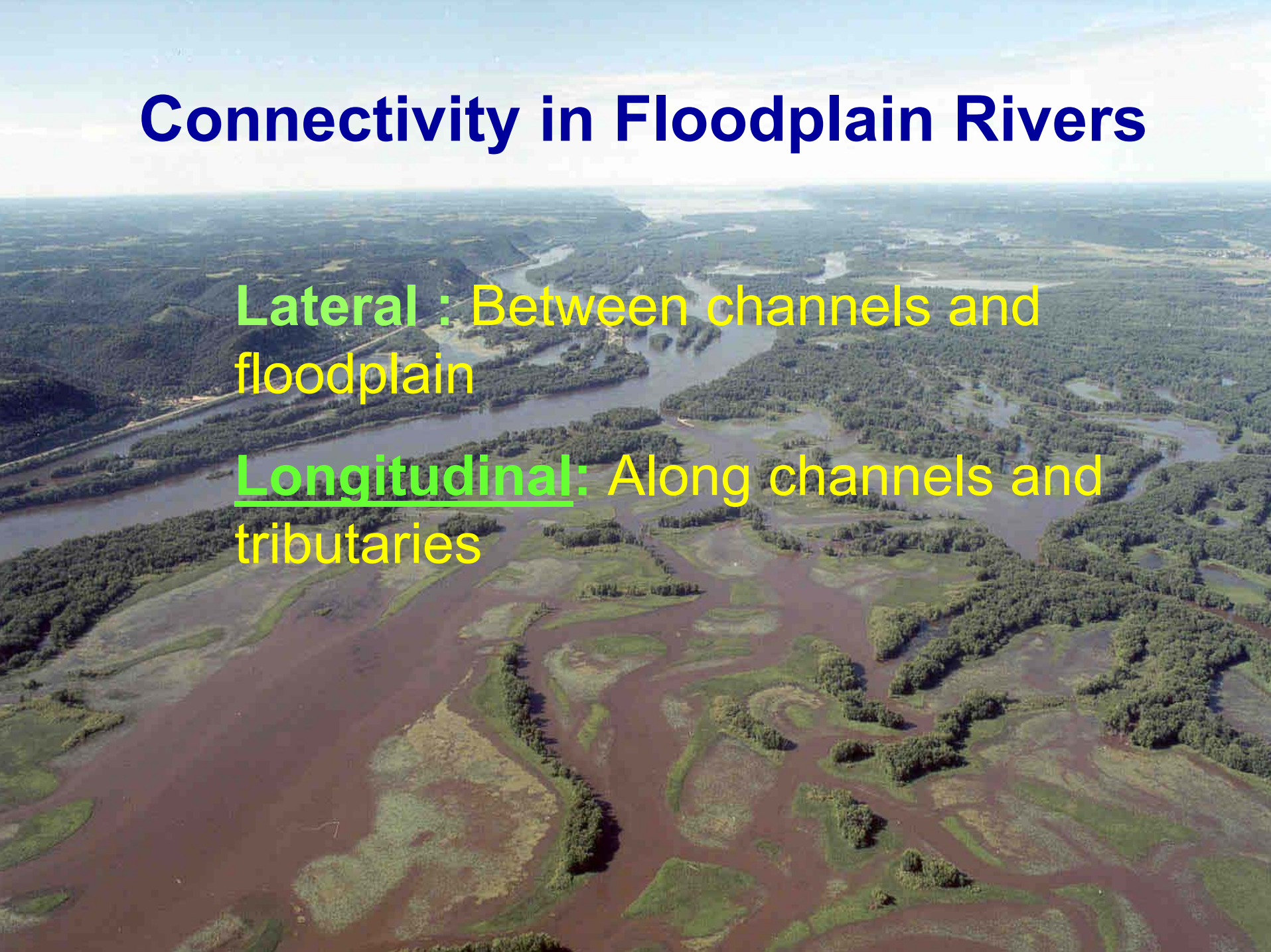
Movements of Fish in Rivers (after McKeown 1984)



Skipjack herring/Ebony shell



Connectivity in Floodplain Rivers



Lateral : Between channels and floodplain

Longitudinal: Along channels and tributaries

Migratory Fishes in the UMR

- Silver lamprey
- Lake sturgeon
- Shovelnose sturgeon
- Paddlefish
- Goldeye
- Mooneye
- American eel
- Alabama shad
- Skipjack herring
- Bigmouth buffalo
- Smallmouth buffalo
- Blue sucker
- White sucker
- Spotted sucker
- Blue catfish
- Channel catfish
- Flathead catfish
- Northern pike
- White bass
- Yellow bass
- Smallmouth bass
- Largemouth bass
- Sauger
- Walleye

Endangered and At-risk Fishes

Pallid Sturgeon

Blue Catfish

Lake Sturgeon

Paddlefish

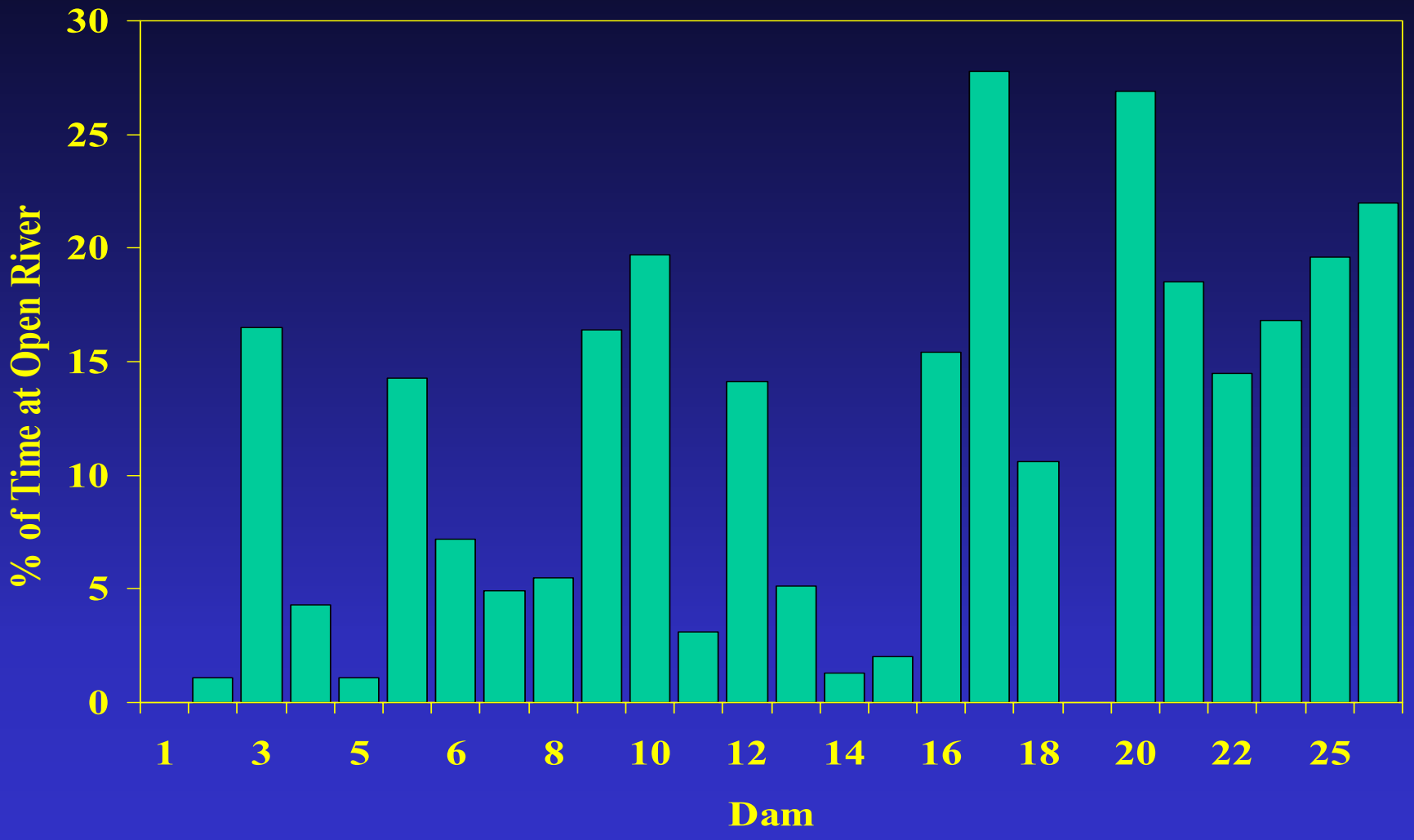
Prolonged Swimming Speeds

m/s	Species
0.9-1.3	Lake sturgeon, Paddlefish, Blue catfish, Flathead catfish, White bass, Largemouth bass, Walleye
0.6-0.9	Freshwater drum, Sauger, Smallmouth bass, Shovelnose sturgeon, Blue sucker, Channel catfish, Yellow bass
0.3-0.6	Bigmouth buffalo, Smallmouth buffalo, White sucker, Spotted sucker, Northern pike, Goldeye, Mooneye, Alabama shad, Skipjack herring

The strong currents through the gates, locks, and other openings, will attract fish to these openings, through which, the Board feels, they will be able to pass more readily than through any fishway. Fishways through the dams will, however, be installed if shown to be necessary.

War Department 1932

Percent of Time that UMR Dams Uncontrolled (Gates Out of the Water)



Hydraulic Conditions at Navigation Dams

- **High velocities - controlled conditions**
- **Lowest velocities - uncontrolled conditions**
- **Spillways usually impassable by fish**

Potential Management Actions to Improve Fish Passage

- Operational alternatives
- Structural alternatives

Management Actions

- Build fishways at mainstem dams
- Modify mainstem dam gate bay openings and operation to improve fish passage
- Modify overflow spillways at mainstem dams to improve fish passage
- Induced upstream lockage of fish
- Remove dams on tributaries
- Build fishways on tributary dams

Fish Passage Team Members

Luther Aadland	MN DNR
Butch Atwood	IL DNR
Ron Benjamin	WI DNR
Bernard Schonhoff	IA DNR
Ken Brummett	MO DOC
Bob Clevenstine	USFWS
Greg Conover	USFWS
Scott Yess	USFWS
Gary Wege	USFWS
Mark Cornish	Corps
Brian Johnson	Corps
Gary Lee	Corps
John Nestler	Corps
Dan Johnson	Corps
Elliot Stefanik	Corps
Dan Kelner	Corps
Dan Wilcox	Corps
Brian Ickes	USGS
Steve Zigler	USGS

Outline – Fish Passage Report

Introduction

Importance of habitat connectivity

Longitudinal connectivity through navigation dams

Lateral connectivity through levees and embankments

Fish migrations, behavior, and swimming performance

Unionid mussels in the UMRS

Fish passage through UMRS dams

Exotic fish species in the UMRS

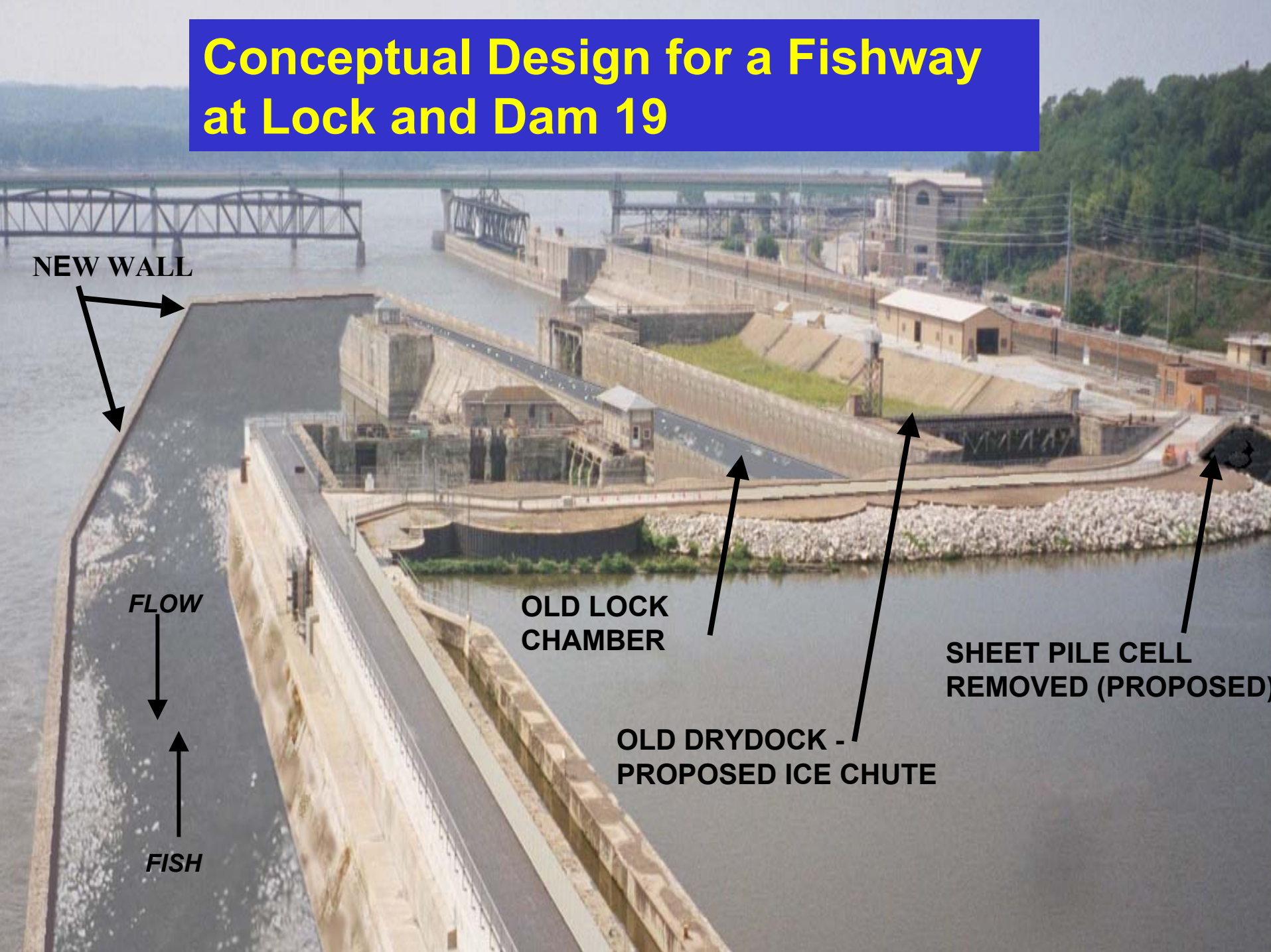
Outline – Fish Passage Report

Alternatives for improving fish passage through dams
Alternatives for limiting dispersal of exotic fish species
Potential for fishways at UMRS dams
Benefits of improving fish passage
Priority of sites for improving fish passage
Summary evaluation of costs and benefits
Monitoring effectiveness of actions to improve fish passage
Recommendations for implementation

Denil-type Fishway
Oberwasser River, Brandenburg,
Germany

Fishway on Ottertail River
Breckenridge Minnesota

Conceptual Design for a Fishway at Lock and Dam 19



Next Steps

- Compile draft report
- Provide draft to Fish Passage Team
- Meet in LaCrosse May 7, 8
- Provide final report to Rock Island District in June

Fish Passage Through Dams on the Upper Mississippi River System

Improving fish passage through dams is recognized as an important way to restore the river ecosystem. A fish passage study effort has begun as part of the Navigation Study. An interagency Fish Passage Team was formed to plan for improving fish passage at the UMRS navigation dams. The fish passage study will provide information and recommendations for use in the Navigation Study feasibility report and EIS.

Fish Passage Team members include:

Luther Aadland	MN DNR	218-739-7449	Luther.Aadland@dnr.state.mn.us
Butch Atwood	IL DNR	618-664-2330	eatwood@dnrmail.state.il.us
Ron Benjamin	WI DNR	608-785-9012	benjar@dnr.state.wi.us
Bernard Schonhoff	IA DNR	563-263-5062	fishiowa@muscanet.com
Ken Brummett	MO DOC	573-248-2530	brummk@mdc.state.mo.us
Bob Clevenstine	USFWS	309-793-5600	Robert_Clevenstine@fws.gov
Greg Conover	USFWS	618-997-6869	Greg_Conover@fws.gov
Gary Wege	USFWS	612-725-3348	Gary_Wege@fws.gov
Scott Yess	USFWS	608-783-8431	Scott_Yess@fws.gov
Mark Cornish	Corps	309-794-5385	Mark.A.Cornish@usace.army.mil
Brian Johnson	Corps	314-331-8146	Brian.L.Johnson@usace.army.mil
Gary Lee	Corps	314 -331-8245	Gary.J.Lee@usace.army.mil
John Nestler	Corps	601-634-3870	John.M.Nestler@usace.army.mil
Dan Johnson	Corps	309-794-5857	Daniel.J.Johnson@usace.army.mil
Elliot Stefanik	Corps	651-290-5260	Elliot.L.Stefanik@usace.army.mil
Dan Kelner	Corps	651-290-5277	Daniel.E.Kelner@usace.army.mil
Dan Wilcox	Corps	651-290-5276	Daniel.B.Wilcox@usace.army.mil
Brian Ickes	USGS	608-783-8431	Brian_ickes@usgs.gov
Steve Zigler	USGS	608-783-8431	steven_zigler@usgs.gov

The Upper Mississippi River has a series of 29 navigation dams and the Illinois River has 7 navigation dams that restrict fish movements in the river system. Of the 143 native fish species in the river system at least 34 species are migratory. Migrations are innate behaviors resulting from the evolution of fish life history strategies over millennia. Migratory fish species in the river system include lake sturgeon, shovelnose sturgeon, pallid sturgeon, paddlefish, American eel, blue sucker, nine other species of suckers, bigmouth buffalo, blue catfish, channel catfish, flathead catfish, northern pike, white bass, yellow bass, smallmouth bass, largemouth bass, sauger, walleye, and freshwater drum.

The design characteristics and operation of most UMR navigation dams allow both upriver and downriver fish passage. Downriver fish passage can occur through the locks and the gated sections of the dams. Some fish may pass upriver through the navigation locks, but the locks do not provide favorable pathways for upriver fish passage. Opportunity for upriver fish passage is dependent upon hydraulic conditions at the dams, fish behavior, and fish swimming abilities.

Operational changes and structural modifications at UMR navigation dams are possible and may improve opportunity for fish passage throughout the UMR system.

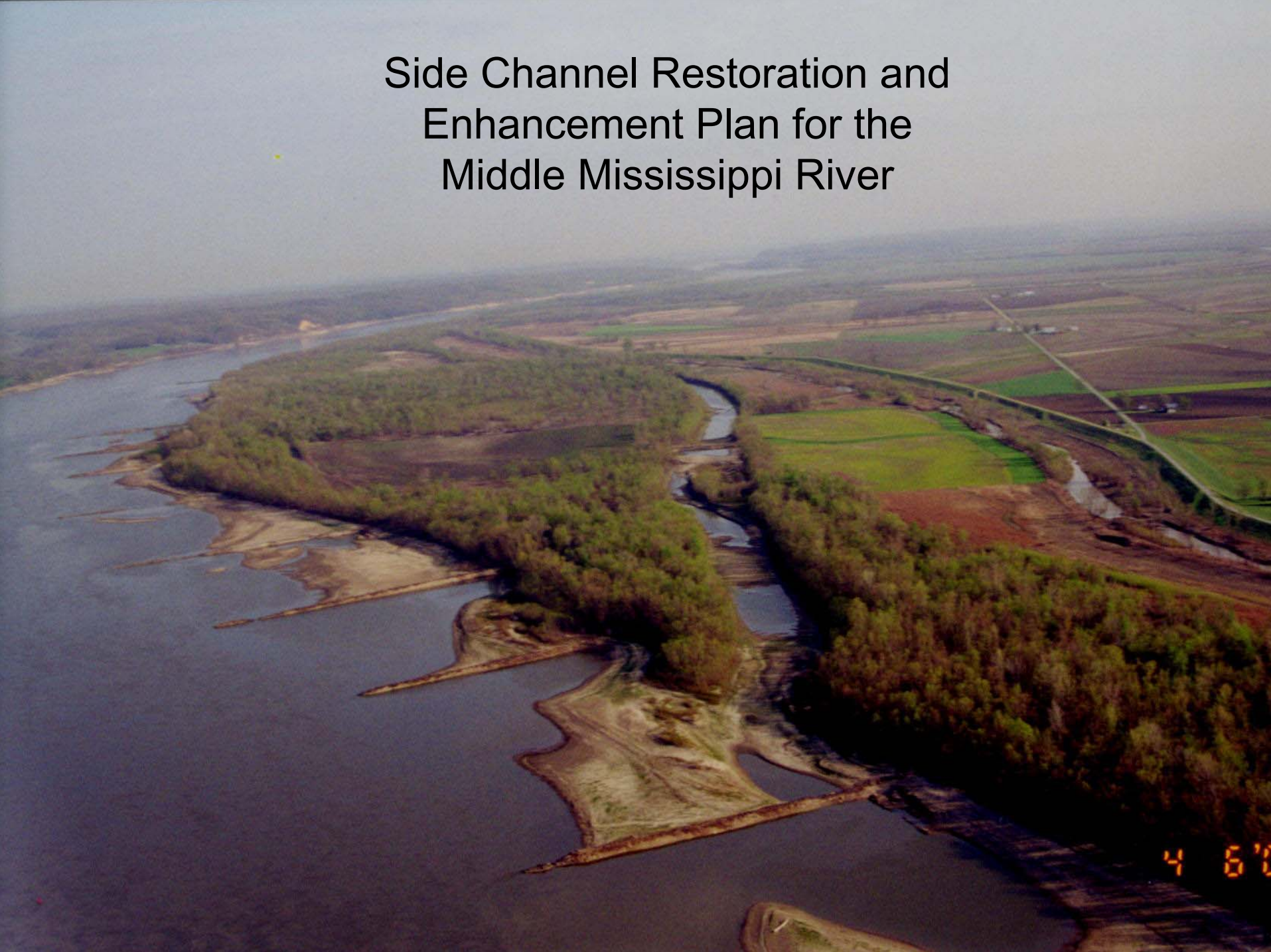
Improved access to habitats should benefit fish and mussel populations in the river system.

Recent accomplishments include preparation of a table of mussel species distribution by navigation pool, and a table of aquatic habitat type areas and tributary river miles by navigation pool. A workshop was held on April 1-2 to identify the best potential locations for fishways at UMRS navigation dams. Preliminary engineering design, quantities, and cost estimates for fishways will be prepared. A workshop with most members of the Fish Passage Team will be held on May 7 and 8 in Onalaska WI to present and discuss sections of the draft report.

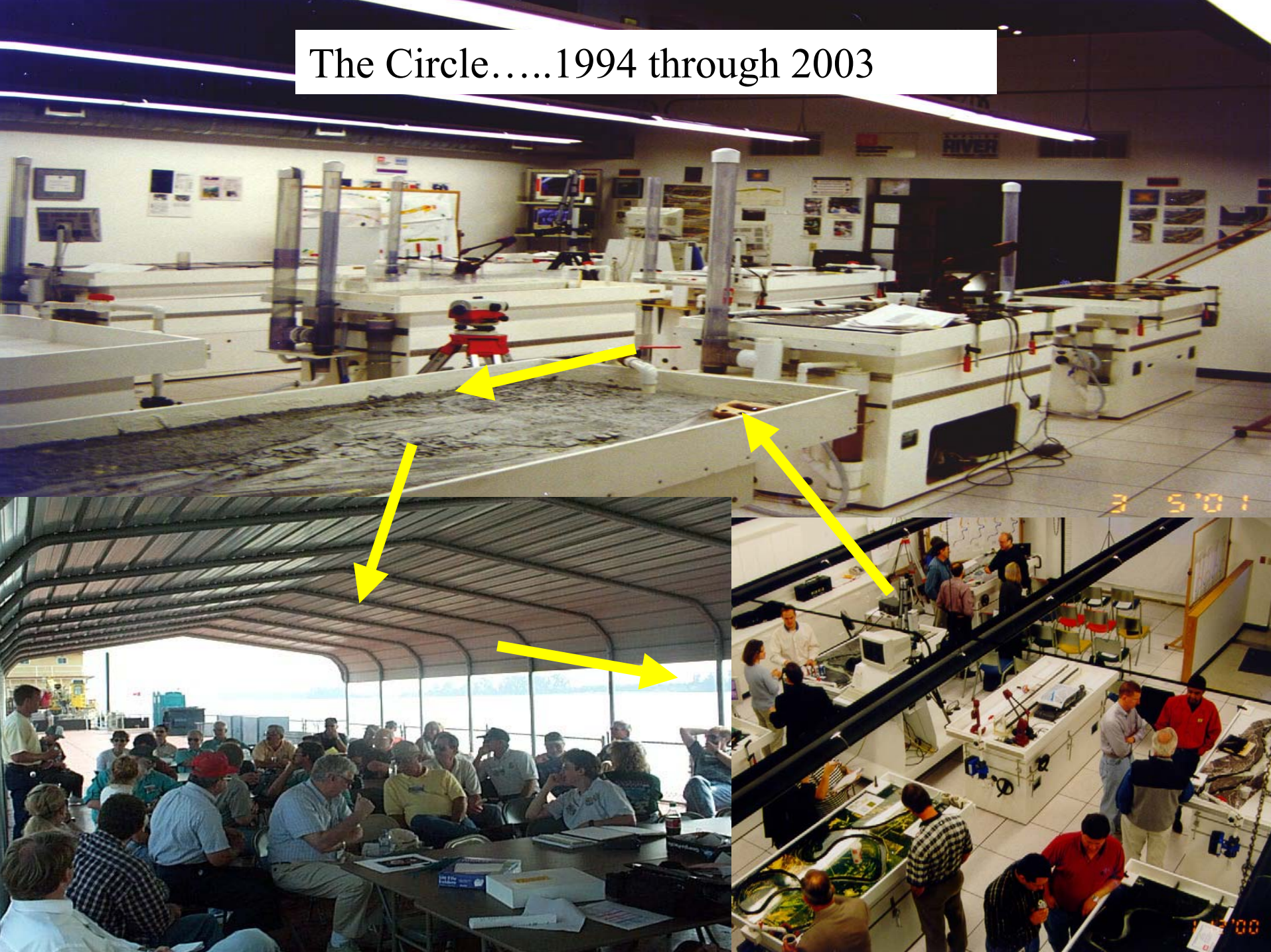
The fish passage study report will be completed in June this year. Please contact Dan Wilcox at 651-290-5276, email: daniel.b.Wilcox@usace.army.mil if you have any questions.

Attachment 5

Side Channel Restoration and Enhancement Plan for the Middle Mississippi River



The Circle…..1994 through 2003



MODOC

FWS

IDNR

Side Channel Restoration and Enhancement Plan for the Middle Mississippi River

1997 Final Document

ALC

RIAC

USACE

- Identifies Major Side Channels in Middle Mississippi River, including problems and wish-list of solutions

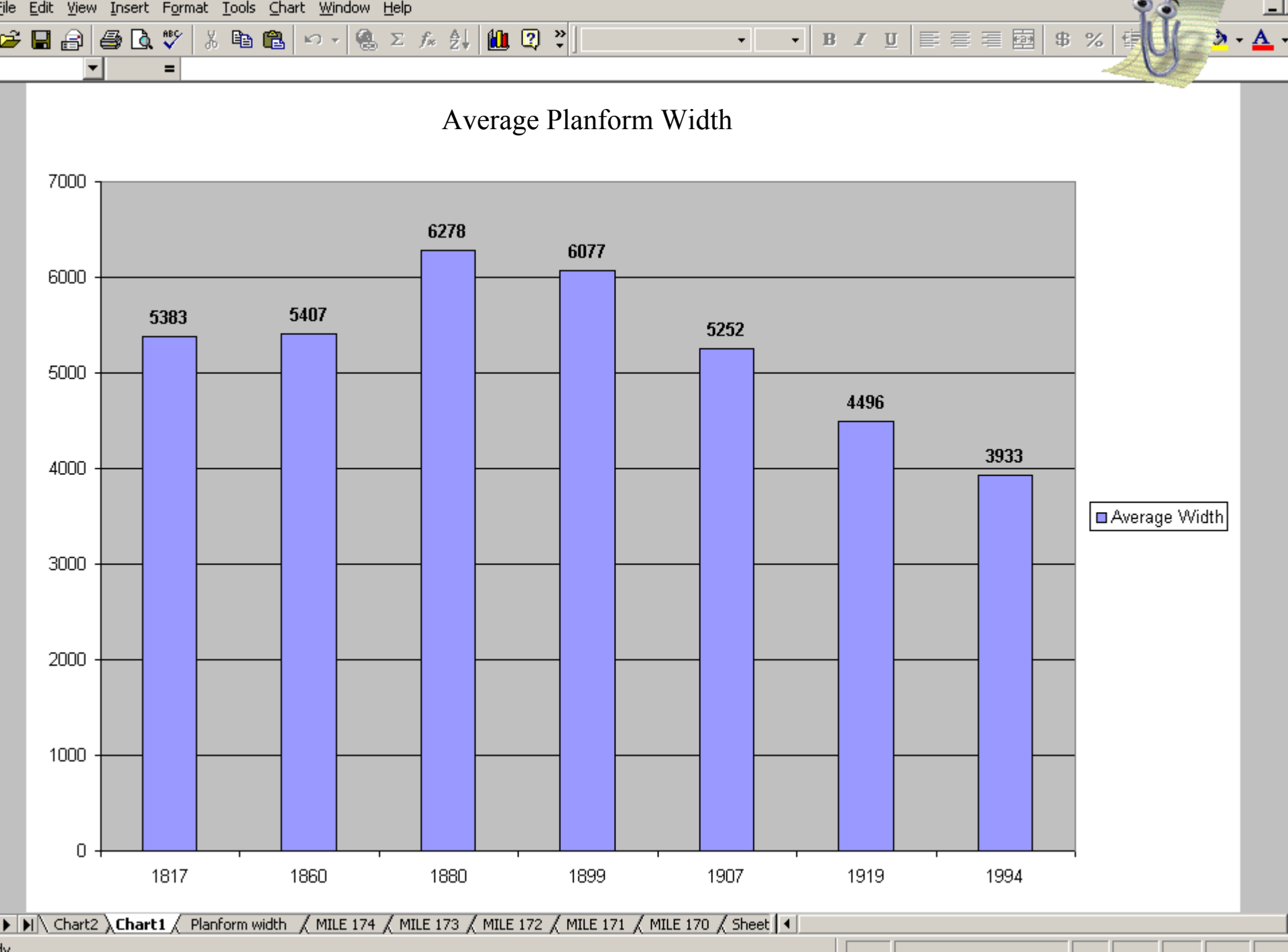
- Congressional Legislation Crafted From Document by ALC for "100 % Future Federal Project"…WRDA 2004?

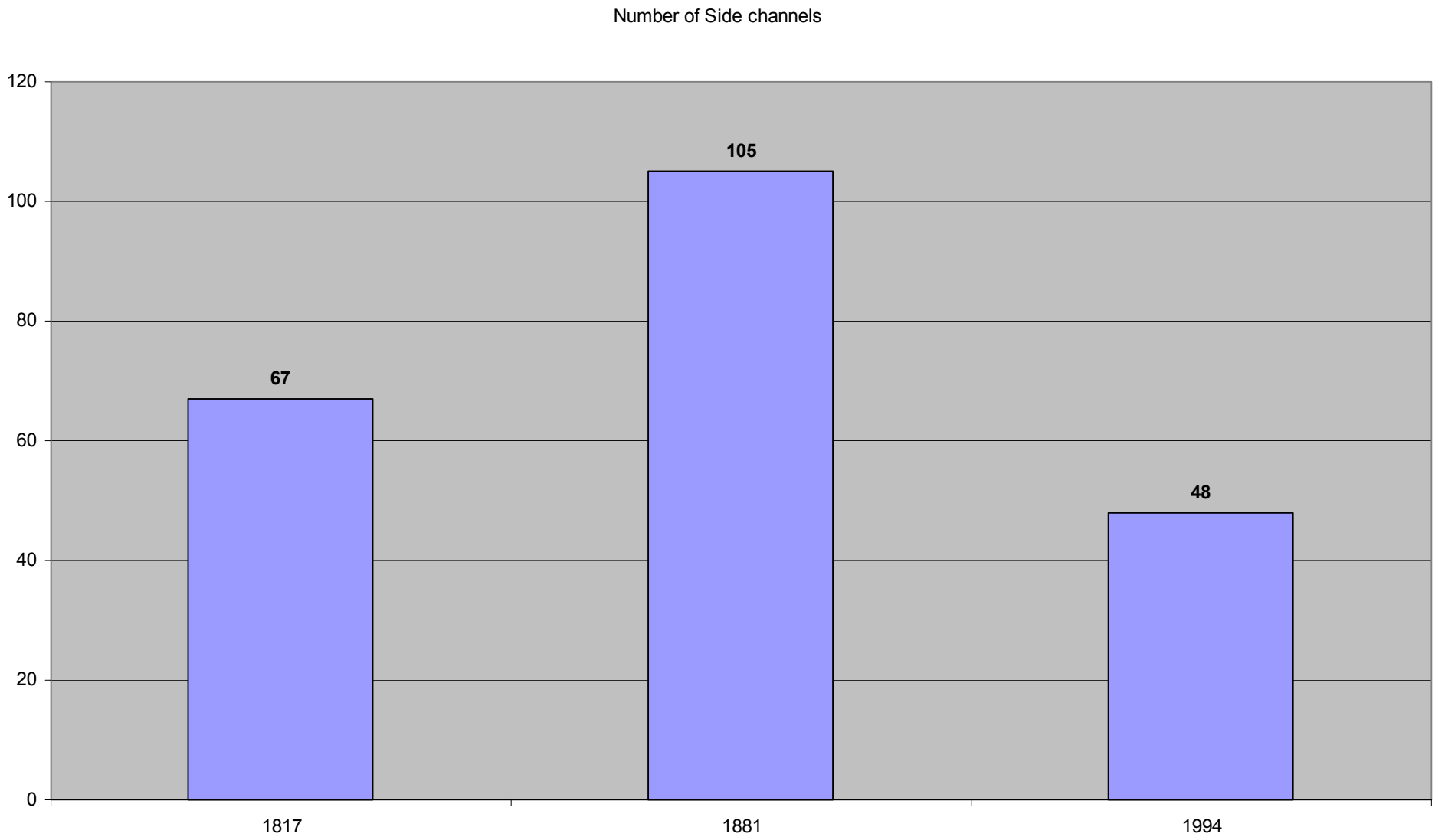
Attachment 6

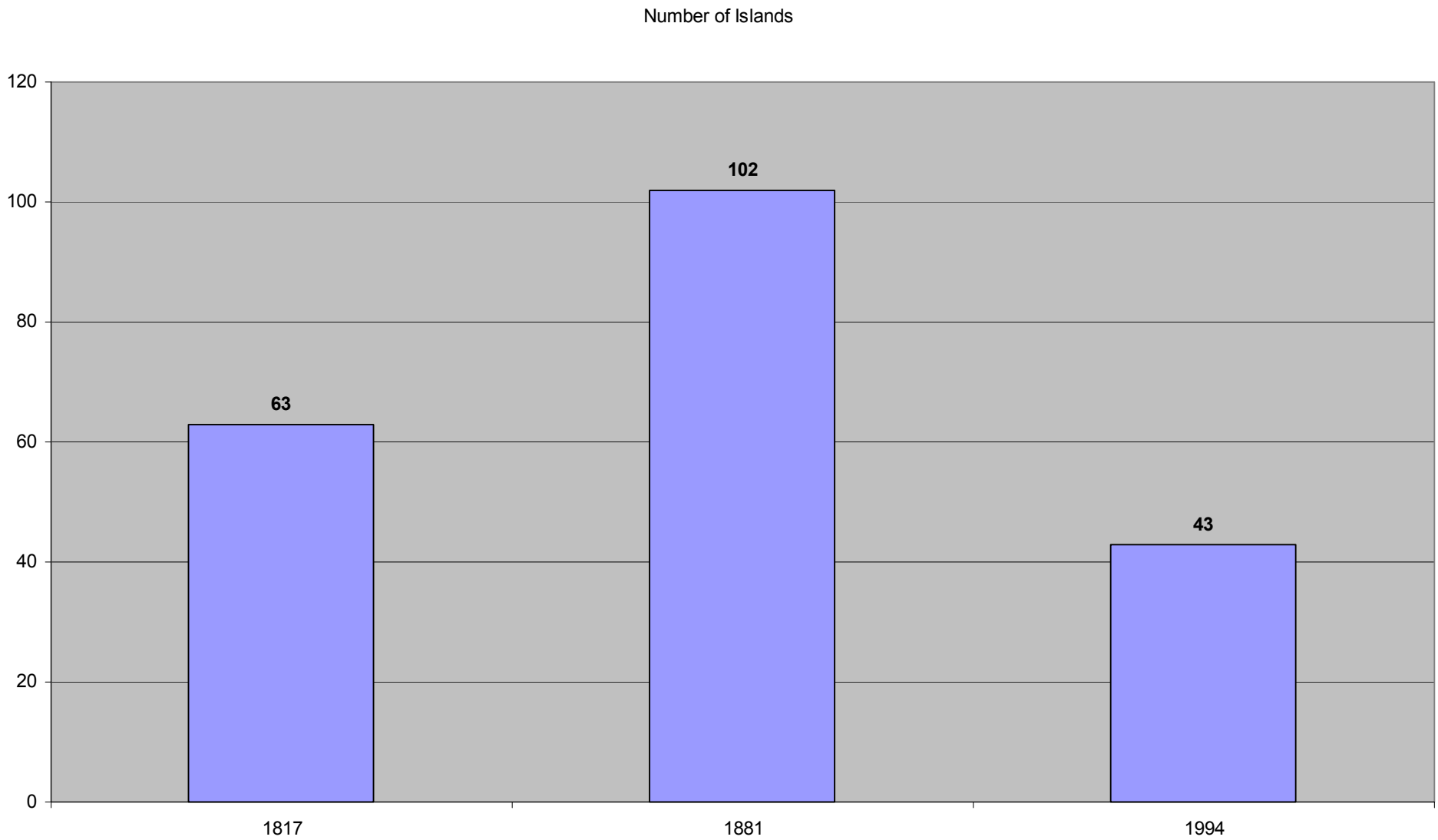
Historical River Morphology Study of the Middle Mississippi River

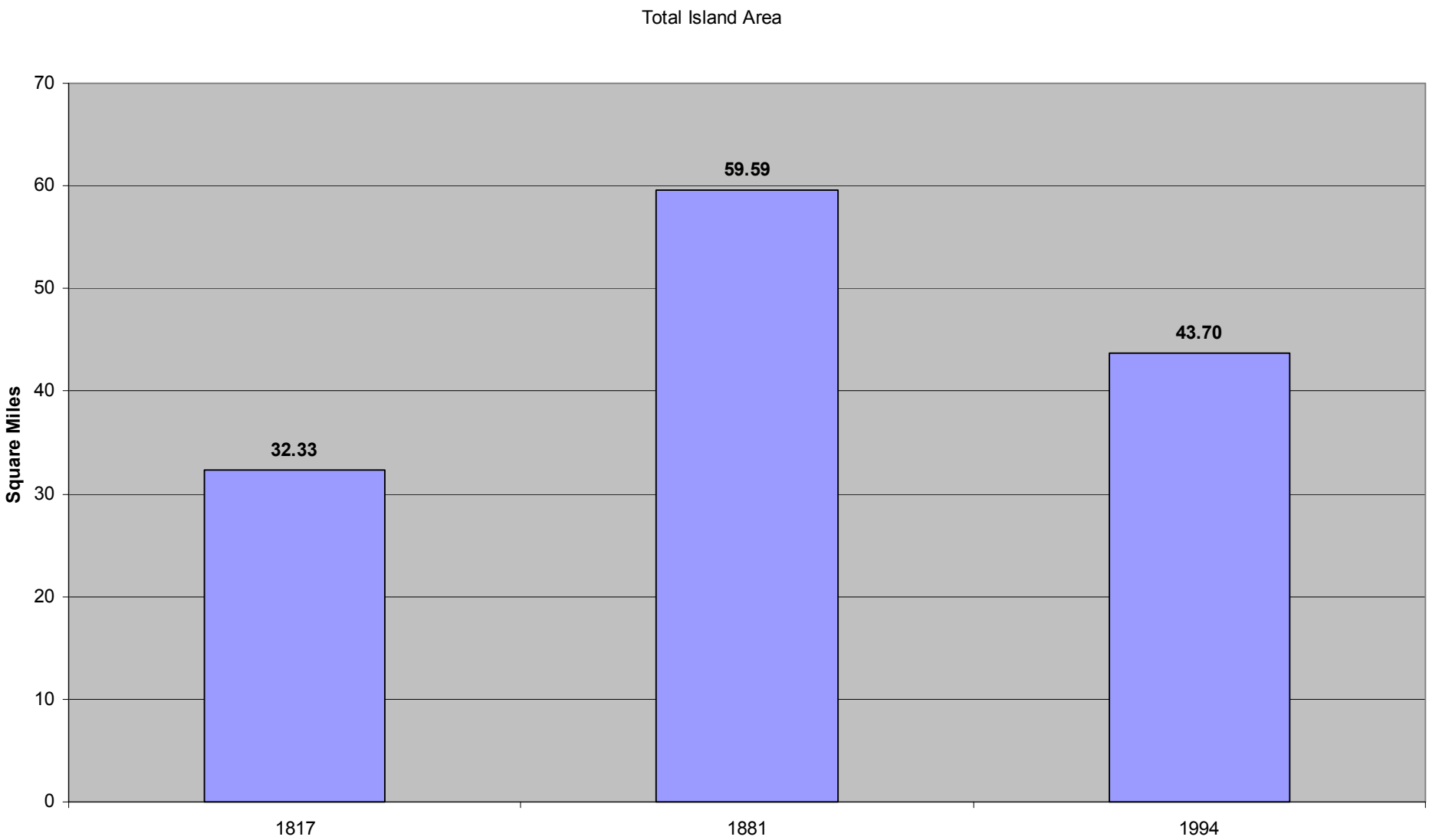
US Army Corps of Engineers
St. Louis District

APPLIED RIVER ENGINEERING CENTER
St. Louis- Memphis- Rock Island

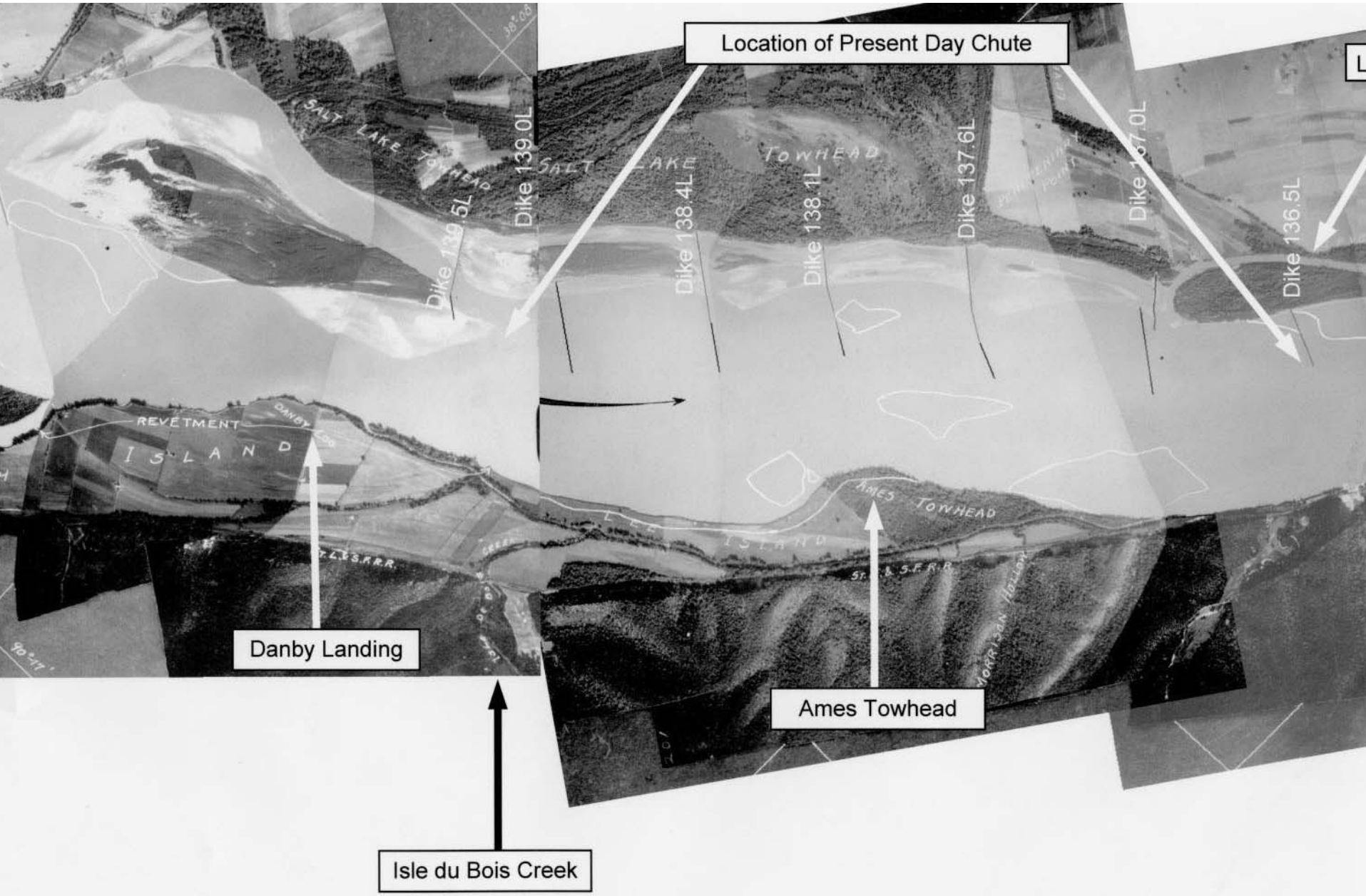

File Edit View Insert Format Tools Chart Window Help
Average Planform Width
7000
6000
5000
4000
3000
2000
1000
0
5383
5407
6278
6077
5252
4496
3933
1817
1860
1880
1899
1907
1919
1994
Average Width
Chart2
Chart1
Planform width
MILE 174
MILE 173
MILE 172
MILE 171
MILE 170
Sheet

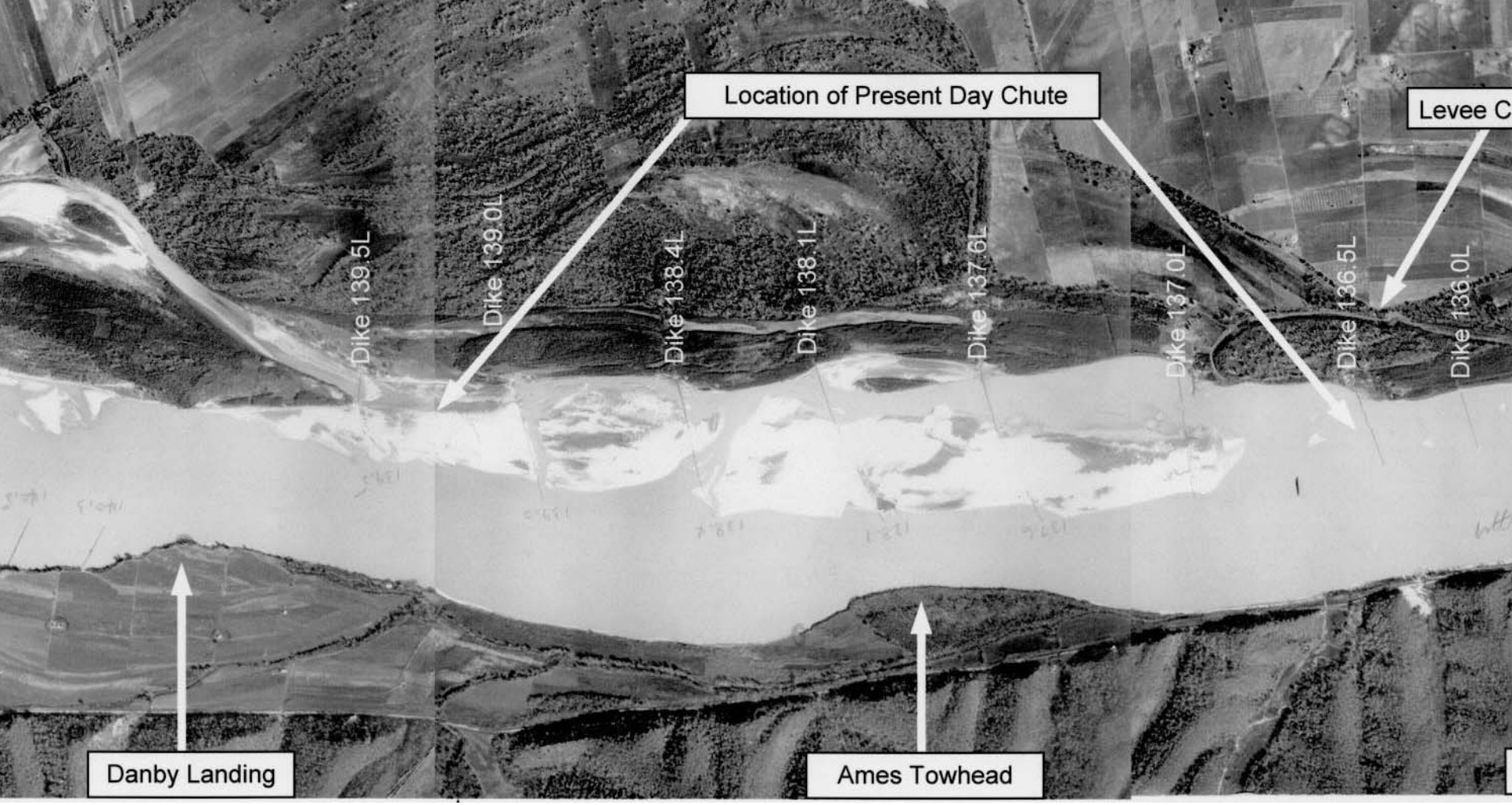

Number of Side channels
120
100
80
60
40
20
0
67
105
48
1817
1881
1994


Number of Islands
120
100
80
60
40
20
0
63
102
43
1817
1881
1994


Total Island Area
Square Miles
70
60
50
40
30
20
10
0
32.33
59.59
43.70
1817
1881
1994

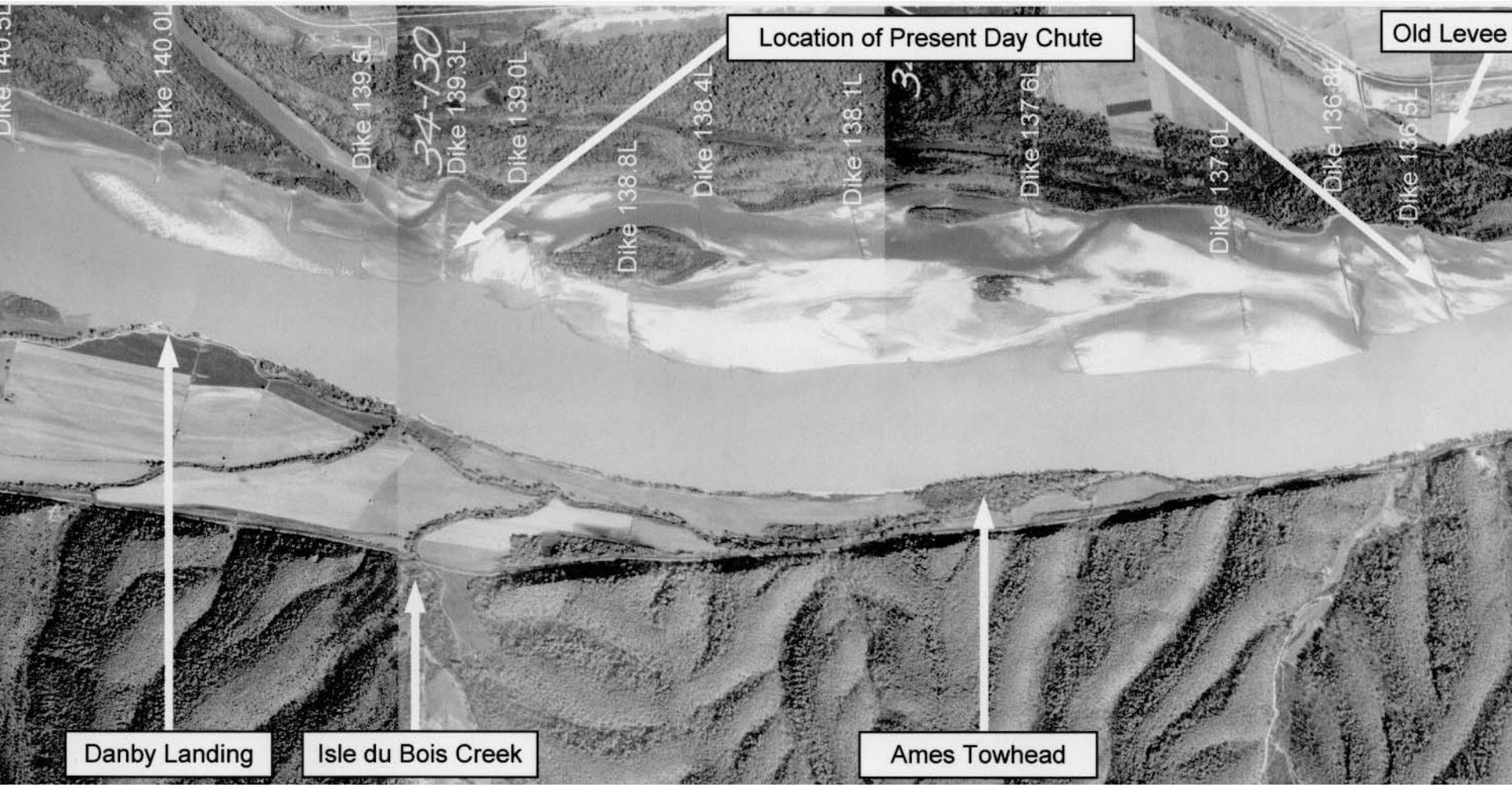
1928

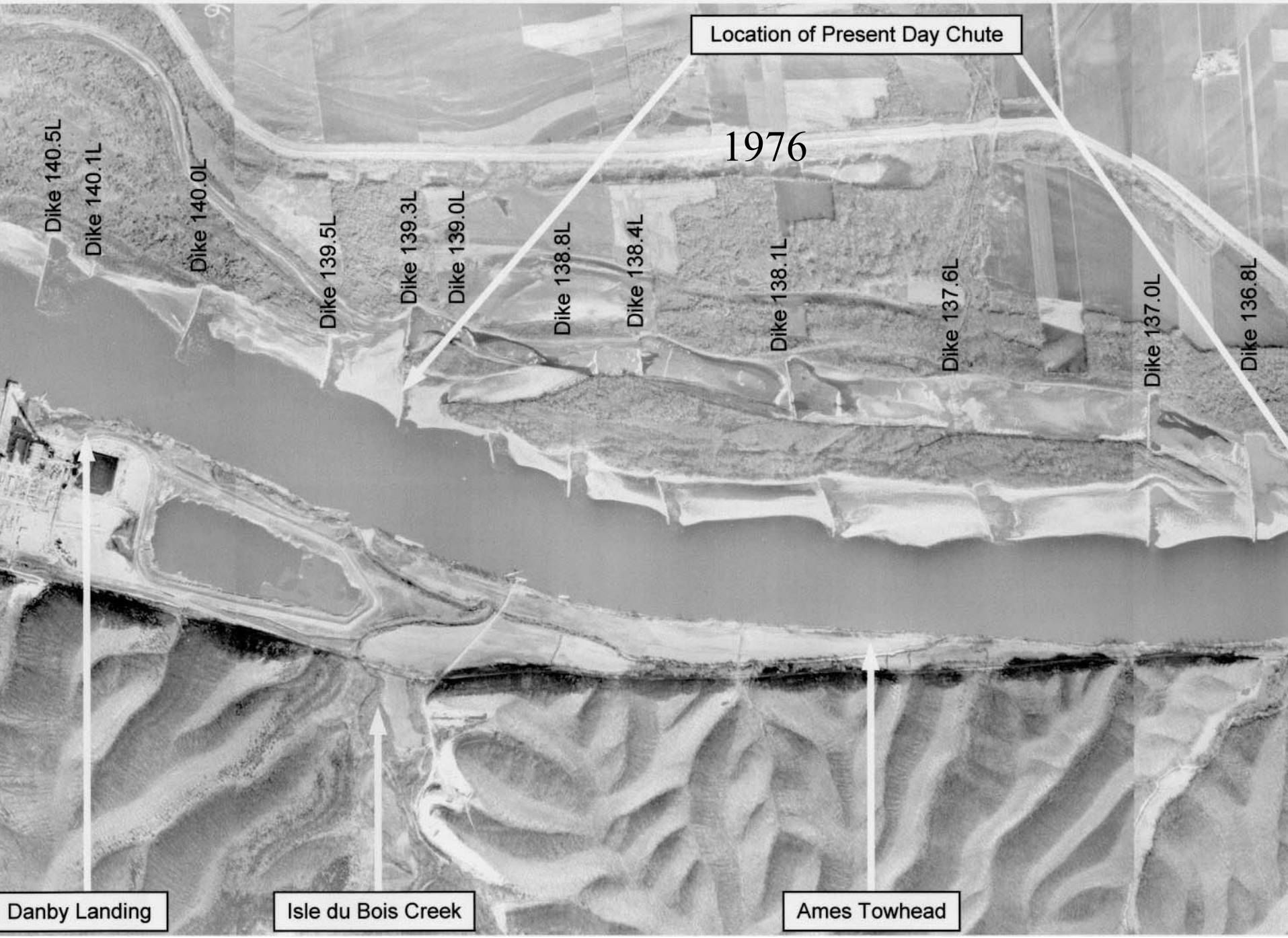

Location of Present Day Chute
Dike 139.0L
Dike 138.4L
Dike 138.1L
Dike 137.6L
Dike 136.5L
SALT LAKE TOWHEAD
REVETMENT
ISLAND
AMES TOWHEAD
Danby Landing
Ames Towhead
Isle du Bois Creek


Location of Present Day Chute
Levee C
Dike 139.5L
Dike 139.0L
Dike 138.4L
Dike 138.1L
Dike 137.6L
Dike 137.0L
Dike 136.5L
Dike 136.0L
Danby Landing
Ames Towhead

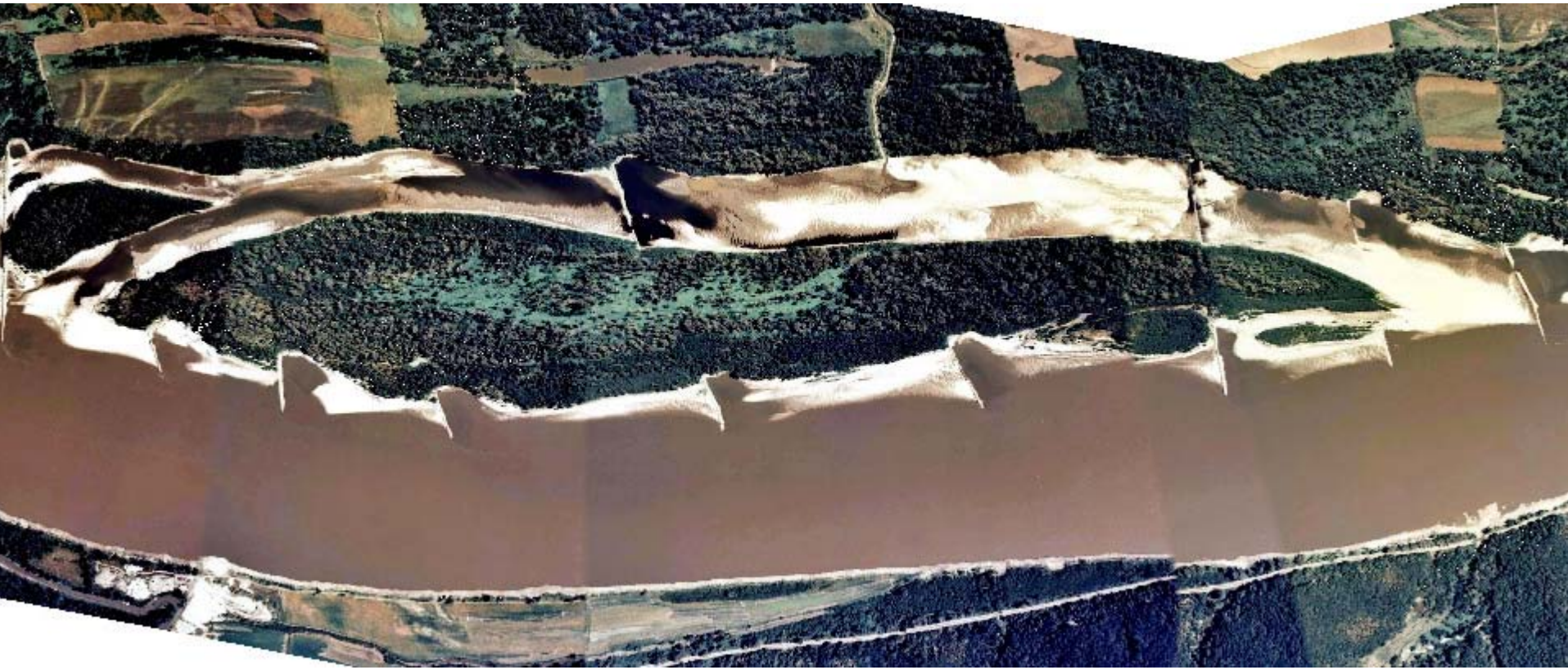
1935

1948

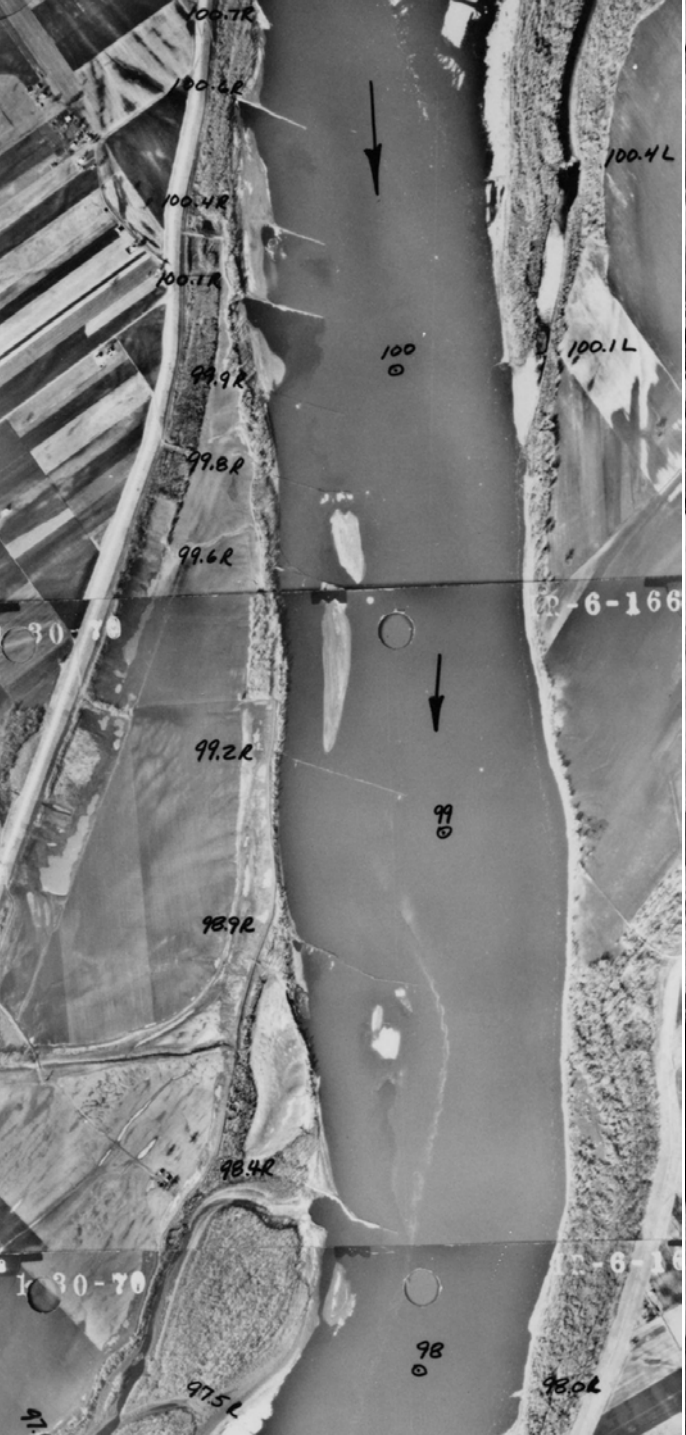

Location of Present Day Chute
Old Levee
Dike 140.0L
Dike 139.5L
Dike 139.3L
Dike 139.0L
Dike 138.8L
Dike 138.4L
Dike 138.1L
Dike 137.6L
Dike 137.0L
Dike 136.5L
Danby Landing
Isle du Bois Creek
Ames Towhead


Location of Present Day Chute
1976
Dike 140.5L
Dike 140.1L
Dike 140.0L
Dike 139.5L
Dike 139.3L
Dike 139.0L
Dike 138.8L
Dike 138.4L
Dike 138.1L
Dike 137.6L
Dike 137.0L
Dike 136.8L
Danby Landing
Isle du Bois Creek
Ames Towhead

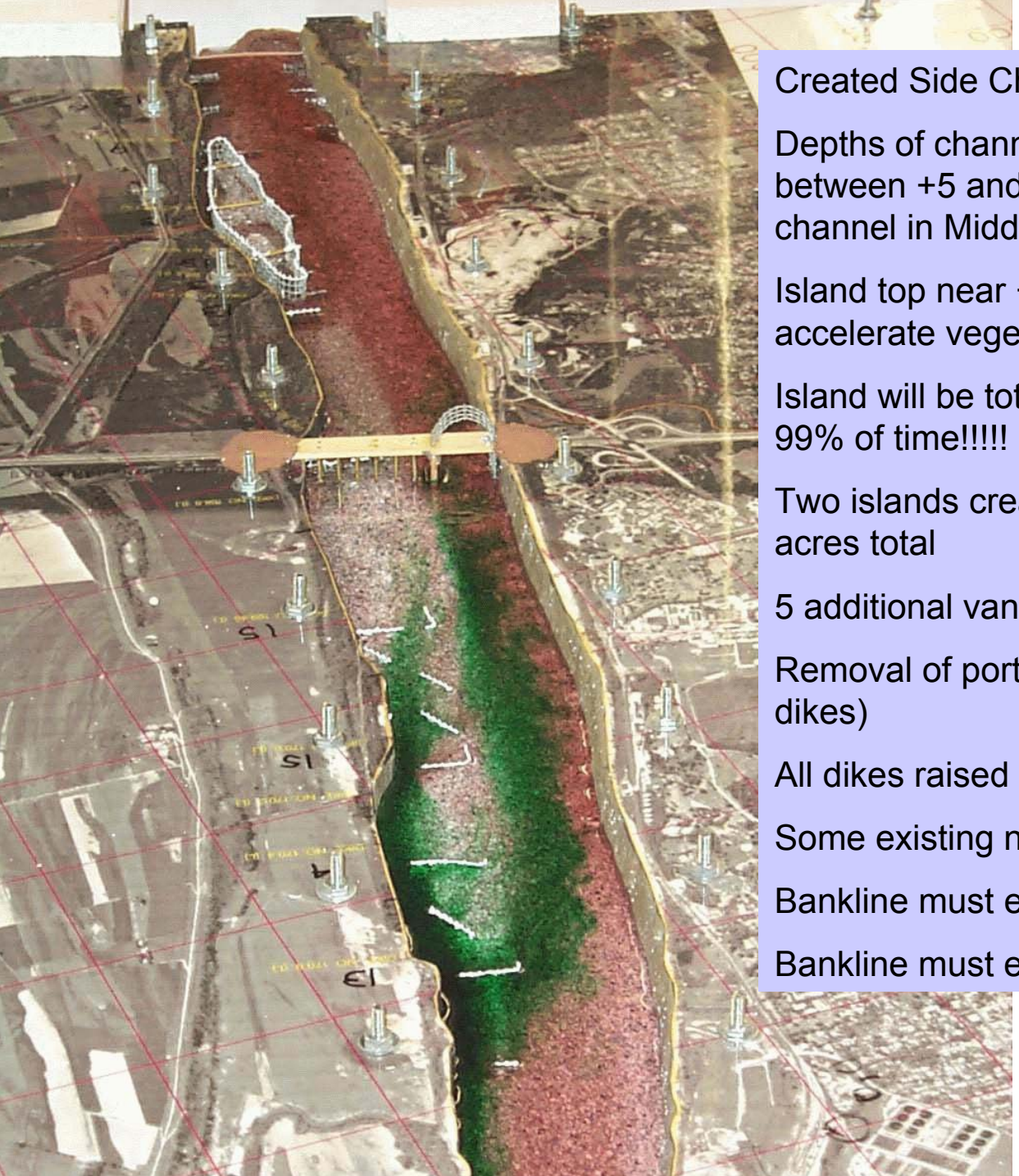
1998



1999


100.7R
100.6R
100.4L
100.4R
100.1R
100.1L
100
99.9R
99.8R
99.6R
99.2R
99
98.9R
98.4R
98
98.0R
97.5L

Creating New Side Channels and Islands Through Stone Dike Modification or Channel Improvement Projects



Created Side Channel is 1.5 miles long!!

Depths of channel in upper one third of channel between +5 and -20 LWRP (Will be deepest side channel in Middle Mississippi River) !!!!!

Island top near +10 LWRP, may need seeding to accelerate vegetation (if desired)

Island will be totally isolated from bankline near 99% of time!!!!!

Two islands created, 240 and 360 acres, 600 acres total

5 additional vane dikes required

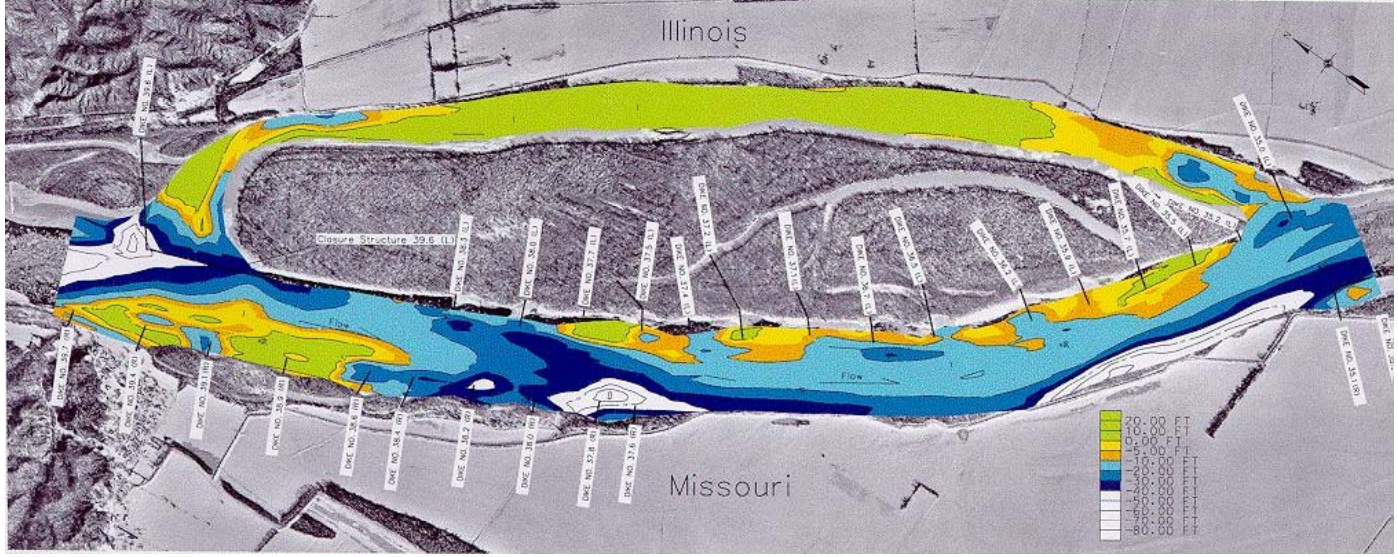
Removal of portion of existing dikes (rootless dikes)

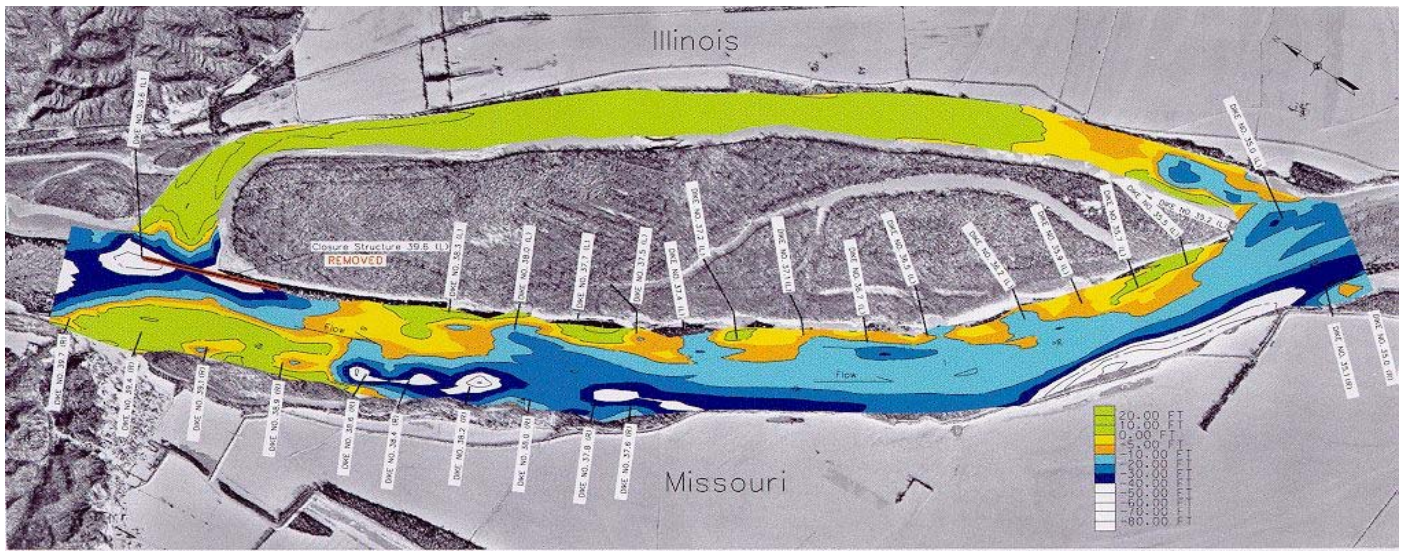
All dikes raised to +17 LWRP

Some existing notches filled

Bankline must either be protected or land acquired

Bankline must either be revetted, or acquired.


Illinois
Missouri
Closure Structure 39.6 (L)
Flow
20.00 FT
10.00 FT
0.00 FT
-5.00 FT
-10.00 FT
-20.00 FT
-30.00 FT
-40.00 FT
-50.00 FT
-60.00 FT
-70.00 FT
-80.00 FT

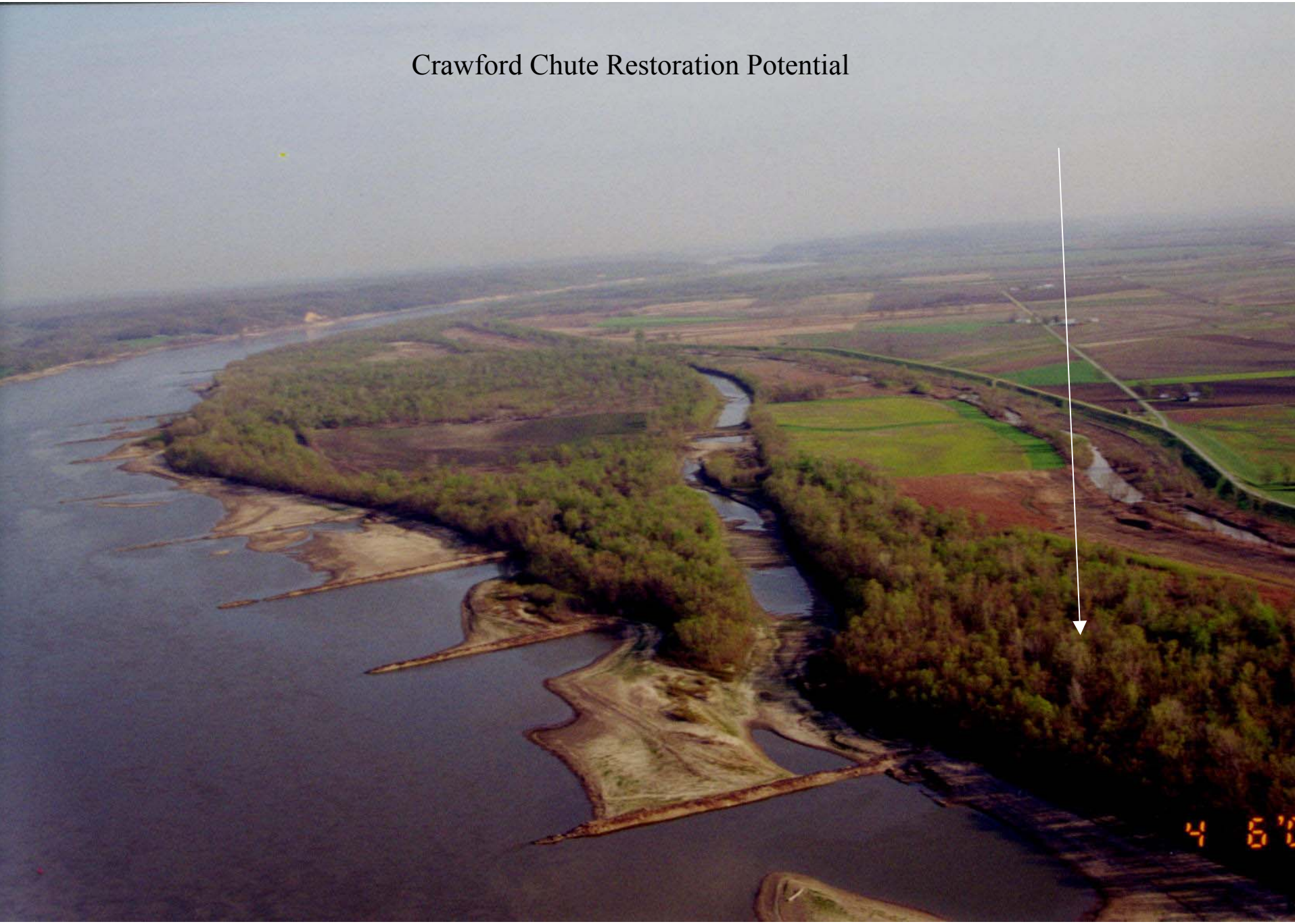

Illinois
Missouri
Closure Structure 39.6 (L)
REMOVED
Flow
20.00 FT
10.00 FT
0.00 FT
-5.00 FT
-10.00 FT
-20.00 FT
-30.00 FT
-40.00 FT
-50.00 FT
-60.00 FT
-70.00 FT
-80.00 FT

Flow Visualization

Crawford Chute Restoration Potential Mile 74 to 71

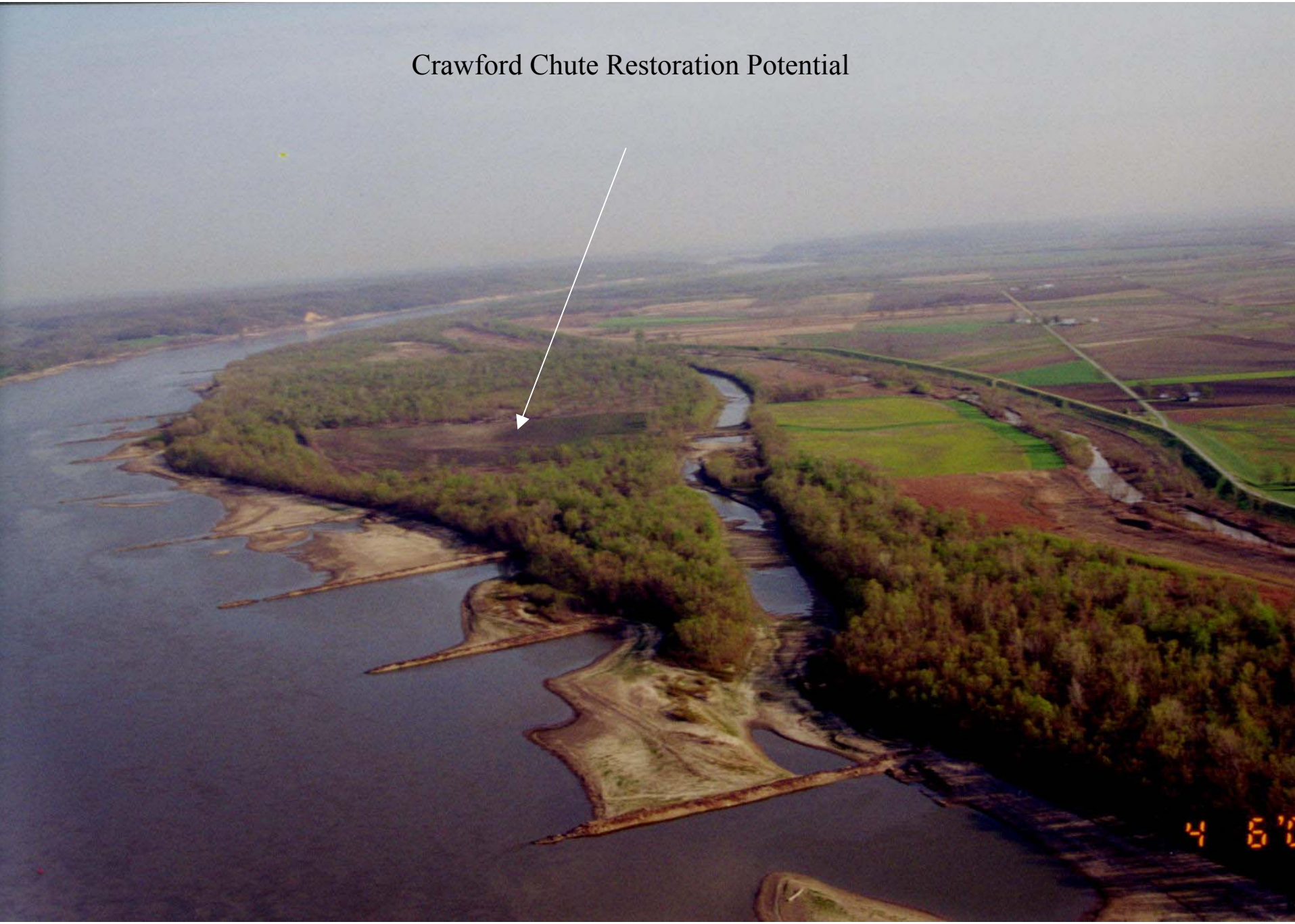
Crawford Chute Restoration Potential

Crawford Chute Restoration Potential



Crawford Chute Restoration Potential

Crawford Chute Restoration Potential



4 6'0

Crawford Chute Restoration Potential

Crawford Chute Restoration Potential

Attachment 7

Fish Passage Through Dams on the Upper Mississippi River System

Improving fish passage through dams is recognized as an important way to restore the river ecosystem. A fish passage study effort has begun as part of the Navigation Study. An interagency Fish Passage Team was formed to plan for improving fish passage at the UMRS navigation dams. The fish passage study will provide information and recommendations for use in the Navigation Study feasibility report and EIS.

Fish Passage Team members include:

Luther Aadland	MN DNR	218-739-7449	Luther.Aadland@dnr.state.mn.us
Butch Atwood	IL DNR	618-664-2330	eatwood@dnrmail.state.il.us
Ron Benjamin	WI DNR	608-785-9012	benjar@dnr.state.wi.us
Bernard Schonhoff	IA DNR	563-263-5062	fishiowa@muscanet.com
Ken Brummett	MO DOC	573-248-2530	brummk@mdc.state.mo.us
Bob Clevenstine	USFWS	309-793-5600	Robert_Clevenstine@fws.gov
Greg Conover	USFWS	618-997-6869	Greg_Conover@fws.gov
Gary Wege	USFWS	612-725-3348	Gary_Wege@fws.gov
Scott Yess	USFWS	608-783-8431	Scott_Yess@fws.gov
Mark Cornish	Corps	309-794-5385	Mark.A.Cornish@usace.army.mil
Brian Johnson	Corps	314-331-8146	Brian.L.Johnson@usace.army.mil
Gary Lee	Corps	314 -331-8245	Gary.J.Lee@usace.army.mil
John Nestler	Corps	601-634-3870	John.M.Nestler@usace.army.mil
Dan Johnson	Corps	309-794-5857	Daniel.J.Johnson@usace.army.mil
Elliot Stefanik	Corps	651-290-5260	Elliot.L.Stefanik@usace.army.mil
Dan Kelner	Corps	651-290-5277	Daniel.E.Kelner@usace.army.mil
Dan Wilcox	Corps	651-290-5276	Daniel.B.Wilcox@usace.army.mil
Brian Ickes	USGS	608-783-8431	Brian_ickes@usgs.gov
Steve Zigler	USGS	608-783-8431	steven_zigler@usgs.gov

The Upper Mississippi River has a series of 29 navigation dams and the Illinois River has 7 navigation dams that restrict fish movements in the river system. Of the 143 native fish species in the river system at least 34 species are migratory. Migrations are innate behaviors resulting from the evolution of fish life history strategies over millennia. Migratory fish species in the river system include lake sturgeon, shovelnose sturgeon, pallid sturgeon, paddlefish, American eel, blue sucker, nine other species of suckers, bigmouth buffalo, blue catfish, channel catfish, flathead catfish, northern pike, white bass, yellow bass, smallmouth bass, largemouth bass, sauger, walleye, and freshwater drum.

The design characteristics and operation of most UMR navigation dams allow both upriver and downriver fish passage. Downriver fish passage can occur through the locks and the gated sections of the dams. Some fish may pass upriver through the navigation locks, but the locks do not provide favorable pathways for upriver fish passage. Opportunity for upriver fish passage is dependent upon hydraulic conditions at the dams, fish behavior, and fish swimming abilities.

Operational changes and structural modifications at UMR navigation dams are possible and may improve opportunity for fish passage throughout the UMR system.

Improved access to habitats should benefit fish and mussel populations in the river system.

Recent accomplishments include preparation of a table of mussel species distribution by navigation pool, and a table of aquatic habitat type areas and tributary river miles by navigation pool. A workshop was held on April 1-2 to identify the best potential locations for fishways at UMRS navigation dams. Preliminary engineering design, quantities, and cost estimates for fishways will be prepared. A workshop with most members of the Fish Passage Team will be held on May 7 and 8 in Onalaska WI to present and discuss sections of the draft report.

The fish passage study report will be completed in June this year. Please contact Dan Wilcox at 651-290-5276, email: daniel.b.Wilcox@usace.army.mil if you have any questions.

Attachment 8

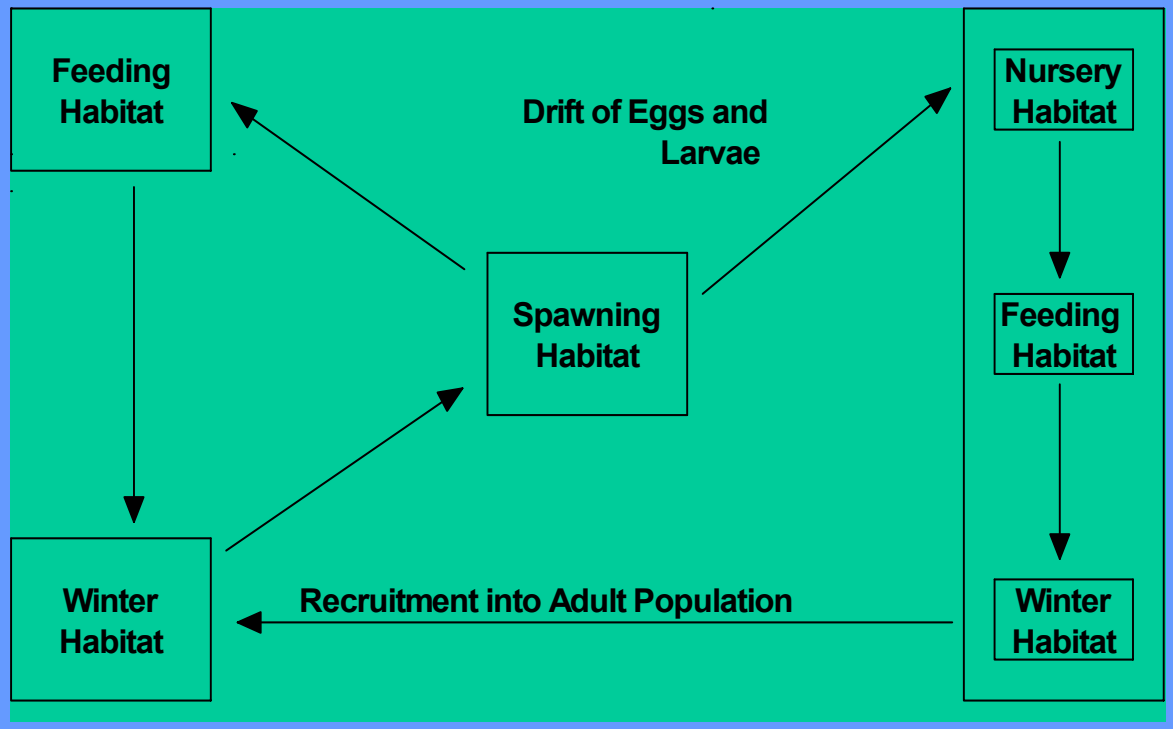
Fish Passage Through Dams on the Upper Mississippi River System

Ecosystem Objectives

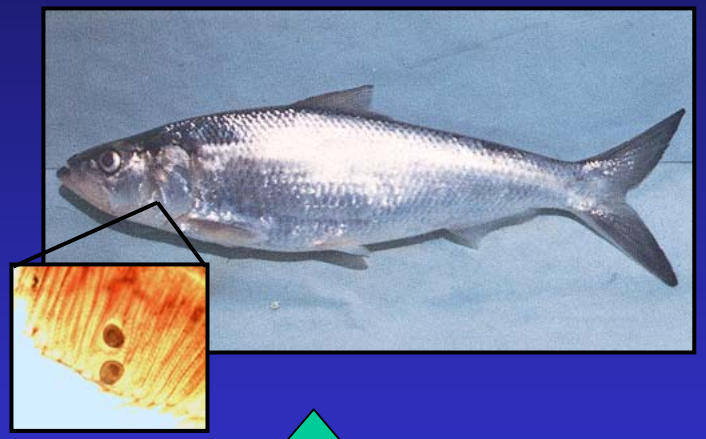
- Maintain viable native fish populations throughout their range in the Upper Mississippi River System

- Maintain viable native mussel populations throughout their range in the Upper Mississippi River System

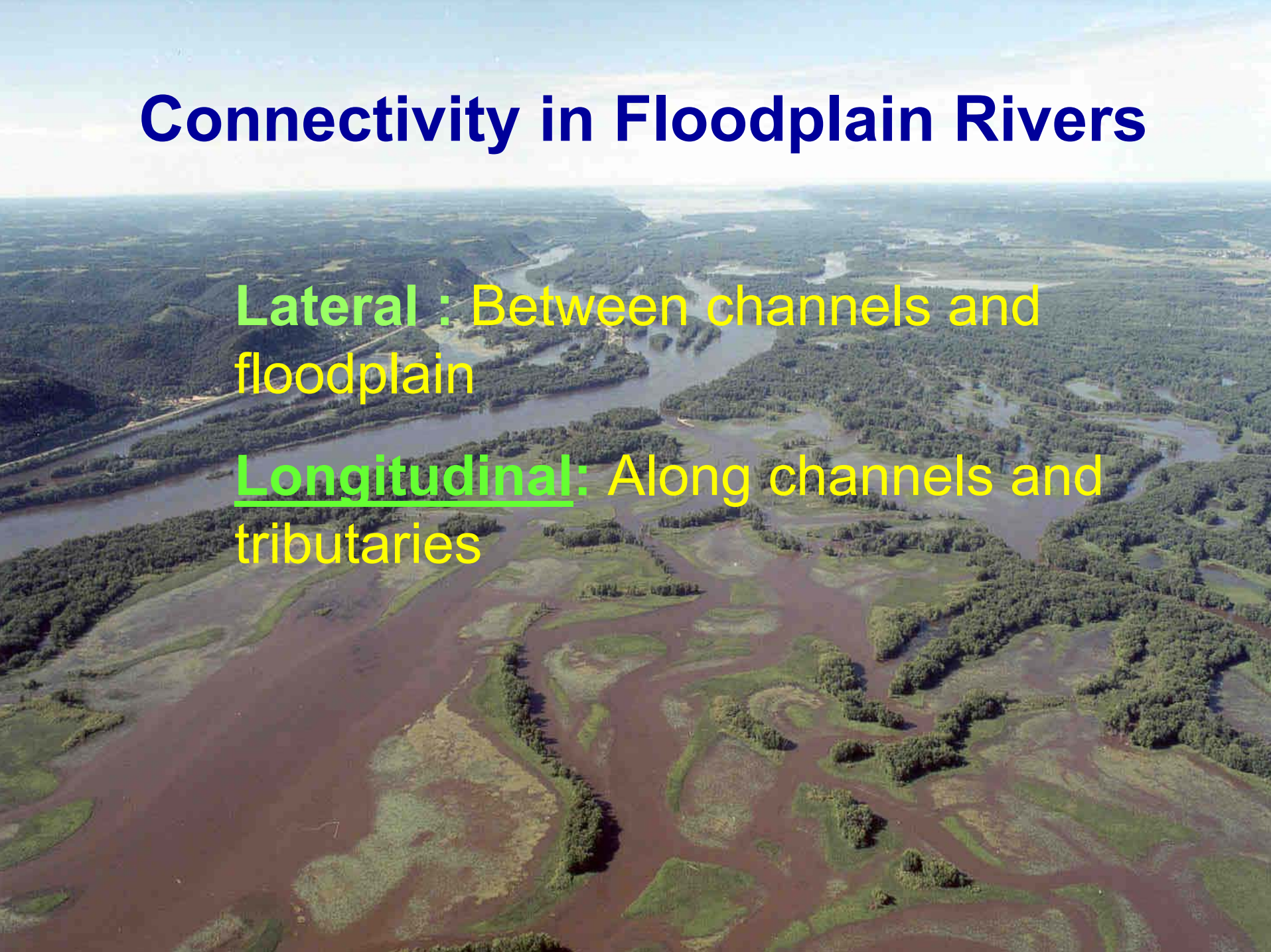
Movements of Fish in Rivers (after McKeown 1984)



Skipjack herring/Ebony shell



Connectivity in Floodplain Rivers



Lateral : Between channels and floodplain

Longitudinal: Along channels and tributaries

Migratory Fishes in the UMR

- Silver lamprey
- Lake sturgeon
- Shovelnose sturgeon
- Paddlefish
- Goldeye
- Mooneye
- American eel
- Alabama shad
- Skipjack herring
- Bigmouth buffalo
- Smallmouth buffalo
- Blue sucker
- White sucker
- Spotted sucker
- Blue catfish
- Channel catfish
- Flathead catfish
- Northern pike
- White bass
- Yellow bass
- Smallmouth bass
- Largemouth bass
- Sauger
- Walleye

Endangered and At-risk Fishes

Pallid Sturgeon

Blue Catfish

Lake Sturgeon

Paddlefish

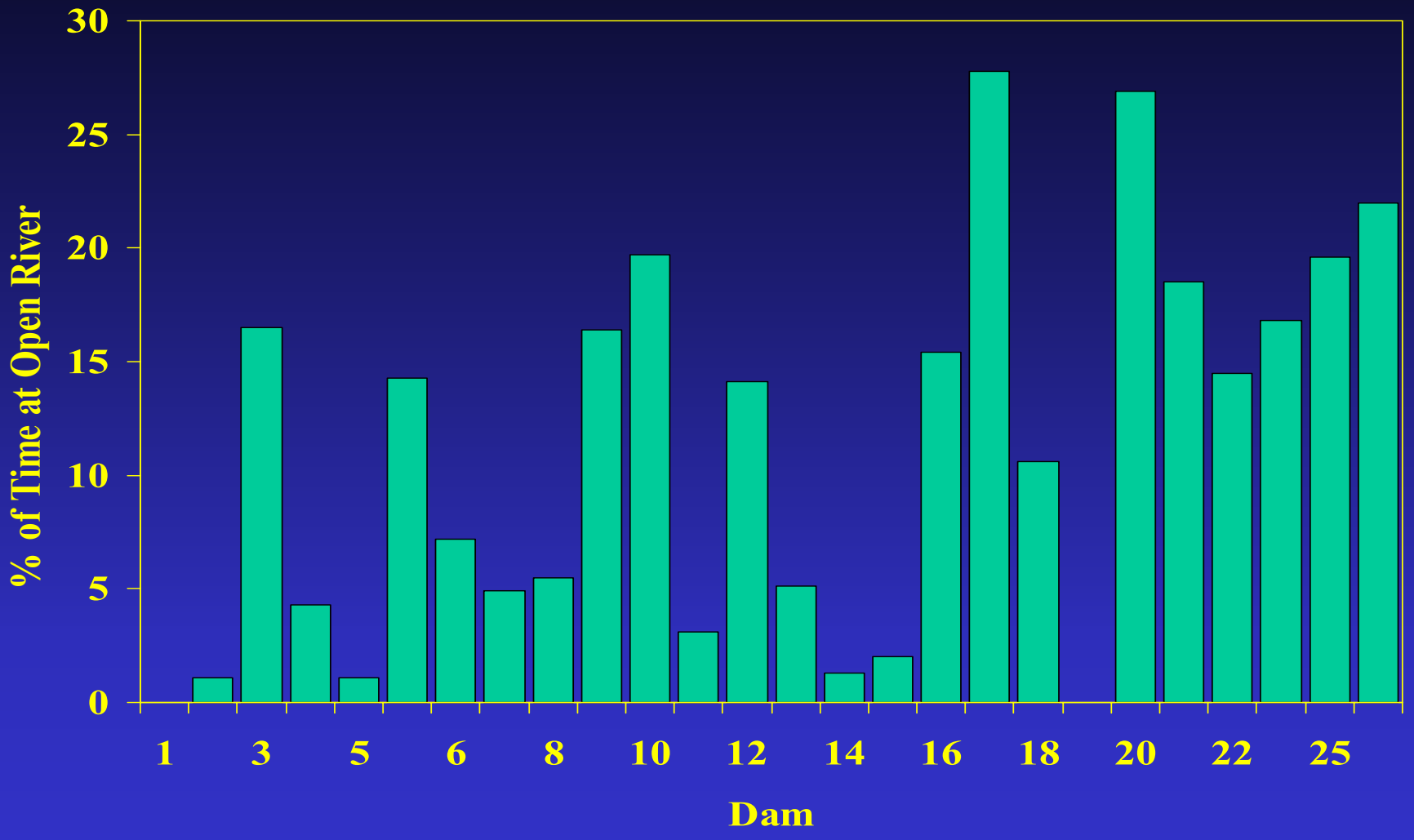
Prolonged Swimming Speeds

m/s	Species
0.9-1.3	Lake sturgeon, Paddlefish, Blue catfish, Flathead catfish, White bass, Largemouth bass, Walleye
0.6-0.9	Freshwater drum, Sauger, Smallmouth bass, Shovelnose sturgeon, Blue sucker, Channel catfish, Yellow bass
0.3-0.6	Bigmouth buffalo, Smallmouth buffalo, White sucker, Spotted sucker, Northern pike, Goldeye, Mooneye, Alabama shad, Skipjack herring

The strong currents through the gates, locks, and other openings, will attract fish to these openings, through which, the Board feels, they will be able to pass more readily than through any fishway. Fishways through the dams will, however, be installed if shown to be necessary.

War Department 1932

Percent of Time that UMR Dams Uncontrolled (Gates Out of the Water)



Hydraulic Conditions at Navigation Dams

- **High velocities - controlled conditions**
- **Lowest velocities - uncontrolled conditions**
- **Spillways usually impassable by fish**

Potential Management Actions to Improve Fish Passage

- Operational alternatives
- Structural alternatives

Management Actions

- Build fishways at mainstem dams
- Modify mainstem dam gate bay openings and operation to improve fish passage
- Modify overflow spillways at mainstem dams to improve fish passage
- Induced upstream lockage of fish
- Remove dams on tributaries
- Build fishways on tributary dams

Fish Passage Team Members

Luther Aadland	MN DNR
Butch Atwood	IL DNR
Ron Benjamin	WI DNR
Bernard Schonhoff	IA DNR
Ken Brummett	MO DOC
Bob Clevenstine	USFWS
Greg Conover	USFWS
Scott Yess	USFWS
Gary Wege	USFWS
Mark Cornish	Corps
Brian Johnson	Corps
Gary Lee	Corps
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Dan Johnson	Corps
Elliot Stefanik	Corps
Dan Kelner	Corps
Dan Wilcox	Corps
Brian Ickes	USGS
Steve Zigler	USGS

Outline – Fish Passage Report

Introduction

Importance of habitat connectivity

Longitudinal connectivity through navigation dams

Lateral connectivity through levees and embankments

Fish migrations, behavior, and swimming performance

Unionid mussels in the UMRS

Fish passage through UMRS dams

Exotic fish species in the UMRS

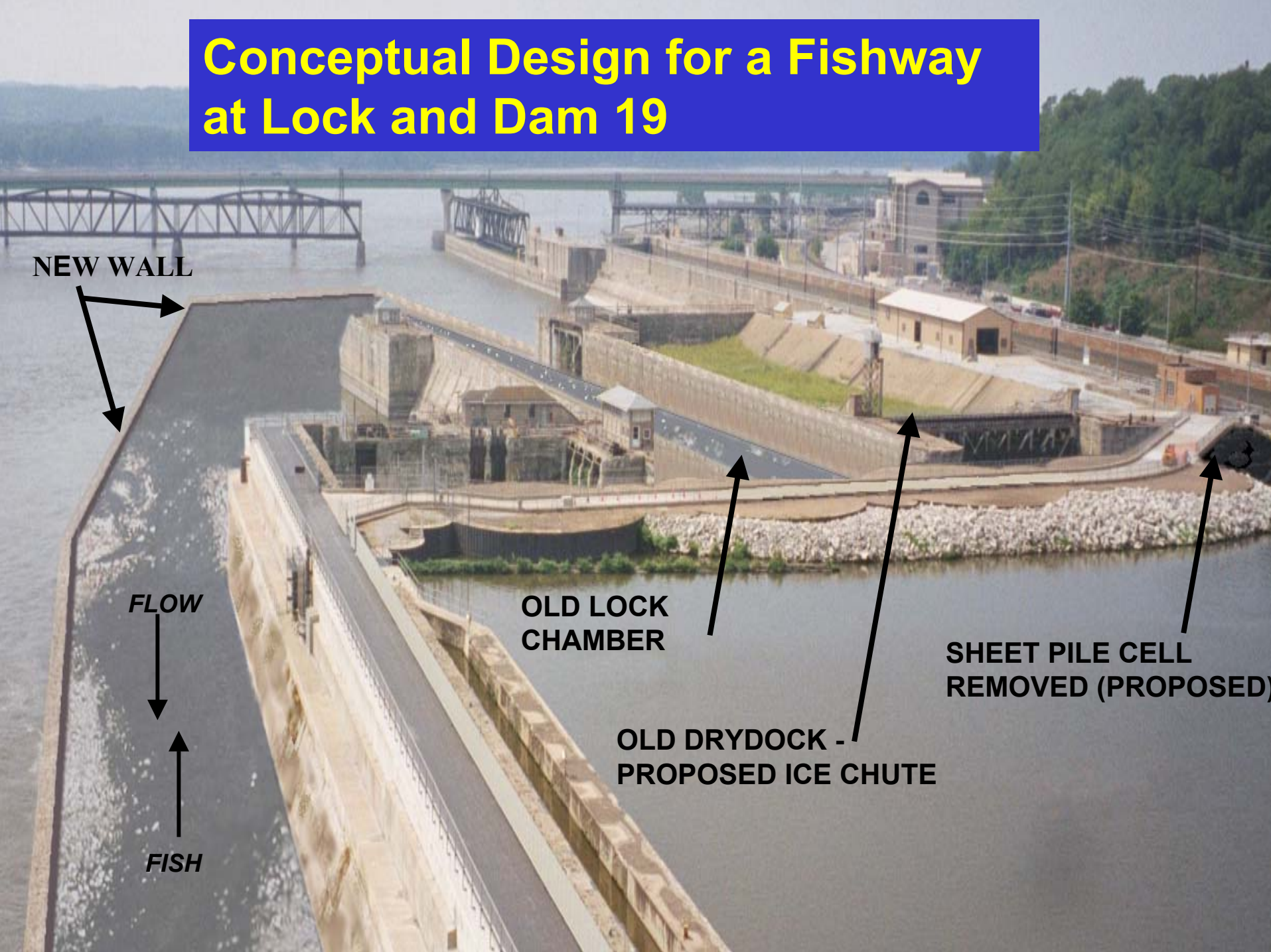
Outline – Fish Passage Report

Alternatives for improving fish passage through dams
Alternatives for limiting dispersal of exotic fish species
Potential for fishways at UMRS dams
Benefits of improving fish passage
Priority of sites for improving fish passage
Summary evaluation of costs and benefits
Monitoring effectiveness of actions to improve fish passage
Recommendations for implementation

Denil-type Fishway
Oberwasser River, Brandenburg,
Germany

Fishway on Ottertail River
Breckenridge Minnesota

Conceptual Design for a Fishway at Lock and Dam 19



Next Steps

- Compile draft report
- Provide draft to Fish Passage Team
- Meet in LaCrosse May 7, 8
- Provide final report to Rock Island District in June

Attachment 9

Restructured Upper Mississippi River – Illinois Waterway System Navigation System

Water Level Management Workgroup Status Update

17 April 2003

Purpose: The purpose of this effort is to conduct a systemic evaluation of Water Level Management (WLM) opportunities on the Upper Mississippi River and Illinois Waterway (UMR-IWW) for use in the Restructured Navigation Study. The results of the investigation will be used to identify potential WLM actions to support environmental objectives identified in the Navigation Study.

Workgroup Meeting:

On March 4 and 5, the Water Level Management (WLM) Workgroup met in Bettendorf, IA, to:

- Review the identified ecological goals and objectives associated with WLM actions.
- Define the range (timing, magnitude, and duration) of WLM actions to be considered in the Restructured Navigation Study.
- Review/define linkages between WLM actions and ecological goals and objectives.
- Define a methodology to conduct prioritization of WLM actions on the system
- Define methods of establishing benefits and costs associated with WLM actions for inclusion in the Environmental Alternatives formulated as part of the Restructured Navigation Study.
- Discuss modeling tools available to predict the biological response(s) to WLM actions.
- Establish direction for completion of the Workgroup's efforts.

In addition to the WLM team members, representatives of the Illinois DNR (Atwood), Iowa DNR (Griffin), and Minnesota DNR (Scot Johnson) participated in the meeting.

Range of WLM Actions Being Considered: At the March 4-5 workgroup meeting, the following six main categories of WLM actions were identified for consideration.

1. Lower the pool level below the existing operating band
   - Growing Season Drawdown
   - Winter Drawdown
   - Increased gradient during Drought Conditions
2. Raise the pool level above the present operating band
   - Fall/Winter Raise
   - Spring Raise
3. Change control point from mid-pool to dam
   - Fall - Winter
   - Spring

4. Modified distribution of flow through dam gates
    - Winter
    - Whole Year (Fish Migration, Habitat)
5. Minimize short-term water level fluctuations (Pools 4, 16, 19, and 20 on the UMR; Lockport, Marseilles, Peoria, and LaGrange on the IWW)
    - Year Round
6. Intentional water level fluctuations (limited range)
    - Winter

In additional to the seasonal (timing) dimension of the six actions to be considered, the range of durations and magnitudes that would be considered in this effort were defined at the meeting. For example, it was decided that when evaluating growing season drawdowns, we would focus on drawdown durations of 30-, 60-, and 90-days, and drawdowns of 1 to 4 feet.

Prioritization of WLM Actions:

Team members in each of the Corps Districts were tasked with developing a draft prioritization/screening of the WLM actions within their individual Districts. This prioritization, using procedures defined during the March 4-5 workgroup meeting, is designed to help identify those combinations of pools and management actions that will provide the greatest ecological benefits while minimizing implementation costs and potential impacts to other users of the river.

It should be noted that the purpose of the prioritization/screening process was to identify those combinations of WLM actions and navigation pools that (1) have identified environmental objectives associated with WLM actions and (2) appear to be the most feasible, efficient, and acceptable locations for implementation. ***The prioritization process is not intended to exclude any pool or management action from possible future consideration*****,** but rather to help focus the workgroup's efforts.

A draft prioritization of WLM actions has been completed for all three districts, and is being distributed to the WLM workgroup for review/comment.

Upcoming Work and Schedule:

Using the measures and methods defined during the WLM Workshop, the benefits and costs associated with the prioritized WLM actions will be developed for inclusion in the Environmental Alternatives being formulated as part of the Restructured Navigation Study.

A draft report describing the procedures, assumptions, and sources of data used to prioritize the WLM actions, as well as to define the benefit and cost information for the prioritized WLM actions will be completed by the end of June.

Questions?

If you have questions concerning this effort, please contact Kevin Landwehr at the Rock Island District, COE, 309-794-5578.

Attachment 10

Water Level Management Workgroup

Purpose of WLM Workgroup:

- Systemic Evaluation of WLM Opportunities
  - Range of Management Actions
  - Link Actions to Defined Ecological Goals and Objectives
  - Prioritize WLM Actions on the System
    - Need
    - Feasibility
    - Efficiency
    - Acceptability

- Development of Physical Data for Defining Benefits and Costs of WLM Actions to be included in the Environmental Alternatives formulated as part of the Restructured Navigation Study

Goals of WLM Workgroup:

- **Review of Identified Ecological Goals and Objectives Associated with WLM Actions.**

- **Define Range of WLM Actions to be Considered in the Restructured Navigation Study.**

Range of WLM Actions Being Considered:

1. Lower the pool level below the existing operating band
    - Growing Season Drawdown
    - Winter Drawdown
    - Increased gradient during Drought Conditions

2. Raise the pool level above the present operating band
    - Fall/Winter Raise
    - Spring Raise

3. Change control point from mid-pool to dam
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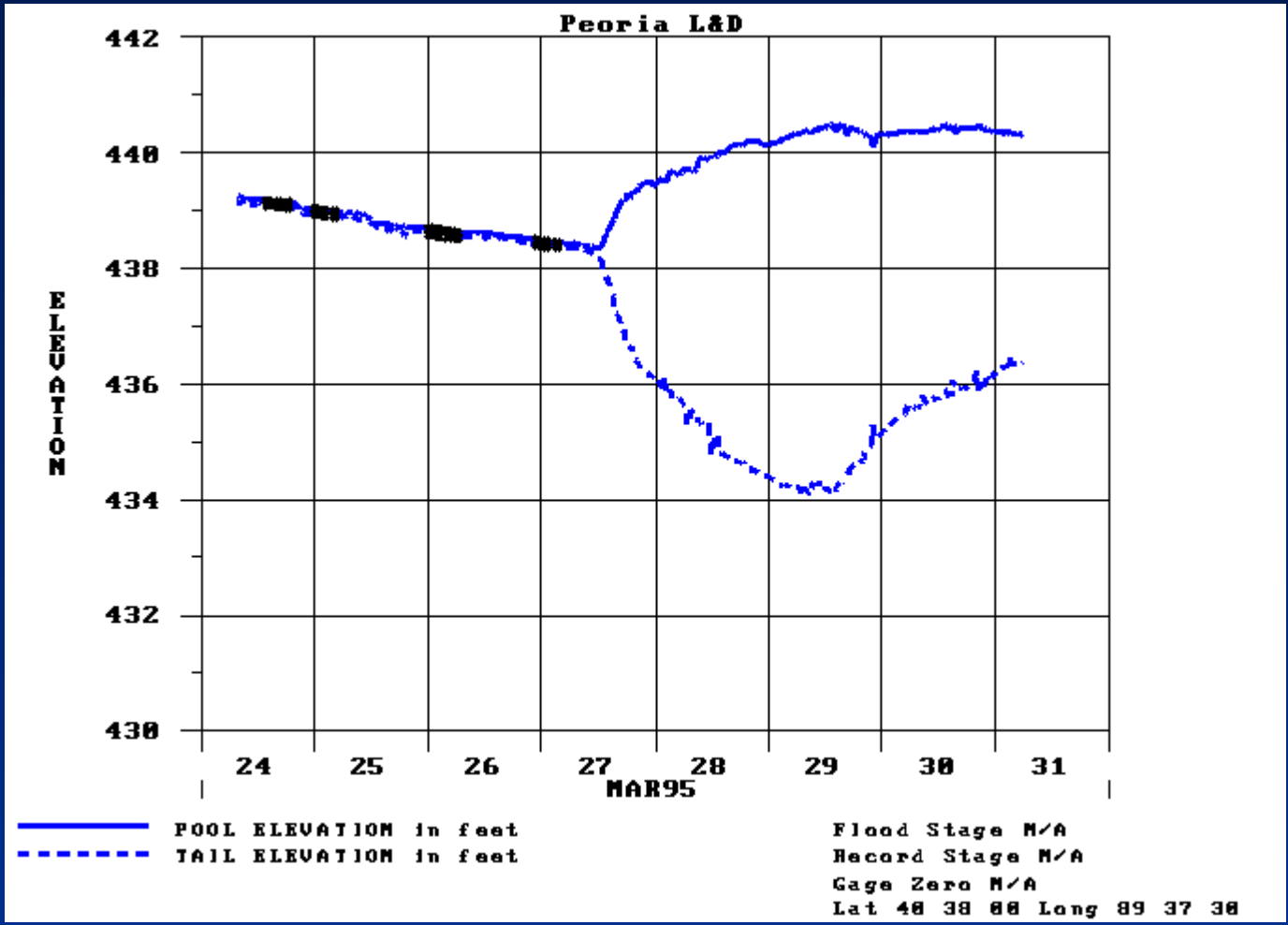
4. Modified distribution of flow through dam gates
    - Winter
    - Whole Year (Fish Migration, Habitat)

5. Minimize short-term water level fluctuations (Pools 4, 16, 19, and 20 on the UMR; Lockport, Marseilles, Peoria, and LaGrange on the IWW)
    - Year Round

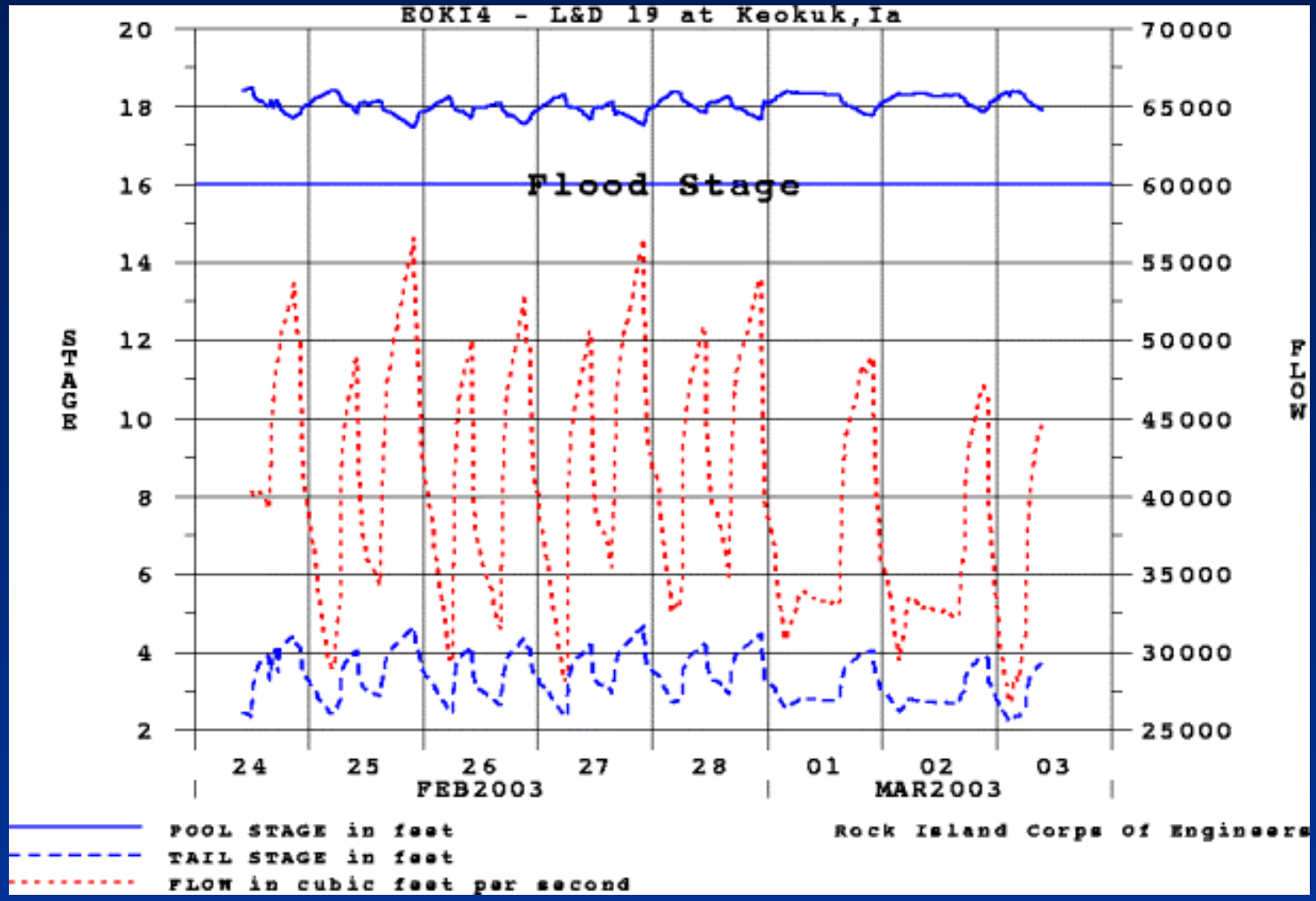
6. Intentional water level fluctuations (limited range)
    - Winter

Peoria L&D


Peoria L&D
ELEVATION
442
440
438
436
434
432
430
24
25
26
27
28
29
30
31
MAR95
POOL ELEVATION in feet
TAIL ELEVATION in feet
Flood Stage N/A
Record Stage N/A
Gage Zero N/A
Lat 40 38 00 Long 89 37 30

Low Flow Fluctuations at Dam 19

- Incoming Flows less than 55,000 cfs



Maximum fluctuation of 2 ft, cannot fall below stage of 2.0

Range of WLM Actions Being Considered:

1. Lower the pool level below the existing operating band
    - Growing Season Drawdown
    - Winter Drawdown
    - Increased gradient during Drought Conditions

2. Raise the pool level above the present operating band
    - Fall/Winter Raise
    - Spring Raise

3. Change control point from mid-pool to dam
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    - Spring

4. Modified distribution of flow through dam gates
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    - Year Round

6. Intentional water level fluctuations (limited range)
    - Winter

Goals of WLM Workgroup:

- Review of Identified Ecological Goals and Objectives Associated with WLM Actions.

- Define Range of WLM Actions to be Considered in the Restructured Navigation Study.

- Review Defined Linkages between WLM Actions and Ecological Goals and Objectives.

- Define methodology and conduct Prioritization/Screening of WLM Actions.

Prioritization (Screening) of WLM Actions

Why Prioritize?

- Differences in Benefits, Costs, Impacts to other users, and potential for implementation.

- Want to identify those combinations of management actions and pools that produce the most benefits for the least cost (efficiency), and which are most likely to be successfully implemented (feasibility).

Some of this prioritization has already been occurring within the Districts.

***The prioritization process is not intended to exclude any pool or management action from possible future consideration (Adaptive Management)*, but rather to help focus the workgroup's efforts.**

Potential Prioritization/Screening Method

Define Different Levels of Prioritization Criteria:

Highest Level

- Need (Defined Objectives)

- Natural Constraints
  - High Flows
  - (Extremely Low Flows)

- MAJOR Constraints – Impacts that must be mitigated for
  - Water Supply (municipal, industrial, commercial)
  - Real Estate Limits / Ownership
  - Legal
  - Hydropower

- Impacts to Other Users / Trade-offs
  - Navigation (Major Constraint in Previous WLM efforts)
  - Recreation
  - Commercial Fishing
  - Competing Environmental Interests
  - Etc.

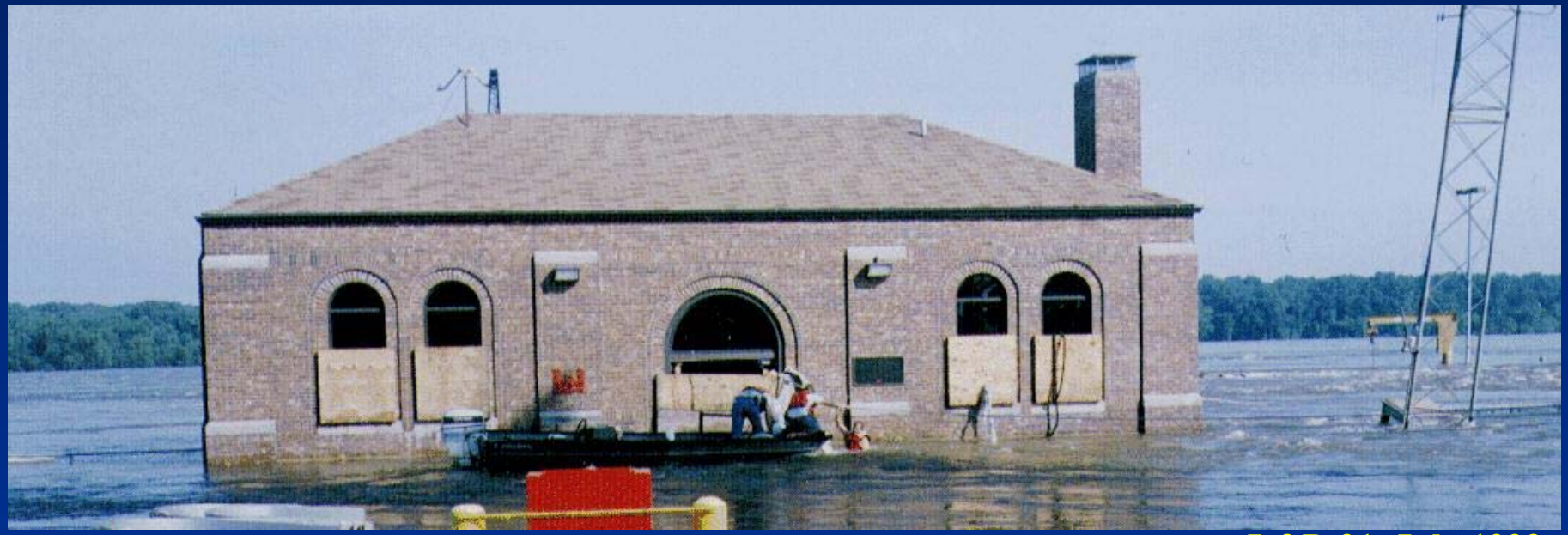
Lowest Level

Prioritizing Criteria - Drawdowns

Hydrology
Identified Objective Supported by Action
Dredging Requirements
Cost Benefit
(Tributary)
Recreation Impacts
Benefits (acreage)
Environmental Impacts
Water Supply
Commercial Navigation Impacts
Commercial Fisheries Impacts

Hydrology

- **High Water Data**



L&D 21, July 1993

Alt-tab

River	Pool	60-Day, 2-foot Success Rate	Suitability Rating
UMR	11	86%	High
	12	41%	Low
	13	86%	High
	14	95%	High
	15	95%	High
	16	55%	Moderate
	17	18%	Very Low
	18	50%	Moderate
	19	100%	Very High
	20	32%	Low
	21	27%	Low
	22	32%	Low
IWW	Dresden	100%	Very High
	Marseilles	100%	Very High
	Starved Rock	~ 100%	High
	Peoria	41%	Low
	LaGrange	32%	Low

Prioritizing Criteria - Drawdowns

Hydrology
Identified Objective Supported by Action
Dredging Requirements
Cost Benefit
(Tributary)
Recreation Impacts
Benefits (acreage)
Environmental Impacts
Water Supply
Commercial Navigation Impacts
Commercial Fisheries Impacts

Goals of WLM Workgroup:

- Review of Identified Ecological Goals and Objectives Associated with WLM Actions.

- Define Range of WLM Actions to be Considered in the Restructured Navigation Study.

- Review Defined Linkages between WLM Actions and Ecological Goals and Objectives.

- Define methodology and conduct Prioritization/Screening of WLM Actions.

- Define methodology for establishing benefits and costs associated with WLM actions for inclusion in the Restructured Navigation Study.

Pool 13 Bathymetry

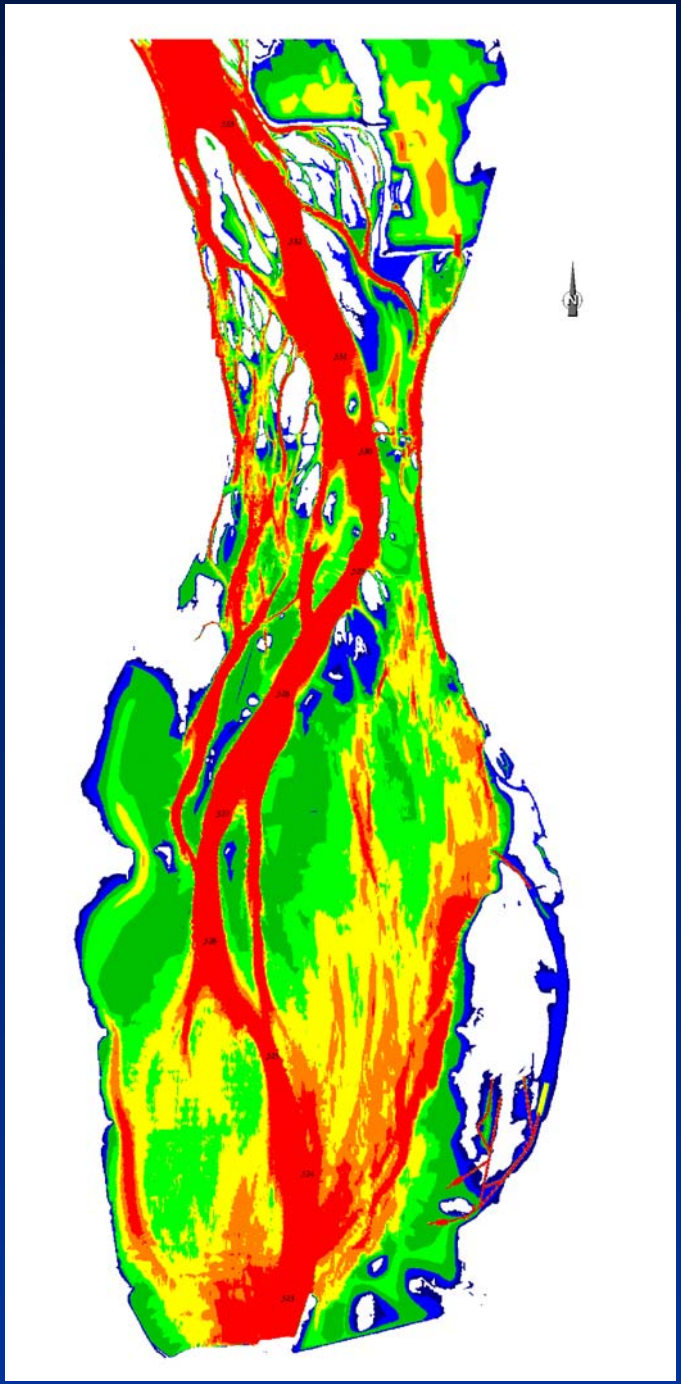
1 Foot Drawdown at the Dam

50,000 cfs

Water Depth

- Dewatered Aquatic Area
- 0 - 1 feet
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- > 5 feet

Source: EMTC



Goals of WLM Workgroup:

- Review of Identified Ecological Goals and Objectives Associated with WLM Actions.
- Define Range of WLM Actions to be Considered in the Restructured Navigation Study.
- Review Defined Linkages between WLM Actions and Ecological Goals and Objectives.
- Define methodology and conduct Prioritization/Screening of WLM Actions.
- Define methodology for establishing benefits and costs associated with WLM actions for inclusion in the Restructured Navigation Study.
- Discuss tools for predictive analysis and monitoring needs/requirements

May 22 - Prior to Drawdown

June 22 - 2 Days After Drawdown

July 15 - Near End of Drawdown Period

September 25 - Post-Drawdown

Timeline:

April 25 - Results of Draft Prioritization/Screening Process Distributed to Team Members.

April 28 – June 20 – Development of benefit and cost information for prioritized WLM actions.

June 20 – Draft Report.

Range of WLM Actions Being Considered:

MVR→ MVP→

1. Lower the pool level below the existing operating band
   - Growing Season Drawdown
   - Winter Drawdown
   - Increased gradient during Drought Conditions

2. Raise the pool level above the present operating band
   - Fall/Winter Raise
   - Spring Raise

MVS→

3. Change control point from mid-pool to dam
   - Fall - Winter
   - Spring

All, with Fish Passage→

4. Modified distribution of flow through dam gates
   - Winter
   - Whole Year (Fish Migration, Habitat)

MVR→

5. Minimize short-term water level fluctuations (Pools 4, 16, 19, and 20 on the UMR; Lockport, Marseilles, Peoria, and LaGrange on the IWW)
   - Year Round

6. Intentional water level fluctuations (limited range)
   - Winter

Timeline:

April 25 - Results of Prioritization/Screening Process Distributed to Team Members.

April 28 – June 20 – Development of benefit and cost information for prioritized WLM actions.

June 20 – Draft Report.

Questions?

Attachment 11

The mission of The Nature Conservancy is to preserve the plants, animals, and natural communities that represent the diversity of life on earth by protecting the lands and waters they need to survive.

EMIQUON PROJECT VISION STATEMENT

February 2003

With the acquisition of 7,600 acres along the Illinois River in Fulton County, Illinois during 2000, the Illinois Chapter of The Nature Conservancy has embarked on its Emiquon Project, a planning and restoration opportunity that will become the Chapter's linchpin in its efforts to conserve the Illinois River ecosystem, as summarized in the Chapter's Site Conservation Plan for the Illinois River Watershed (1998). The overriding goal of the conservation plan is to preserve the natural biological diversity of the Illinois River Valley. The recovery and maintenance of native plants, animals, and natural communities of the Illinois River ecosystem require restoration of the ecological processes that once structured these large floodplain river habitats and the native plant and animal communities they supported. Restoration and management of lands at the Conservancy's Emiquon Project and other strategically located places along the Illinois River are key to returning the river's natural resources toward their former richness and productivity and to sustaining the restored natural communities for generations yet to come.

The Emiquon Project provides an opportunity for restoration of approximately 1,200 acres of uplands and 6,400 acres of wetlands and floodplain habitat to support native plant and animal communities. With proper planning and implementation, this effort will be a model for restoration and management of large floodplain river systems, demonstrating their tremendous capacity for regeneration despite having been significantly altered and impacted.

The primary objective for the restoration and management of the lands within the boundaries of the Conservancy's Emiquon Project is to restore natural ecological processes and habitats that promote and sustain the native species and aquatic and terrestrial communities once found in this region of the Illinois River. Secondary objectives are to:

1. develop, test, and export successful techniques for restoring and sustaining the natural biological diversity of large floodplain river ecosystems;
2. incorporate the principles of adaptive management as a necessary component of natural area management;
3. demonstrate the benefits of ecological restoration of critical habitats for threatened and endangered species;
4. evaluate the potential for storing floodwaters and reducing unnatural water level fluctuations;
5. promote the ecological and cultural importance of the Emiquon area by developing and implementing educational programs;
6. demonstrate that natural area conservation efforts can be an important component of local and regional economic development strategies; and
7. provide excellent recreational opportunities.

-over-

In the naturally functioning Illinois River ecosystem, the major ecological process was the interaction of the river with its floodplain; consequently, to fully achieve the objectives of the Emiquon Project, reconnection of the Illinois River to its floodplain is imperative. Therefore, we anticipate the Illinois River will be reconnected to the Thompson Drainage and Levee District and possibly the Globe Drainage and Levee District. Through management of the reconnection(s) and water levels, we will contribute to the maintenance of ecological processes needed to sustain floodplain habitats and provide access for riverine aquatic organisms.

At Emiquon we will use a science-based approach and principles of adaptive management to guide restoration and operation to make the best use of new information and to maximize the project's effectiveness in achieving our primary and secondary goals. As the overall restoration effort progresses, we will use monitoring data to assess the status of indicator species, communities, and conditions to evaluate progress and to take corrective action in time to reverse any undesirable trends. New restoration and management techniques will be developed, implemented, evaluated, refined, and documented, and lessons learned will be exported to aid other large floodplain river restoration projects.

Restored habitats will benefit native plants and animals including threatened and endangered species. In addition, the restored complex of backwater wetland communities will support an abundance of fish and wildlife including recreationally important species, thereby providing opportunities for recreation and associated compatible economic development.

Educational programs will be developed to attract visitors and to interpret the cultural and ecological resources of the area. The Emiquon Project will become a showcase for landscape restoration and management of floodplain habitat. It will raise awareness about the potential for and benefits of recovering large floodplain river systems and thereby build constituency for this and other restoration efforts. In addition, these programs and their participants will provide both quality of life and economic benefits to the local communities.

For more information contact:

The Nature Conservancy
Illinois River Project Office at Emiquon
11304 N. Prairie Road
Lewistown, IL 61542

Phone: (309)547-2730
Fax: (309)547-2731
Email: emiquon@tnc.org

Attachment 12

Sustainable Management Endpoints and Measures for the Upper Mississippi and Illinois Rivers Navigation Study

Mark B. Bain
Center for the Environment, Cornell University, 200 Rice Hall, Ithaca, New York 14853
Mark.Bain@Cornell.edu – Ph: 607-254-4750

Robert C. Clevenstein
US Fish and Wildlife Service, Rock Island Field Office - ES, 4469-48th Avenue Court
Rock Island, IL 61201-9213 – Robert_Clevenstine@fws.gov – 309/793-5800 ext 521

PRESENTATION FOR THE
Upper Mississippi River-Illinois Waterway System
Navigation Feasibility Study Expert Panel
River Center, 131 West 2nd Street, Davenport, IA
22-23 April 2003

METHOD FOR DERIVING AND DOCUMENTING ENDPOINTS AND MEASURES VERSION 3 - 4 April 2003

PROPERTIES OF AN ENDPOINT

1. A select system attribute that captures a signal on a set of environmental objectives within one Essential Ecosystem Characters (EEC)

2. Provide an assessment of status - can be labeled as to quality state

3. With repeated observations through time it assesses trend

4. Linked to values of people and actions of managers; specifically the environmental objectives workshop results

5. Needs to be numerical and informative, simple to use and understand, and practical with available and routine information.

6. Important enough that it constitutes 20 to 35% of an EEC scope; that is 3 or 4 endpoints cover an EEC.

PROCESS FOR IDENTIFYING ENDPOINTS

DONE INDEPENDENTLY FOR EACH ESSENTIAL ECOSYSTEM CHARACTERISTIC (EEC)

1. **Start with 3 items: The synthesized list of environmental objectives from the Fall 2002 objectives planning workshops. C Theiling's Excel file that pairs objectives grouped by EEC and management actions. Criteria for endpoint selection.**

2. **Consider each planning objective by EEC title against the three endpoint selection criteria. Save for possible selection as an endpoint any objective that meets all three criteria.**

3. **Consider additional candidate endpoints by: thinking of missing EEC properties, reviewing the EEC documentation, and checking with other documents and reports.**

4. **Check over list of candidate endpoints by EEC for redundancy, and produce final endpoints for development.**

5. **Seek review and comment by others on the endpoint selections. Make adjustments in final endpoint list of needed.**

6. **Document each endpoint on one page with the following: endpoint name, definition, justification following 3 criteria, endpoint illustrating graphic, trend plot or example, and identity of recommended measurements.**

CRITERIA FOR ENDPOINT SELECTION

1. Policy and Management Relevance

Addresses societal issues? Related to management actions and capabilities? Can quality levels be assigned to indicator values? Can interested citizens and involved public groups understand the indicator with minimal preparation?

2. Technical Merit

Related to structural and functional properties of the system of interest? Grounded in principles and scientific concepts? Known to yield reliable information? Is variability likely to reflect environmental changes of interest? How vulnerable to confounding influences over time or space? Can users be confident that indicator values reflect information of interest and not random or misleading variations?

3. Practicality

Are practitioners capable of routinely collecting data in adequate amounts and quality? Is the costs and benefits of using the indicator clear to program managers and the public? Are costs reasonable over many years of use and fluctuations in agency budgets? Is quality control, timely reporting, and data storage and distribution easily managed? Is the indicator closely related and compatible with established monitoring programs?

UMR-nav Work
1/22-23/03 ha

Upper Mississippi River-Illinois Waterway Navigation Study
Environmental Objectives Planning Workshops
Pool-wide Objectives

Attached are the pool-wide objectives gathered from each of the four environmental objective-planning workshops held in November 2002. The objectives are organized by workshop region (i.e., La Crosse, Moline, St. Louis, and Peoria). For the most part, system, reach and pool-wide objectives have been compiled into one list per region – the exception being St. Louis, where the objectives are organized by impounded and unimpounded reaches. These lists have also been further broken down into objective categories of water quality, geomorphology, pattern of habitats, plants and animals, and other. Please use the key provided below to assist in interpreting the target ranges, frequency of occurrence, and other supporting information that is listed with the environmental objectives.

Key
TR = Target Range
S = Season
FO = Frequency of Occurrence in a 10-year period.
TD = Target Date

Pattern of Habitats and Floodplain Features

- Increase abundance of isolated aquatic areas (5 percent of total floodplain area)
- Restore or maintain large contiguous habitats (forest, grassland, and wetland) every 30 – 40 miles by 2020
- Restore or maintain 1,000 acre or greater contiguous forest patches every 30 miles by 2050
- Achieve 20 – 40 percent forested floodplain area
- Restore habitat corridors (e.g., riparian forests, contiguous prairie, etc.)
- Achieve 200 foot non-agricultural riparian corridor along diversion ditches
- Increase abundance of emergent aquatic plants 100 percent over 1989 abundance by 2010 (20 – 50 stems/m^2)
- Increase abundance of submersed aquatic plants 100 percent over 1989 abundance by 2010 (50 - 100 stems/m^2)
- Achieve 10 percent coverage of submersed aquatic plants in every backwater
- Achieve 80 percent coverage of submersed aquatic plants in shallow backwater areas (<1 m deep)
- Achieve 10 percent coverage of grasslands in the floodplain by 2010
- Achieve 10 percent coverage of scrub shrub in the floodplain by 2010
- Increase marsh habitat management opportunities in leveed areas
- Restore age and species diversity in floodplain forests
- Restore flood intolerant tree species
- Restore or maintain a diverse mosaic of plant communities
- Maintain current areal abundance of crop land
- Protect high quality native habitats
- Increase woody debris in secondary channels
- Restore tributaries and floodplain streams

Management Actions

1= Low ecological effectiveness, but would help achieve objective
2 = Medium ecological effectiveness
3 = High ecological effectiveness

	Ecological Objectives and Need Statements	Water Quality	Achieve USEPA and state full use standards to improve water quality	Reduce contaminant loadings to the river	Manage contaminated sediments	Achieve USEPA and state non-point TMDL standards to improve water quality	Reduce fine sediment loadings to the river	Reduce coarse sediment loadings to the river	Reduce contaminant loadings to the river REDUNDANT	Reduce nutrient loading from tributaries to the mainstem river and Gulf of Mexi	Increase nutrient processing (e.g., denitrification) in river habitats	Establish water quality standards for aquatic biota EXISTING WQ CRITERIA??	Maintain DO concentrations >5 ppm during ice free periods for fish	During winter-ice covered periods maintain DO concentrations >3 ppm,	Create thermal and velocity refugia (e.g., holes >3 m) in backwaters and channe	Maintain water clarity sufficient to support submersed aquatic vegetation, aquat	
River Regulation																	
Water control decision-making																	
Directions to lockmasters																	
Mainstem dam gate operation																	
Make frequent gate adjustments to minimize fluctuations																	
Automate dam operations																	
Use dam point control more - limit hinge point operations																	
Acquire real estate rights, modify regulation of Pools 24,25,26																	
Growing season drawdowns to promote emergent vegetation																	
Spawning season drawdowns to strand fish eggs (carp)																	
Drawdowns to consolidate sediment			1														

HABITAT

Restore and maintain a diverse mosaic of plant communities
Increase extent, abundance and diversity of submersed aquatic plants
Increase extent, abundance and diversity of emergent aquatic plants
Increase extent, abundance and diversity of floodplain grassland
Increase extent, abundance and diversity of floodplain shrub cover
Restore and maintain large contiguous grassland patches (>1,000 acres)
Restore and maintain large contiguous forest patches (>1,000 acres) with conneted corridors
Restore and maintain large contiguous wetland patches (>1,000 acres) every 30 - 40 miles
Restore age and species diversity in floodplain forests
Maintain and restore geomorphic diversity in aquatic and floodplain areas
Restore physical habitat features in MMR
Restore or increase sand bar habitat
Maintain or increase depth of existing secondary channels
Increase topographic diversity (e.g., Increase elevation by two meters on 10% of all floodplain and island terrestrial habitats)
Restore, create islands
Restore, create rapid and riffle habitat
Restore, create sand/mud flats
Restore, create, gravel bars
Restore and maintain substrate diversity in channels, (e.g., >2% of substrate area gravel and rock Restore and maintain backwater areas for sport and commercial fish
Provide for longitudinal fish passage in the mainstem and tributary rivers
Increase marsh habitat management opportunities in leveed areas
Maintain current areal abundance of crop land
Restore habitat corridors (eg riparian forests, contiguous prairie, etc.)
Create, maintain vegetated riparian buffer strips along tributaries and ditches basin-wide (e.g., 200-ft wide strips)
Restore tributaries and floodplain streams
Create, restore floodplain terrestrial habitats.
Restore habitat on islands
Increase woody debris in secondary channels
Restore aquatic habitat every 10 miles in MMR (dike alteration)
Provide deepwater fish overwintering areas (e.g., depth range 0-3 m every 2 miles)

HABITAT EEC Working Notes of APRIL 16 - M Bain, B Clevenstein, and C Theiling

Restore natural vegetated aquatic habitats (submersed aquatic plants, emergent aquatic plants, wetland patches (>1,000 acres)
Increase extent, abundance and diversity of submersed aquatic plants
Increase extent, abundance and diversity of emergent aquatic plants
Restore and maintain large contiguous wetland patches (>1,000 acres) every 30 - 40 miles
>> Y, Y, Y -- MBB --

Restore natural terrestrial habitats on floodplain: grassland patches (>1,000 acres), forest patches (>1,000 acres), shrub cover patches
>> Y, Y, Y -- MBB --

Increase special aquatic sites (rapids, riffle, sand/mud flats, sand bar, gravel bars)
>> Y, Y, Y [regulatory basis for this one] -- BC --

Create islands with natural habitats
>> Y, Y, Y [dredged material management planning item] -- BC --

Maintain current acreage of crop land in valley
>> Y, Y, Y -- BC --

EXCLUDED BY CHOICE

Restore and maintain backwater areas
>> Y, Y, Y

Restore and maintain substrate diversity in channels; e.g., >2% of substrate area gravel and rock
>> Y, Y, Y

EXCLUDED BY CRITERIA REVIEW

Restore and maintain a diverse mosaic of plant communities
>> N, too much a generic approach rather than a specific public issue or management need

Create, maintain vegetated riparian buffer strips along tributaries and ditches basin-wide (e.g., 200-ft wide strips)
>> Y, Y, N not really feasible by involved parties

Increase woody debris in secondary channels
>> N, limited interest on large scale, N - benefits hard to show in this system

Restore habitat corridors (eg riparian forests, contiguous prairie, etc.)
>> N, policy relevance weak, N - technical merit uncertain

HABITAT EEC

1. Restore natural vegetated aquatic habitats

2. Restore natural terrestrial habitats on floodplain

3. Increase special aquatic sites

4. Create islands with natural habitats

5. Maintain current acreage of crop land in valley

BIOTA EEC

1. **Support a population of Lake sturgeon**

2. **Support an abundance of waterfowl**

3. **Maintain low abundance of Asian carps**

4. **Support a diversity and abundance of neotropical migrant birds**

5. **Increase freshwater mussel species diversity**

6. **Increase mast tree abundance**

GEOMORPHOLOGY EEC

1. Restore secondary channels

2. Increase ridge and swale floodplain topography

3. Consolidate flocculent backwater sediment

4. Backwater depth management

WATER QUALITY EEC

1. Achieve state water quality criteria

2. Reduce nutrient loading to the mainstem river

3. Manage contaminated sediments (IWW, Twin Cities, Quad Cities) and open river

4. Reduce fine sediment loadings to the river

HYDROLOGY/HYDRAULICS EEC

1. Reduce stage and discharge fluctuations from dams

2. Provide for growing season low water every 5-10 years

3. Maintain maximum pool stage in winter

4. Increase flexibility of dam operations

5. Restore desirable hydraulic connections; river and off channel habitats

BIOTA: Support a Population of Lake Sturgeon

Endpoint definition

Maintain a population of lake sturgeon (*Acipenser fulvescens*) in the upper Mississippi River system.

Policy and Management Relevance

The lake sturgeon is formally recognized as a species of concern in some states, and it is a highly managed species due to its past value as a fishery species. Limited sport harvest of this fish are allowed in the region. Public interest in sturgeon is high because of the atypical nature of these fish. The endpoint of having a population of this fish in the upper Mississippi River system is clear and easily recognized in the public.

Source: http://www3.gov.ab.ca/srd/fw/fishing/sturgeon.html

Technical Merit

Lake sturgeon are member of the rheophilic guild of large river fishes. This species and other large river rheophilic fish occupy main and side channel habitats with deep water and often strong current. Lake sturgeon require access to long stretches of river since migrations to spawning, rearing, and overwintering habitats can be extensive. Spawning conditions can be restrictive since hard substrates free of rapid sediment accumulations are used. Population threats include migration barriers posed by dam and navigation structures, power plant cooling water impingement and entrainment, over exploitation, degradation of spawning habitats, and direct impact of ship propellers. Consequently, the continued presence of this species in the system indicates availability of uninterrupted access to extensive river channel conditions and periodic availability of clean rock substrate in deep channel waters.

Practicality

Lake sturgeon are rarely seen or captured by fisherman or the public, and there are sparse records of the fish in the long term monitoring of the US Geological Survey. However, the presence of the fish, especially young individuals, indicates the persistence of a population. Sighting information can be readily collected and routine fish monitoring is underway with few captures a year.

TREND illustration –

Year	Observations	Life Stage
1999	6	Adults, juveniles
2000	3	Juveniles
20..	...	.....
20..	...	.....
...		

Measures – (1) Annual number of confirmed observations of lake sturgeon in the system; (2) Number of captures in monitoring and research programs; (3) Confirmed captures by fisherman.

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Measures – (1) Annual number of confirmed observations of lake sturgeon in the system; (2) Number of captures in monitoring and research programs; (3) Confirmed captures by fisherman.

ISSUES WITH THIS PROCESS

- Innovative and big ideas did not persist well in selections: biodiversity, natural hydrology, habitat mosaics, corridors
- Emerging issues not incorporated
- Scope of management realm matters but is not clear
- Input was critical but not seen in end product
- We have too many endpoints
- ***END****point* – our work will be the easily seen in the **end**. We will have a big mark on how this study looks to a wide range of users and watchers.

Attachment 13

Sustainability Concepts and Upper Mississippi River Restoration

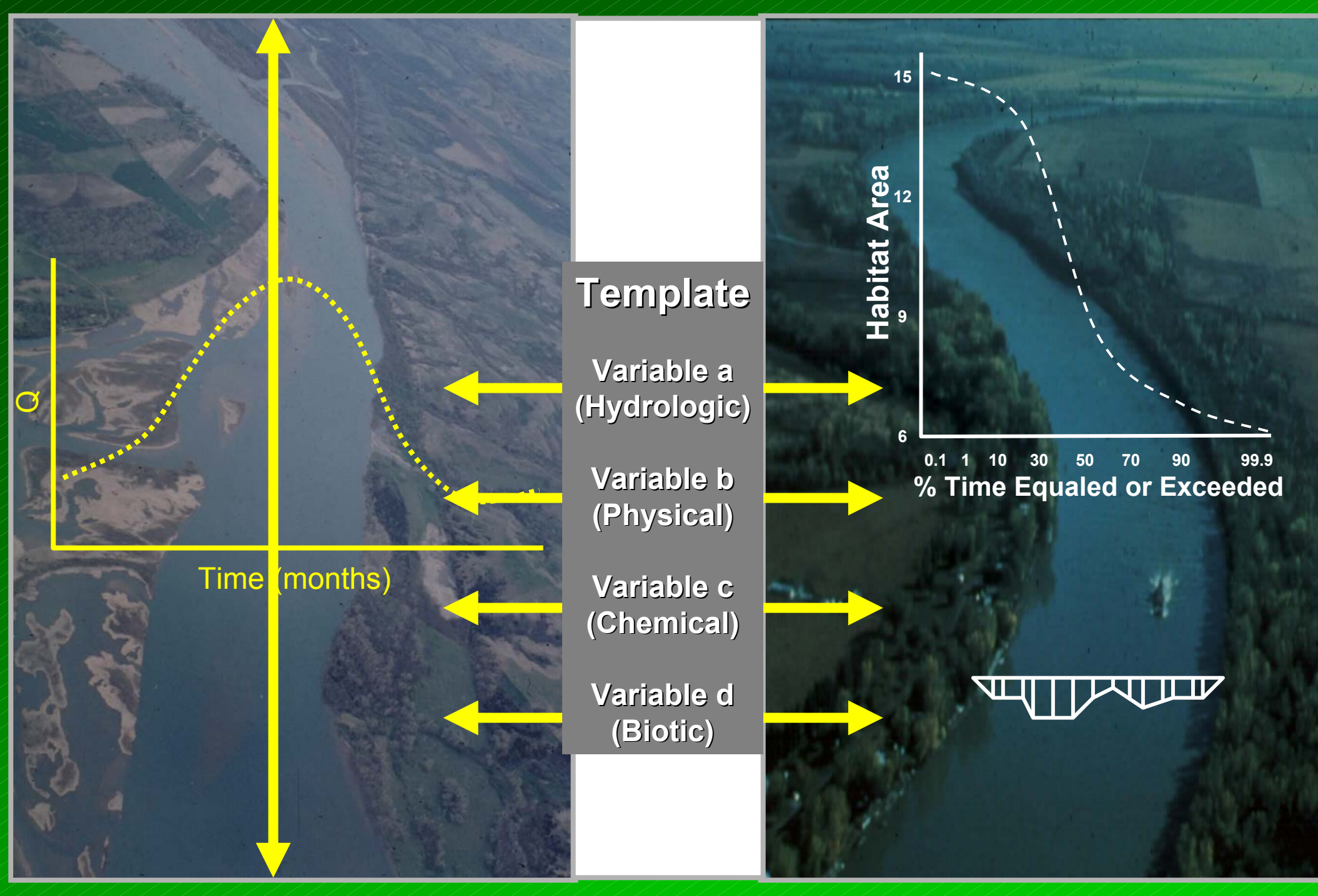
Sustainable Use: Some Definitions

Use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations (World Conservation Union 1980)

A synergistic process whereby environmental, economic, and societal considerations are effectively balanced in Project Planning, Design, Construction and Operation and Maintenance in meeting the needs of the present without compromising the quality of life for future generations.

Us of ecosystem goods & services without depletion

Clause in an inter-generational contract


Q
Time (months)
Template
Variable a
(Hydrologic)
Variable b
(Physical)
Variable c
(Chemical)
Variable d
(Biotic)
Habitat Area
15
12
9
6
0.1
1
10
30
50
70
90
99.9
% Time Equaled or Exceeded

How do you restore an impacted river?

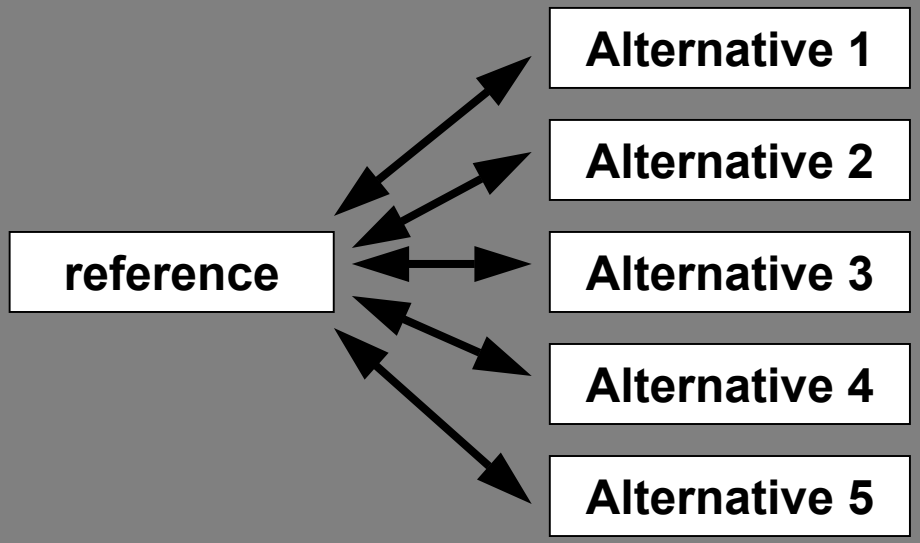
Typical Vision

1) Determine reference condition
   - "Natural River Paradigm"
   - any desired future condition

2) Describe reference & alternatives

3) Rank alternatives to reference

4) Select "best" alternative



Impossible!

- It's not 1854
- People part of the landscape

- Society has spoken
- You want sustainability & Navigation
- Maintained Ecosystem

Conundrum

How to manage for sustainable use when:

- There's no reference
- The system will continue to support navigation
- Even if a natural reference was available it could not be used
- What framework could be used for planning?
- How could decisions be defended?
- What to do? (recognizing that some of the worlds most devastated ecosystems are large rivers).

What are our Assets?

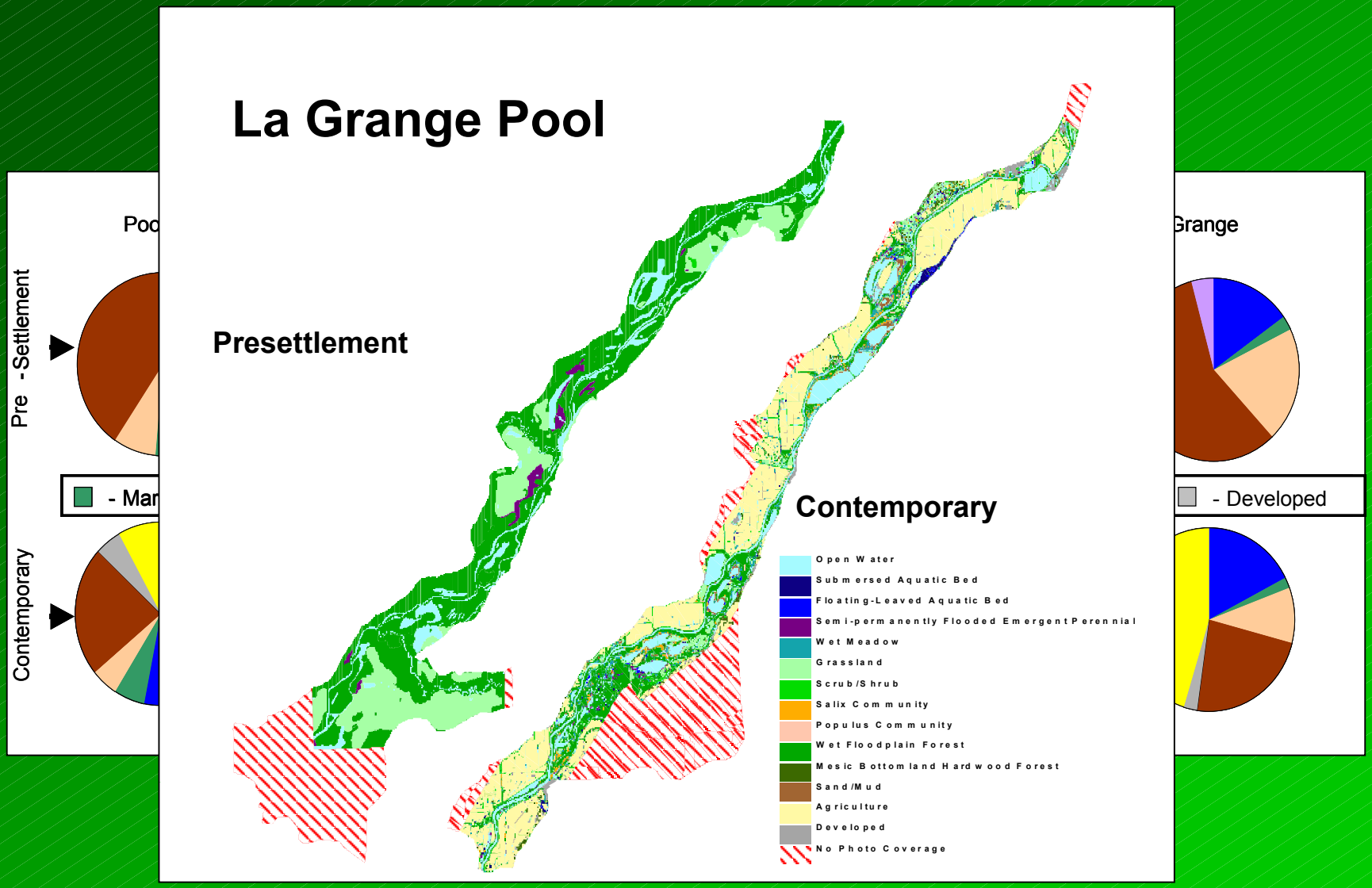
- Tiered goals and objectives
- Localized, detailed objectives
  - some of which probably conflict
- Objectives represent the "desired future condition"
- Involve processes / attributes that can be managed:
  - landscape modifications
  - waterscape modifications
  - manage nutrients / clarity / sediments
- Approximation of a "reference system"
- Snapshots and Process Information about the system:
  - Fish, Wildlife, WQ, Geomorphology, Hydrology, etc.
  - No fish species have been lost (as far as known)
  - Allows development of "internal reference"
- Summary spatial information about pre-navigation system
  - Proportions / maps - a starting point
- Flow / Sediment / WQ models available

A Strategy!

- The reference system is defined by the localized objectives
- Detailed information to create the reference comes from
  - Historiacal Spatial / Hydrologic information
  - Internal References
  - Other systems
- Above information is integrated into a comprehensive model of the system
  - to identify & resolve conflicts in objectives
  - to assess the long-term sustainability of particular measures
  - to identify management plans that promote self-maintenance
- Model becomes a virtual reference system and a framework on which to base management decisions and knowledge gained through adaptive management
- Not a reference that functions at the system level but a reference the functions at the process level.
- Chesapeake Bay Model as a guide

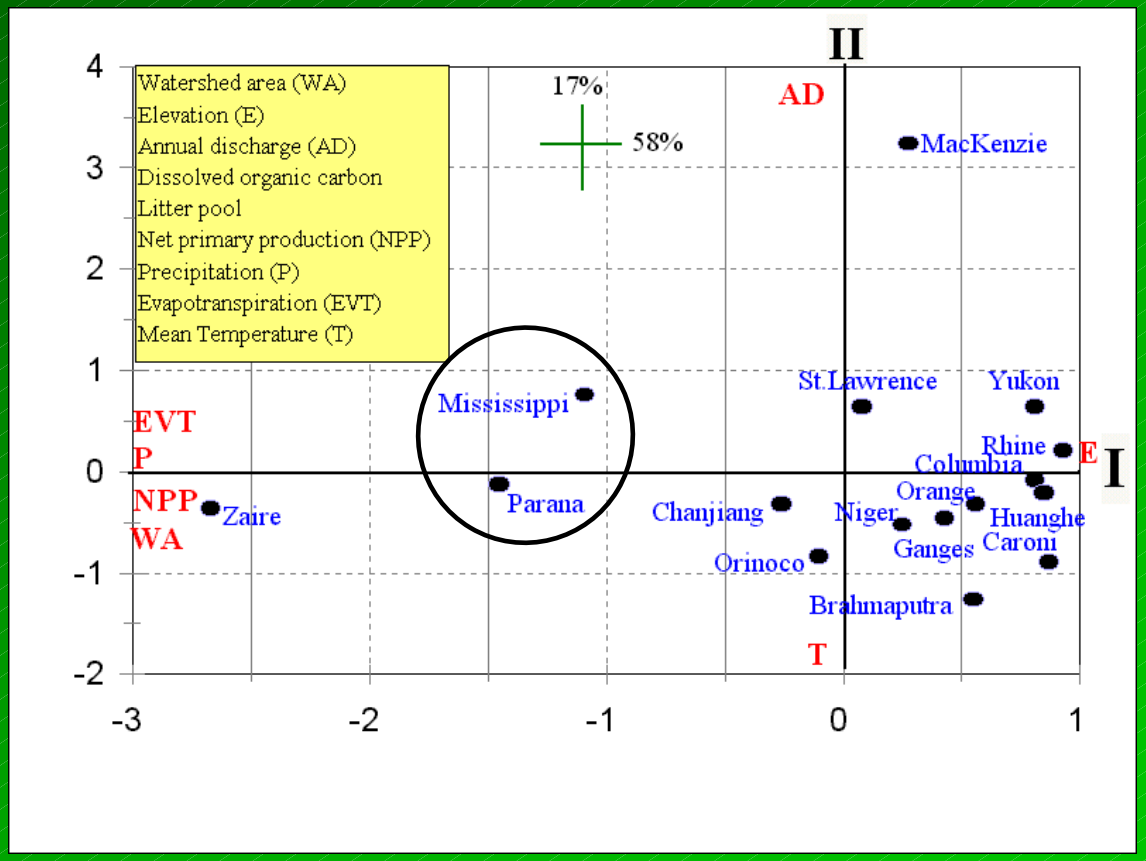
get adaptive management diagram from bartell

Historical Information



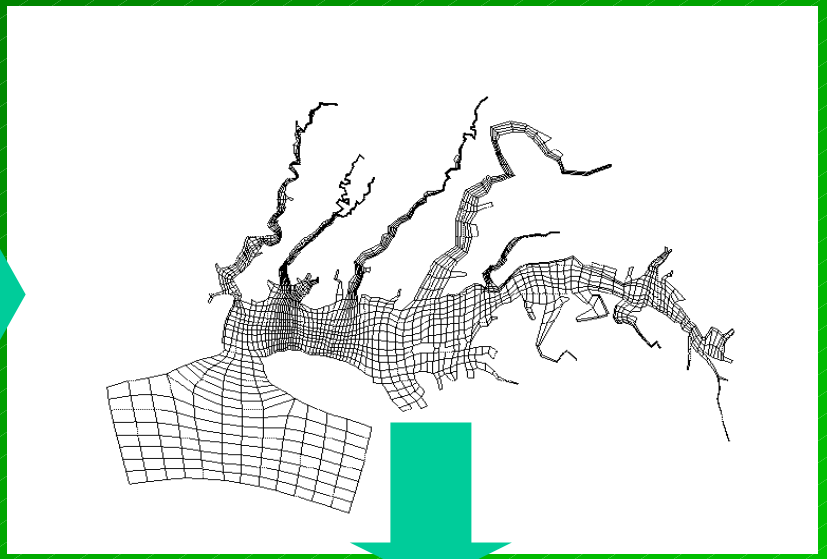
Other Systems

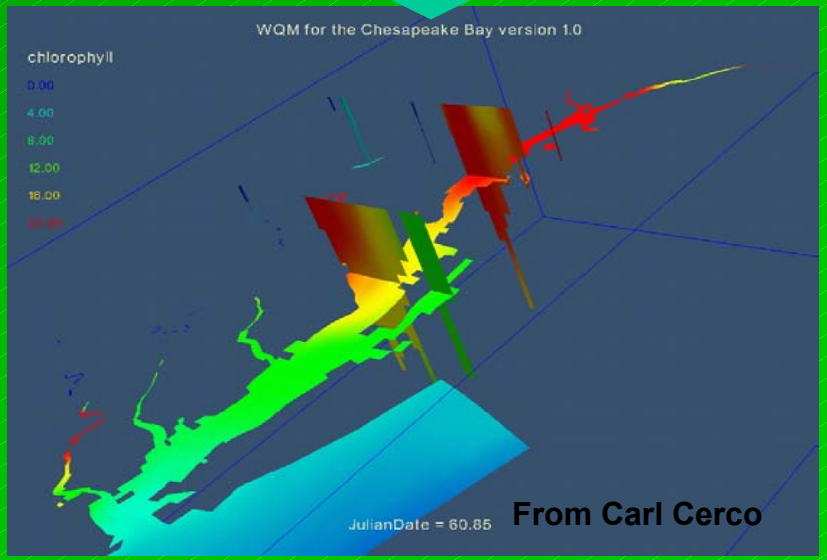
Principal Components Analysis (Baigun and Oldani, unpub.) of the worlds great rivers. Green axes displays the variance accounted by the first two main axis.



Is This Approach Used Anywhere Else?

- Watershed Effects
- GW-SW Transport
- In-River Processes
- Receiving Waters
- Ecological Response
- Ocean Boundary
- Decision-Support
- Information Management

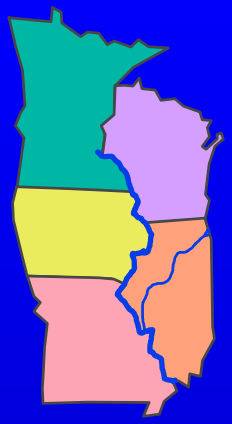




From Carl Cerco

Attachment 14

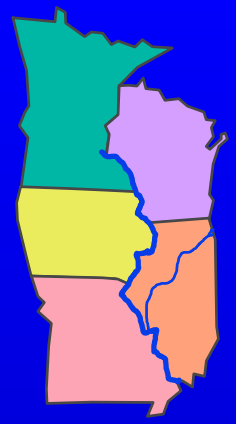
Upper Mississippi River - Illinois Waterway System Navigation Study



October Public Meeting Plan

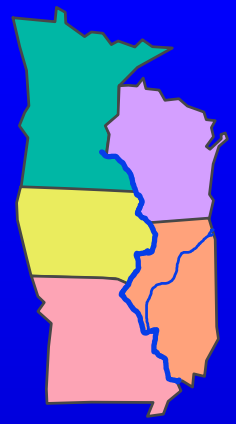
Navigation Study

Goals of the Meetings



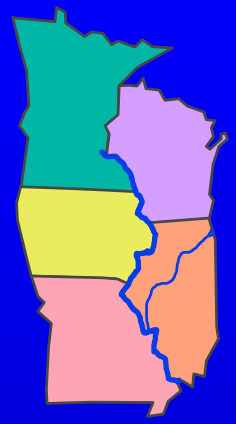
- To obtain an indication of public acceptability regarding the tentative integrated alternative plans
- To determine which alternative(s) best work toward the restructured study goal of ensuring that the Mississippi and Illinois Rivers continue to be nationally treasured ecological resources and effective transportation systems

Four Objectives



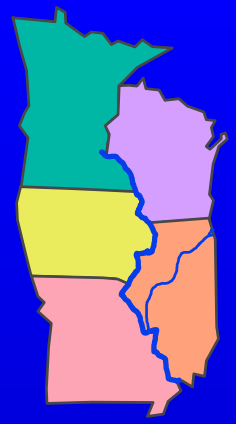
- To educate the public about the decision process used to arrive at the tentative integrated alternative plans
- To involve the public in a Q&A session to clarify questions about the plans
- To solicit feedback from the public via a comment sheet that will indicate which alternative(s) they feel should be considered to meet the goal of the restructured study
- To review the public's feedback and consider it in formulating the final study plan (or recommended plan)

Framing Statement



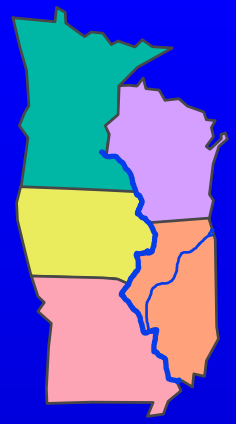
- Which of these alternatives should be considered to ensure that the UMR-IWW System continues to be a nationally treasured ecological resource and an effective transportation system?
- This statement will be printed on top of the matrix-style comment sheet & the public will have the opportunity to select one, some, all, or none of the plans (or select a combination of plan components).

Public Meetings



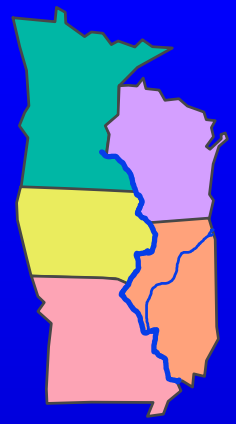
- Mid to Late October 2003
- At 5 locations
  - - St. Louis, MO
  - - Peoria, IL
  - - Bettendorf, IA
  - - La Crosse, WI
  - - St. Paul, MN
- Other locations considered
  - - Quincy, IL
  - - Dubuque, IA
  - - Des Moines, IA
  - - Chicago, IL

Meeting Format



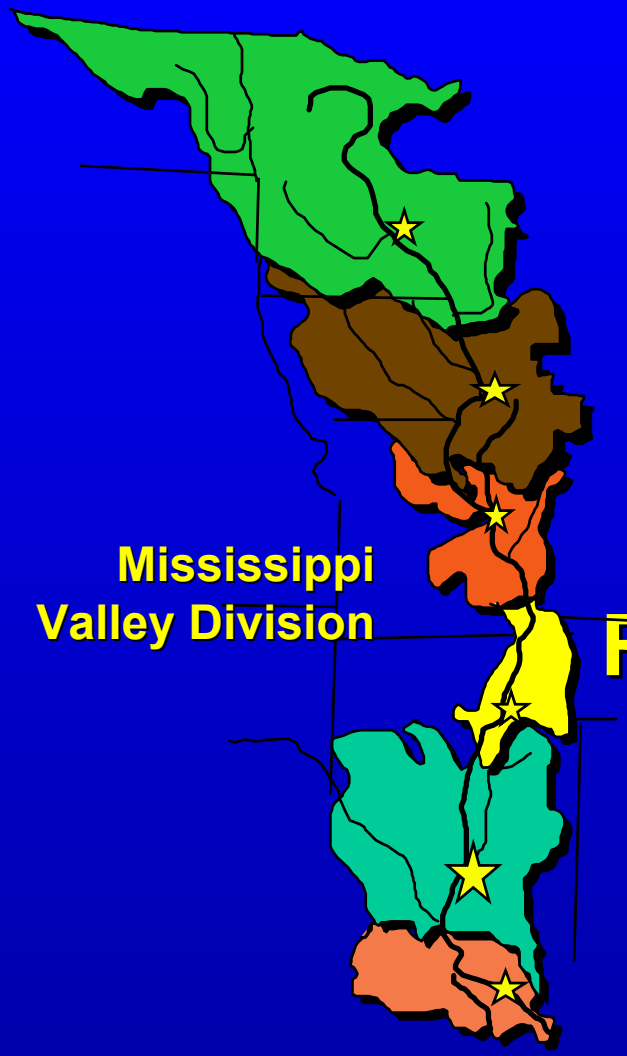
- 30-40 minute presentation- Lundberg
  - Update & present findings to date
- Q&A for presentation materials
  - Serve to clarify questions regarding the presentation
  - No statements at this point
- Comment sheet fill-in period
  - 30 minute time to allow attendees to provide feedback
  - No voting or ranking will be done
- Final segment: Formal Statements & Questions

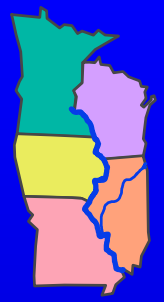
Other Considerations



- Afternoon "Open House" session
  - Allows for more publics to attend
  - All meeting materials & presentation would be available
- Court steno could be utilized to capture all statements/comments made
  - Have used one in past meetings
- Security Officer
  - Is in necessary/responsible to have?

Attachment 15

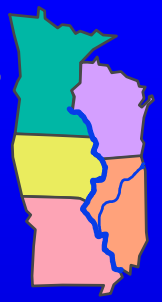




Upper Mississippi River - Illinois Waterway Restructured Navigation Study

NECC/ECC
23 Apr 2003

Preliminary Economic Analysis



Preliminary Economic Analysis

↓

Traffic per Alternative

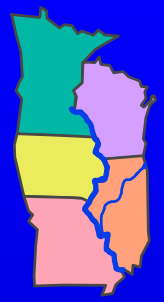
↓

Mitigation Planning

↓

Final Economic Analysis

Navigation Alternatives

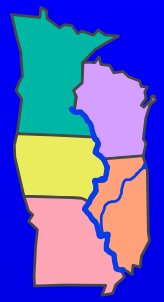


Alt 1-No Action

Alt 2-Congestion Fees

Alt 3-Scheduling/Demand Management

Navigation Alternatives

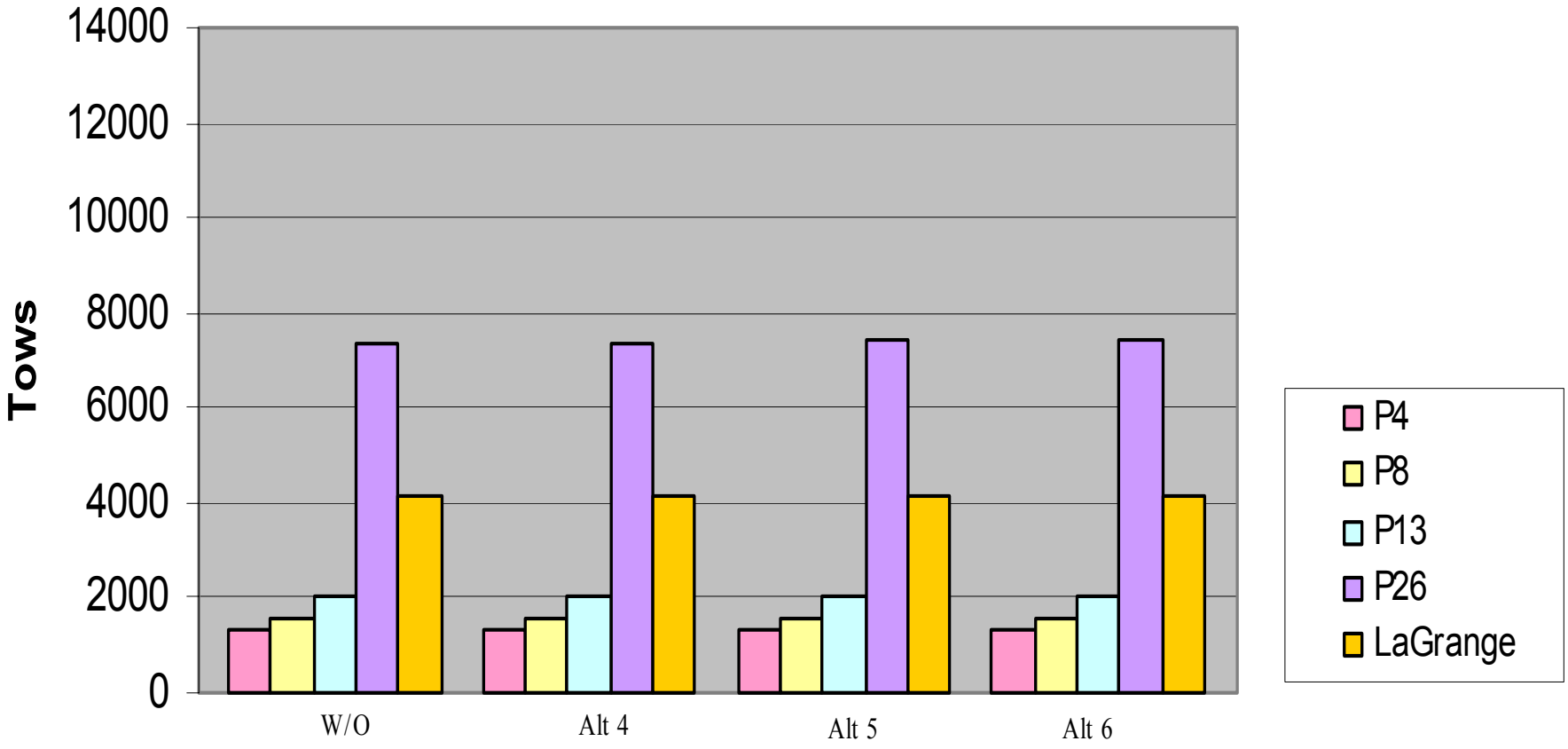


Alt 4 Moorings at 12, 14, 18, 20, 22, 24, & LaGrange; Switchboats @ 20-25

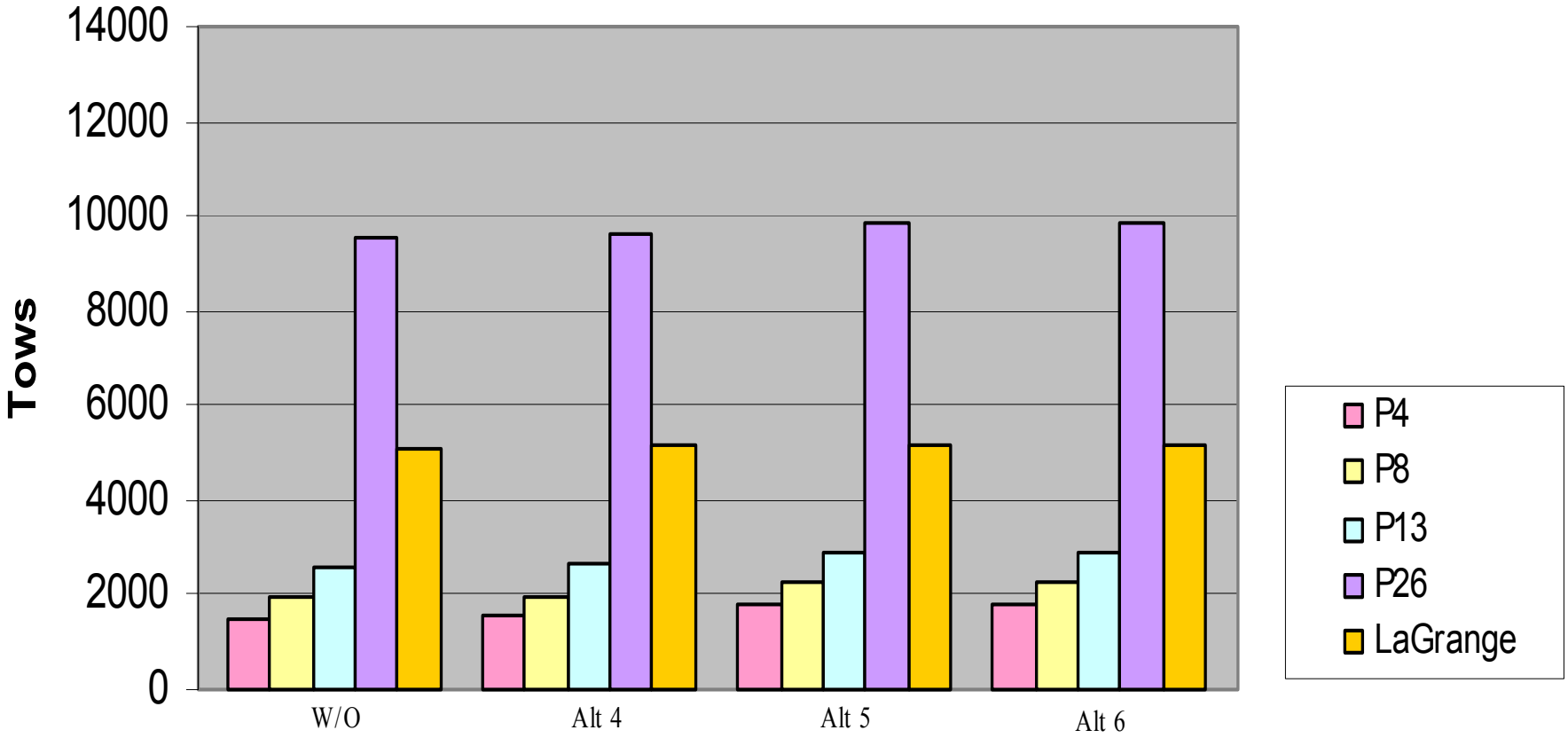
Alt 5-Moorings at 12, 14, 18, 24, & LaGrange; Lock Ext. @ 20-25; Switchboats @ 14-18, Peoria & LaGrange

Alt 6-Moorings at 12, 14, 18, & 24; New 1200' Locks @ 20-25; Lock Ext. @ 14-18; Switchboats @ 11-13, New 1200' Locks @ Peoria & LaGrange

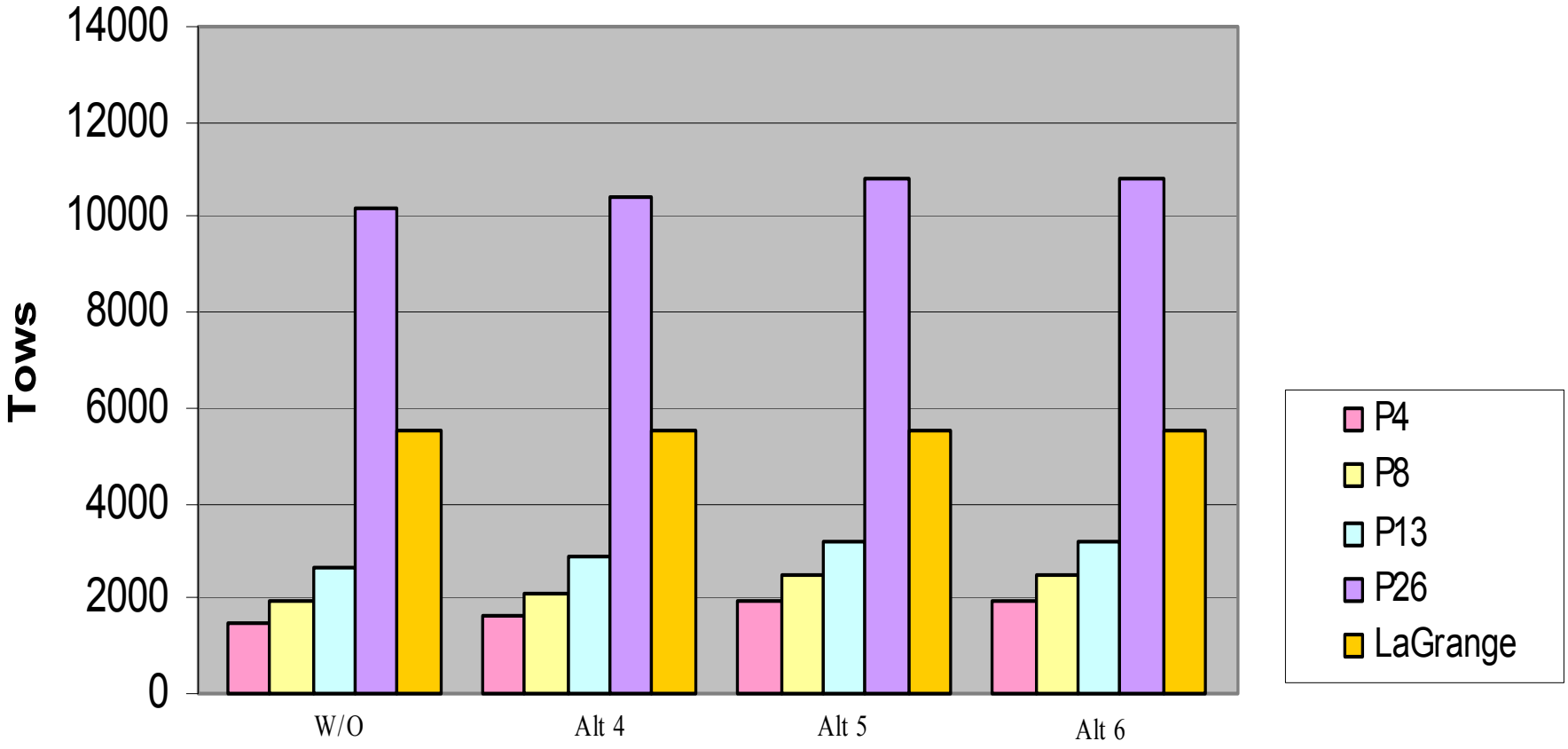
2030
Annual Total Tows
Least Favorable Trade Scenario-TCM



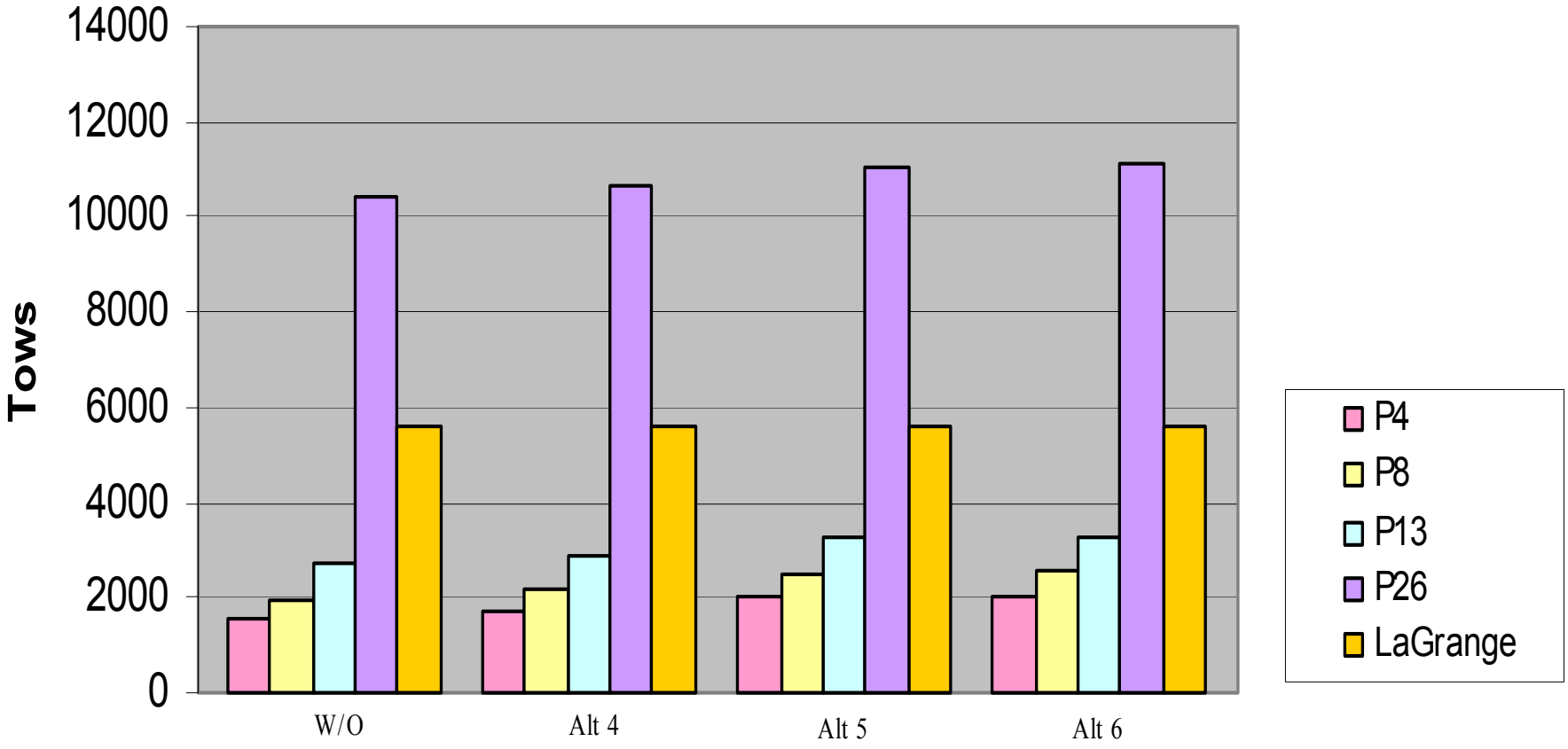
2030
Annual Total Tows
Less Favorable Trade Scenario-TCM



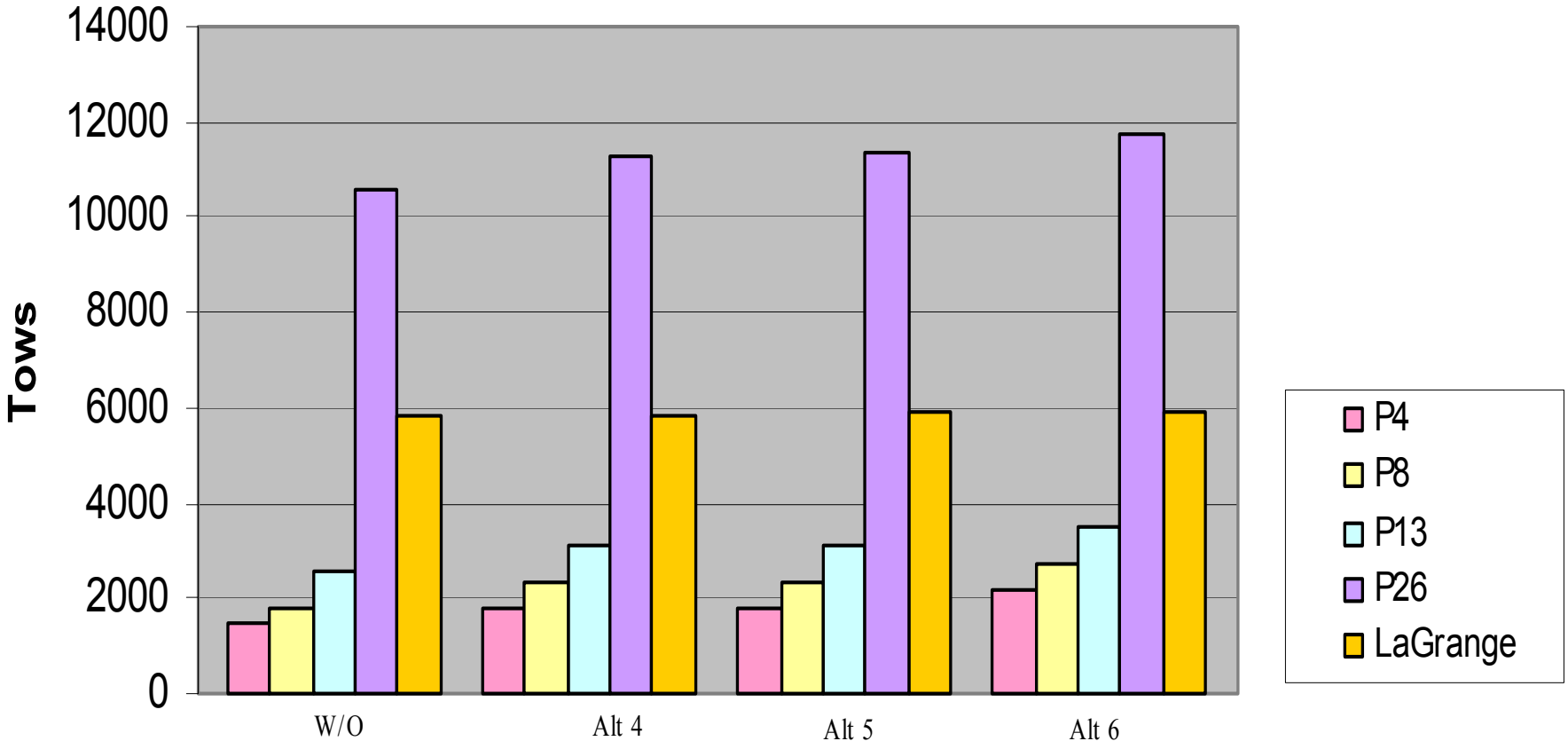
2030
Annual Total Tows
Central Trade Scenario-TCM



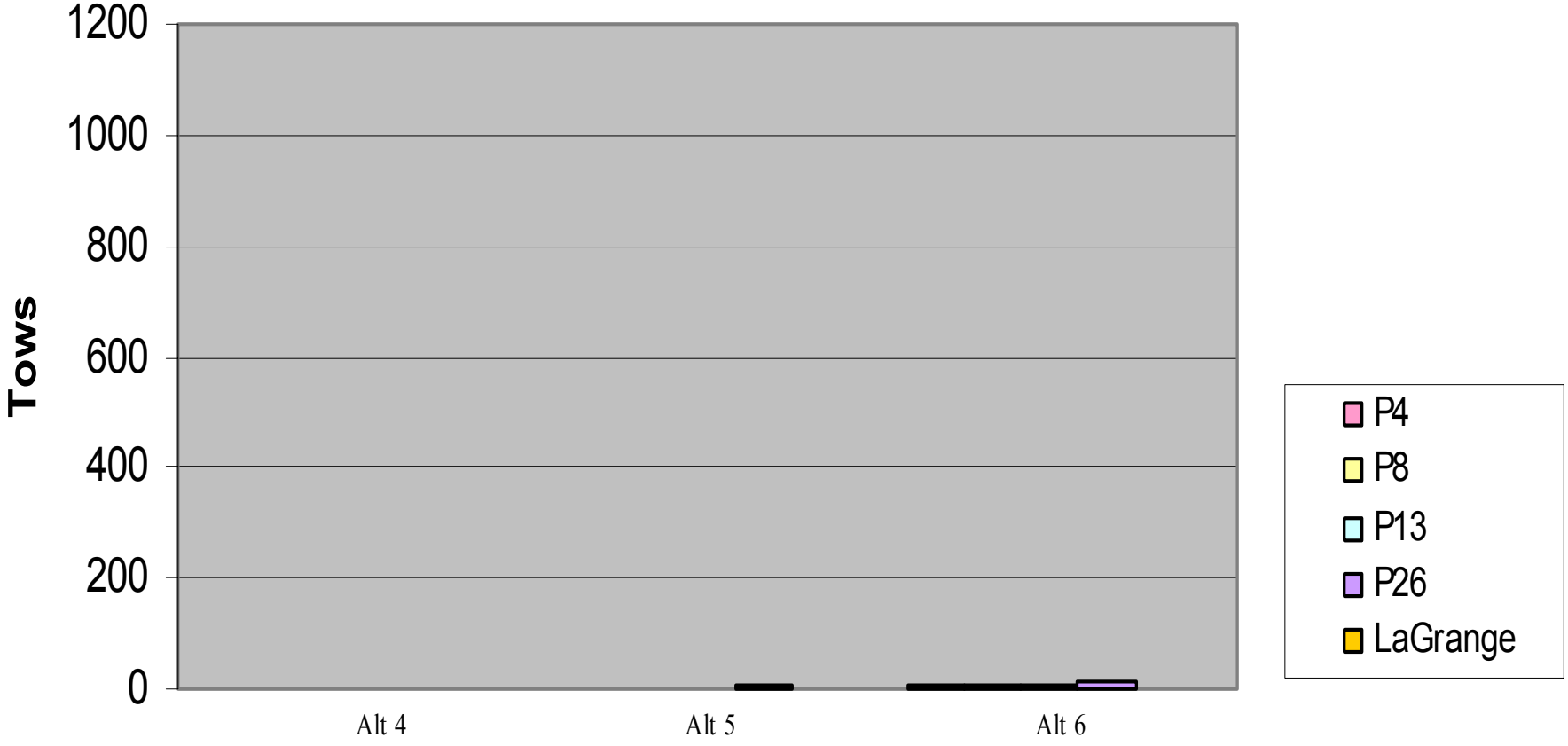
2030
Annual Total Tows
Favorable Trade Scenario-TCM



2030
Annual Total Tows
Most Favorable Trade Scenario-TCM



2030
Annual Incremental Tows
Least Favorable Trade Scenario-TCM



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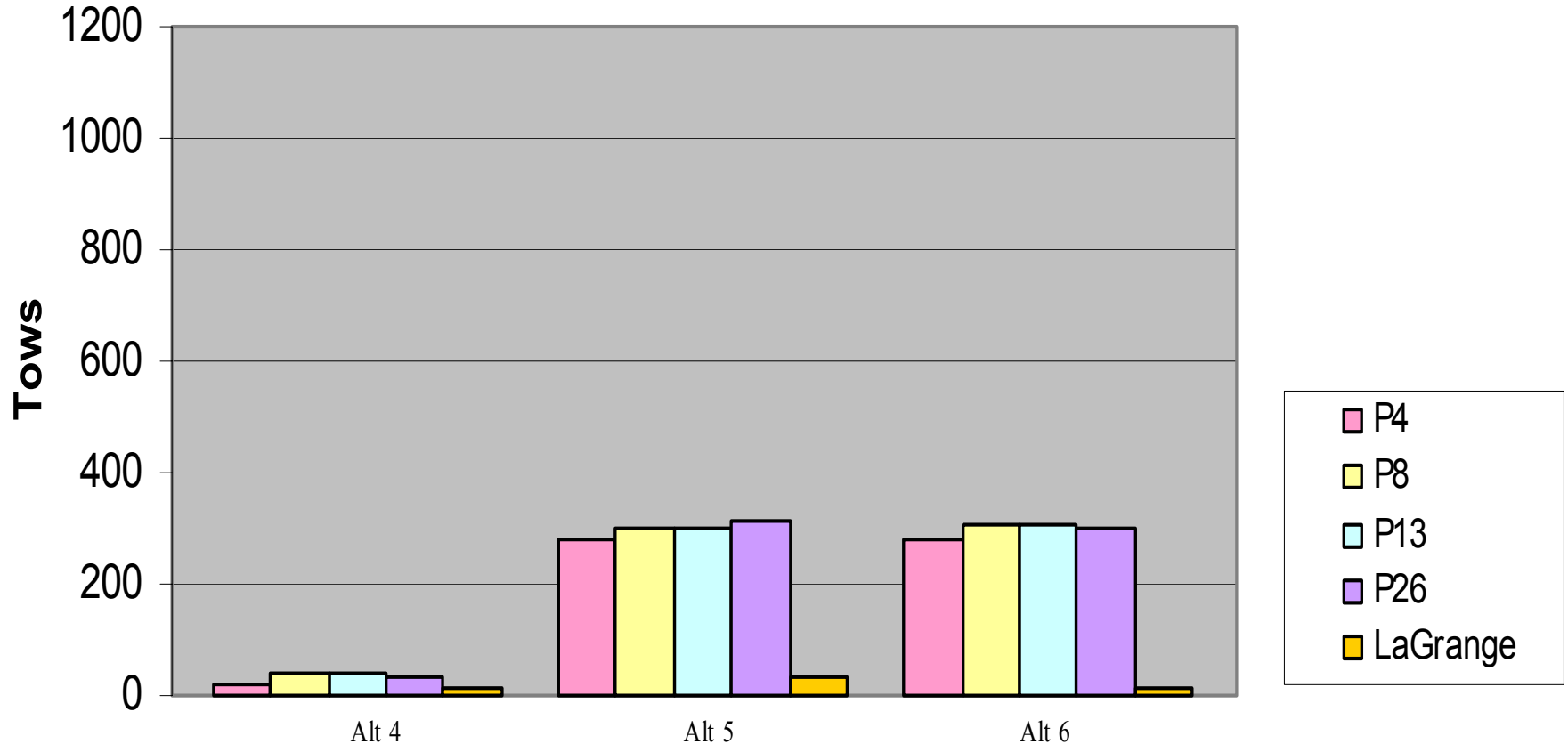
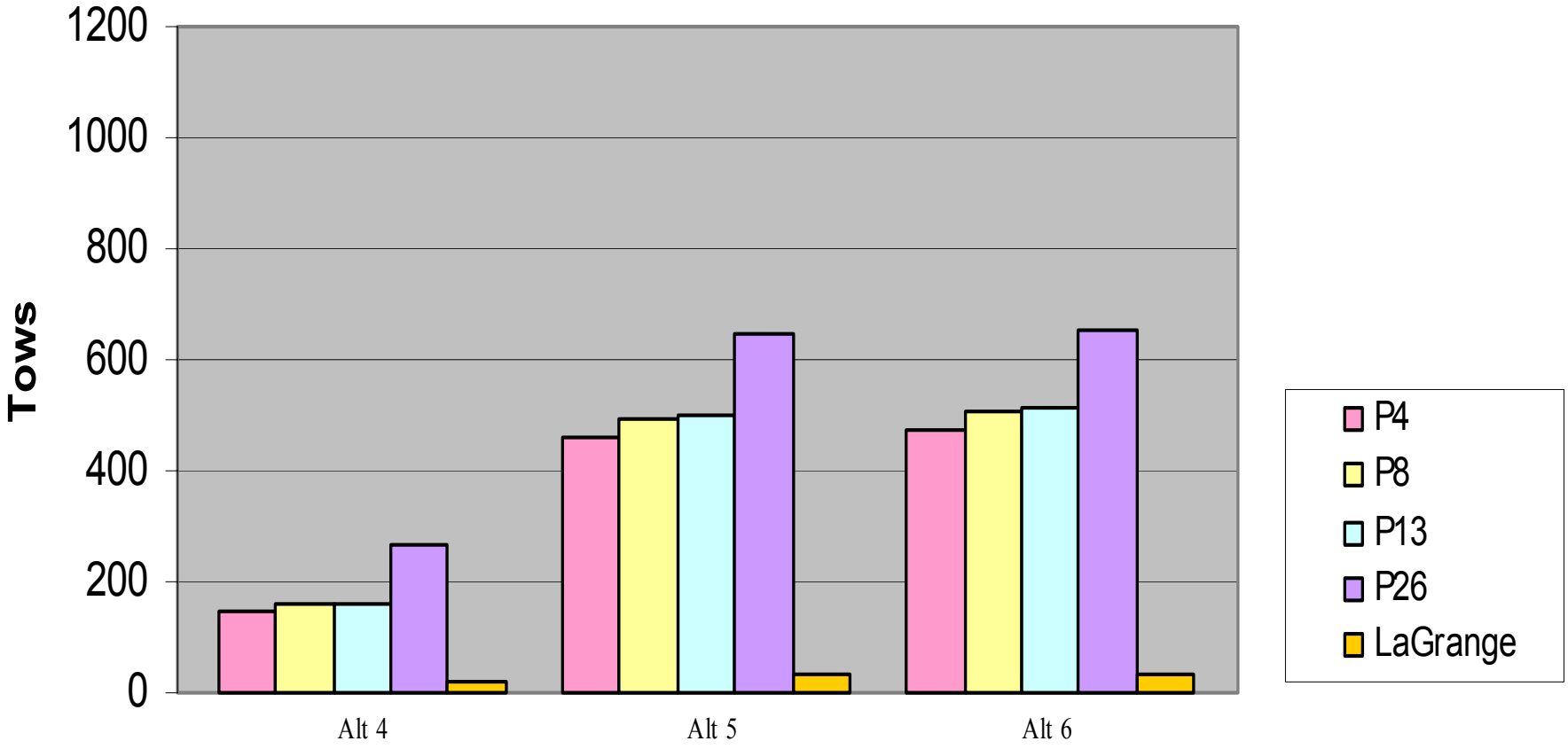
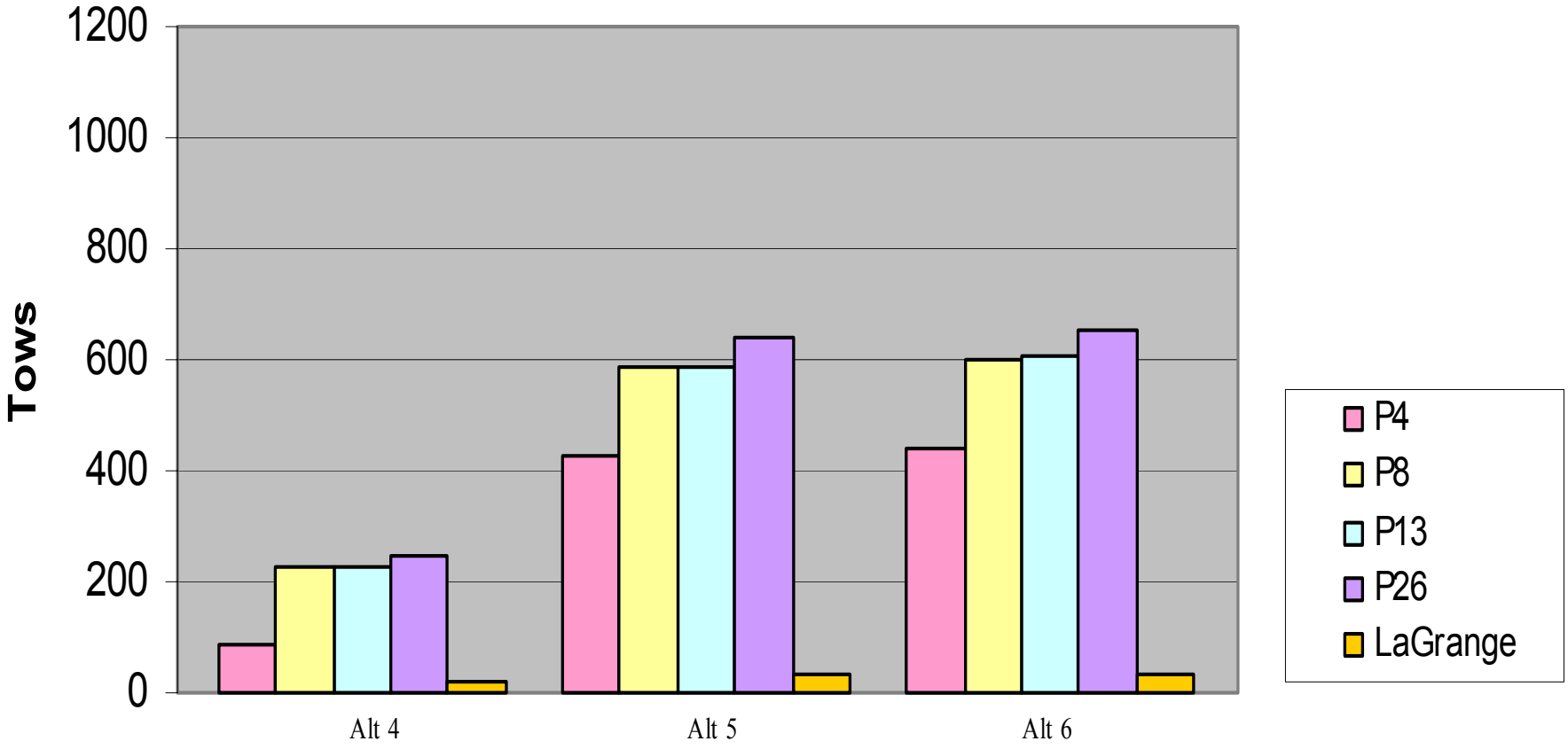
Annual Incremental Tows
Less Favorable Trade Scenario-TCM



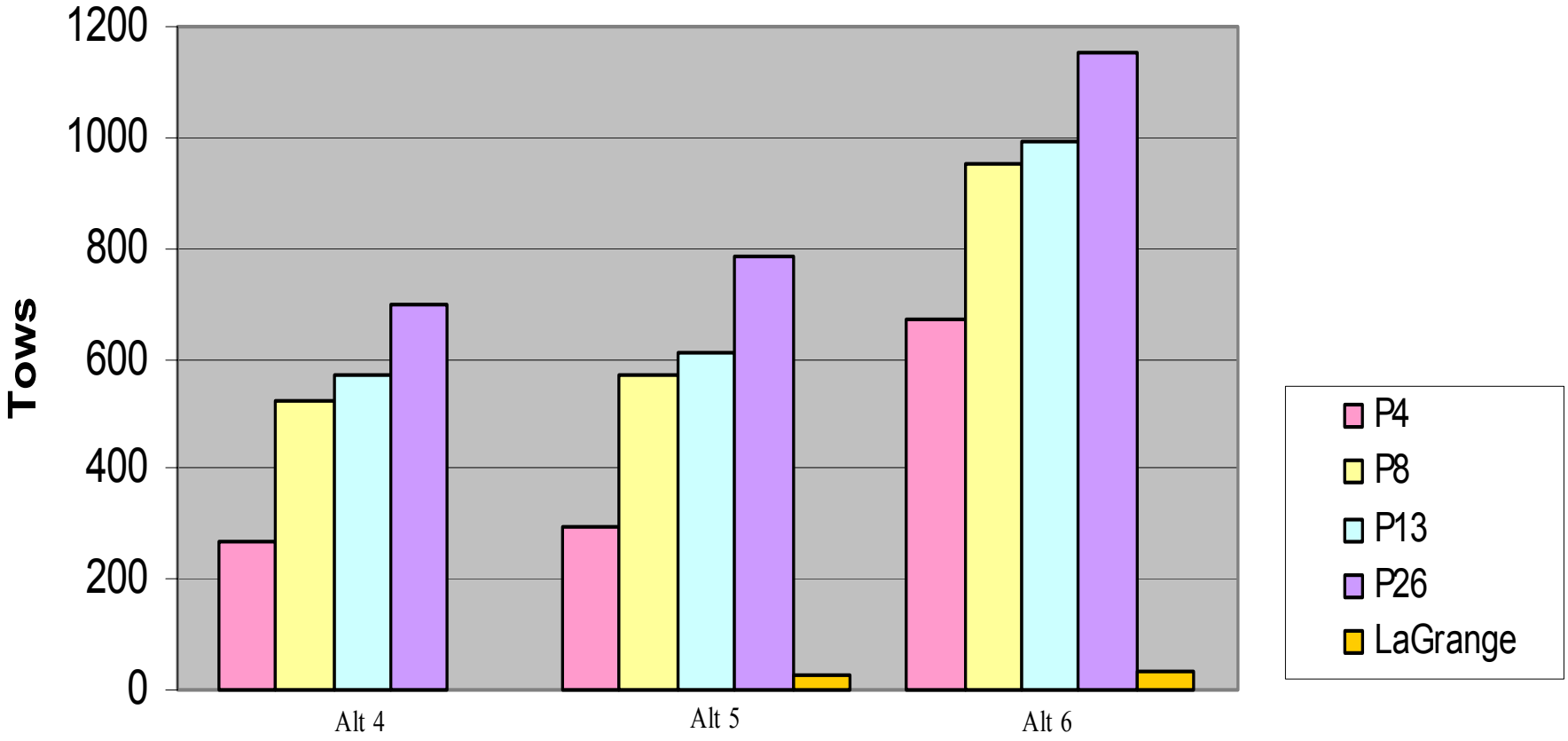
2030
Annual Incremental Tows
Central Trade Scenario-TCM



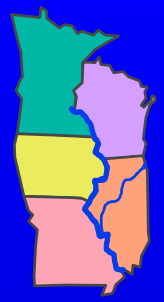
2030
Annual Incremental Tows
Favorable Trade Scenario-TCM



2030
Annual Incremental Tows
Most Favorable Trade Scenario-TCM



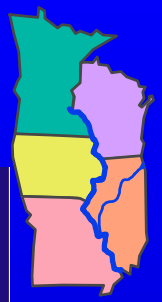
Other Economic Items



- **Volpe-Demand Management/Scheduling**
  - **17-18 April Meeting with Industry and Academics**

- **RED**
  - **Evaluate for both Navigation and Ecosystem Improvements**
  - **Completed in conjunction with Comp Study**
  - **Meeting in Rock Island District on May 15, 2003 to get input from interested parties**

Pathways Group



US Army Corps of Engineers®

82 key UMR-IWW objectives

System Sustainability Goals and Objectives

USFWS - CCP

WRDA '99 Comp. Plan

UMRS - EMP

Navigation Study

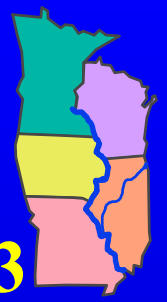
9-Foot Channel O&M

Illinois Ecosystem

Site Specific Planning / Implementation

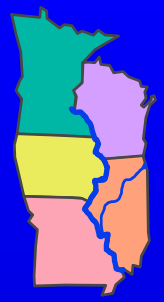
"How do we get this done together?"

Feasibility Study Schedule



- Federal Task Force — Apr 03
- GLC — May 03
  - Preliminary Economic Analysis
  - Cost Sharing → 3 Basket Theory
- NRC Initial Briefing — Jun/Jul 03
  - Stakeholder Involvement
- Federal Task Force — Jul 03
- GLC — Aug 03
- Tentative Plans Identified — Sep 03
- Federal Task Force — Oct 03
- Public Meetings — Oct 03

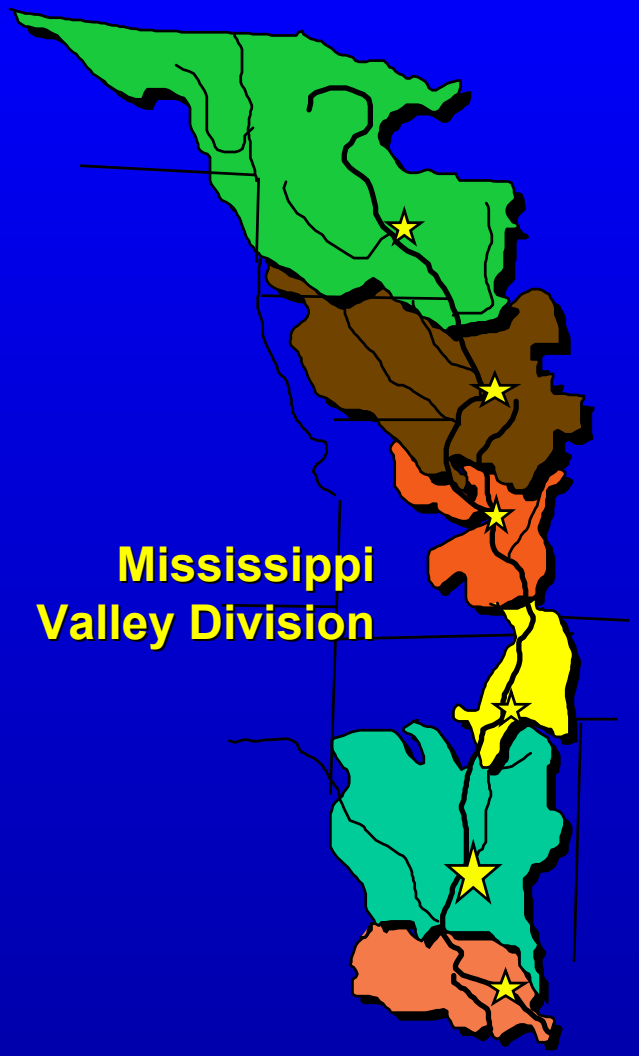
Feasibility Study Schedule

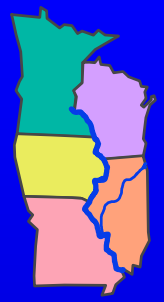


•Alternative Formulation Briefing	Nov 03
•Draft Feasibility Report	Apr 04
•90 day Public Review	Apr-Jun 04
•Public Meetings	May 04
•Final Feasibility Report w/EIS	Aug 04
•Chiefs Report	Nov 04

Attachment 16

Attachment 17



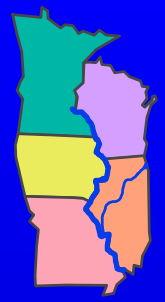


Upper Mississippi River - Illinois Waterway Navigation Feasibility Study

Plan Formulation Process

NECC/ECC
22 April 2003

Formulation Process



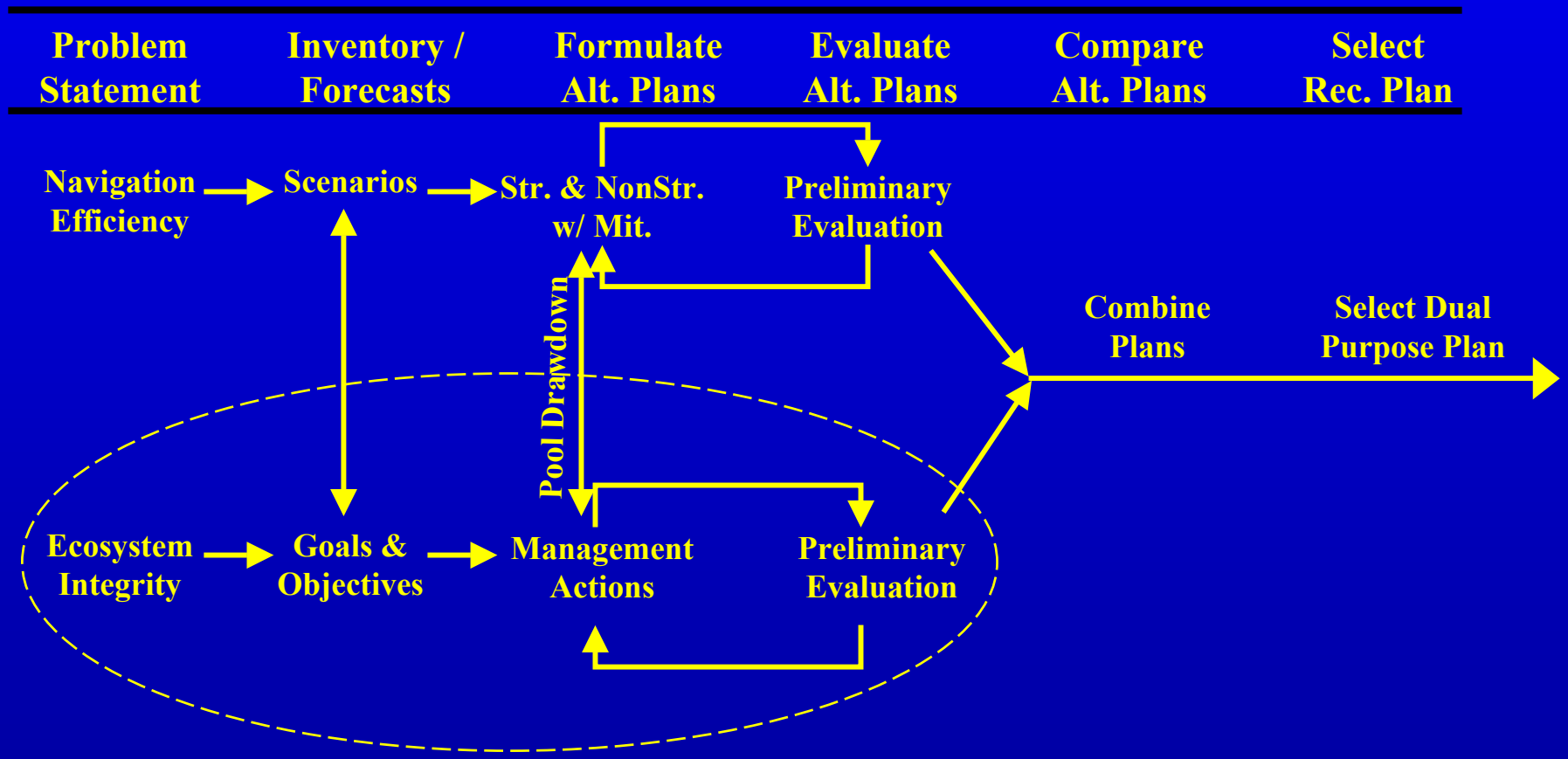
Navigation Efficiency

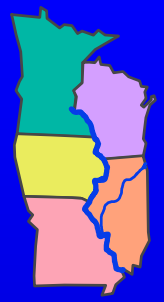
Ecosystem Restoration

Integrated

Dual Purpose Plan

Formulation Process





Ecosystem Integrity

Previous Studies and Workshops

Goals and Objectives

Review (Expert Panel)
Relational Database

Management Actions

Screening (reduce number of potential measures)
Assessment (evaluation criteria)

Environmental Alternatives

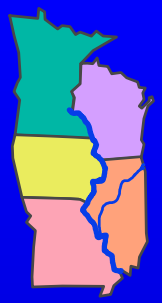
Assessment (evaluation criteria)

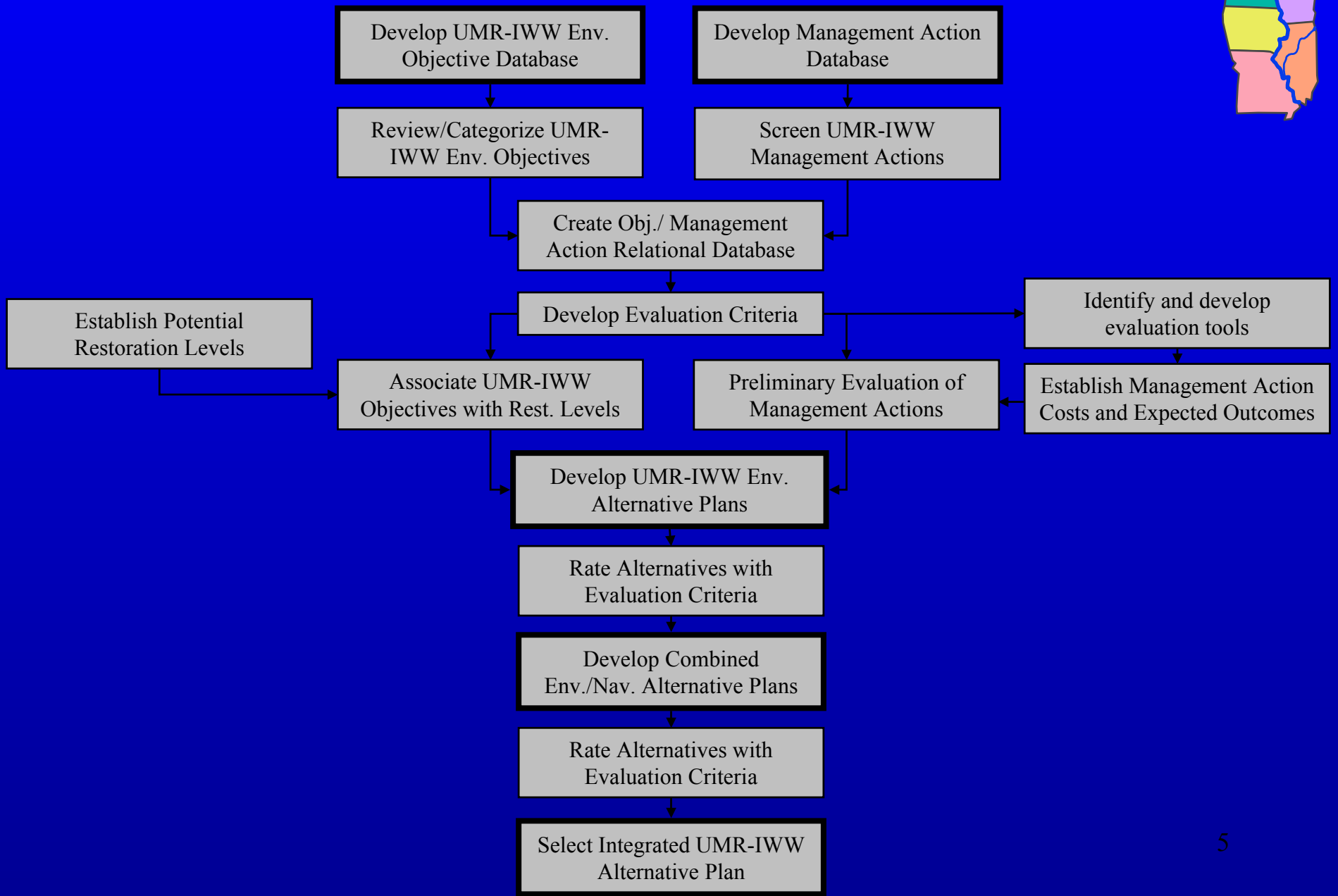
Combined Alternatives

Assessment (evaluation criteria)

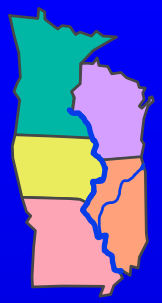
Selected Integrated Plan

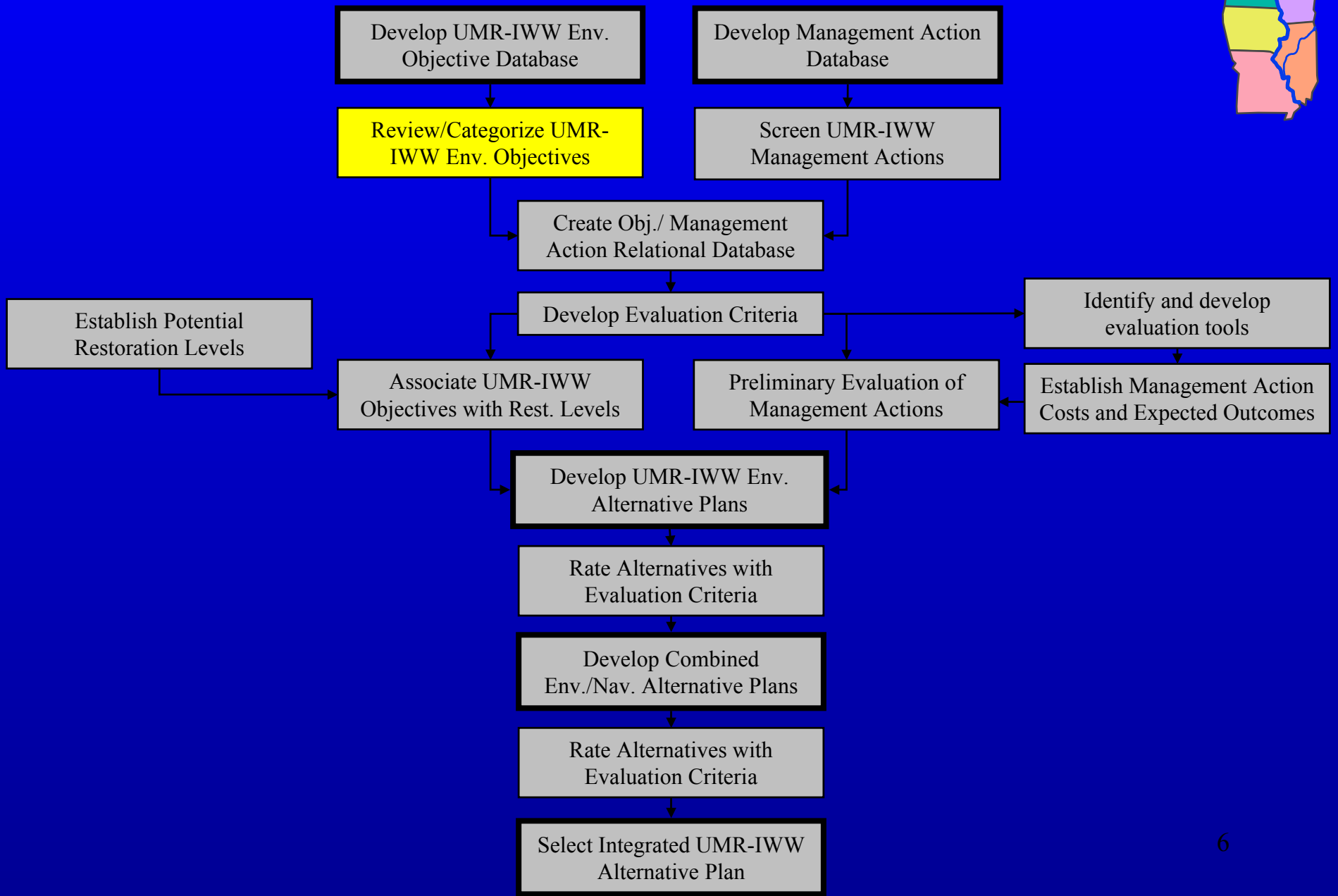
UMR-IWW Ecosystem Sustainability Alternative Formulation/Evaluation Process



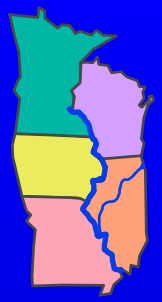


UMR-IWW Ecosystem Sustainability Alternative Formulation/Evaluation Process



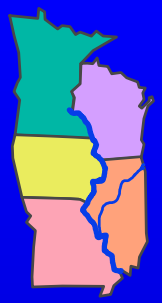


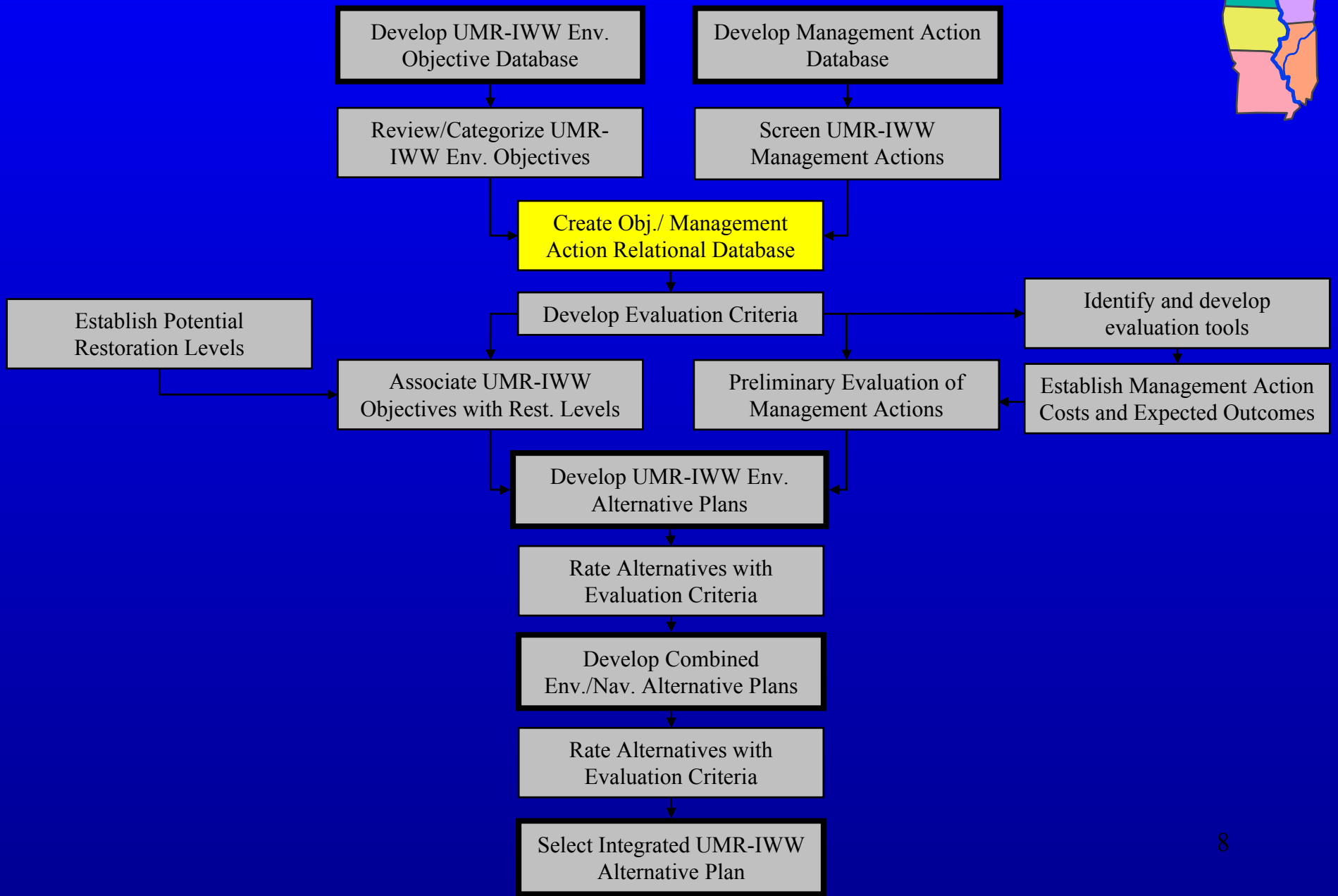
Essential Ecosystem Characteristics



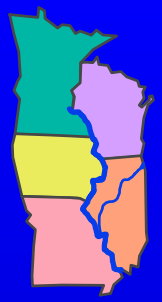
- **Geomorphology**
  - Restore secondary channels
- **Hydrology**
  - Provide low water periods
- **Water Quality**
  - Maintain DO > 5 ppm in selected habitats
- **Habitat**
  - Increase submersed aquatic abundance
- **Biota**
  - Maintain viable population of native mussels

UMR-IWW Ecosystem Sustainability Alternative Formulation/Evaluation Process



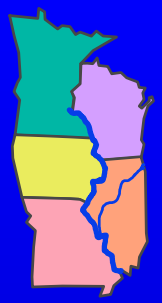


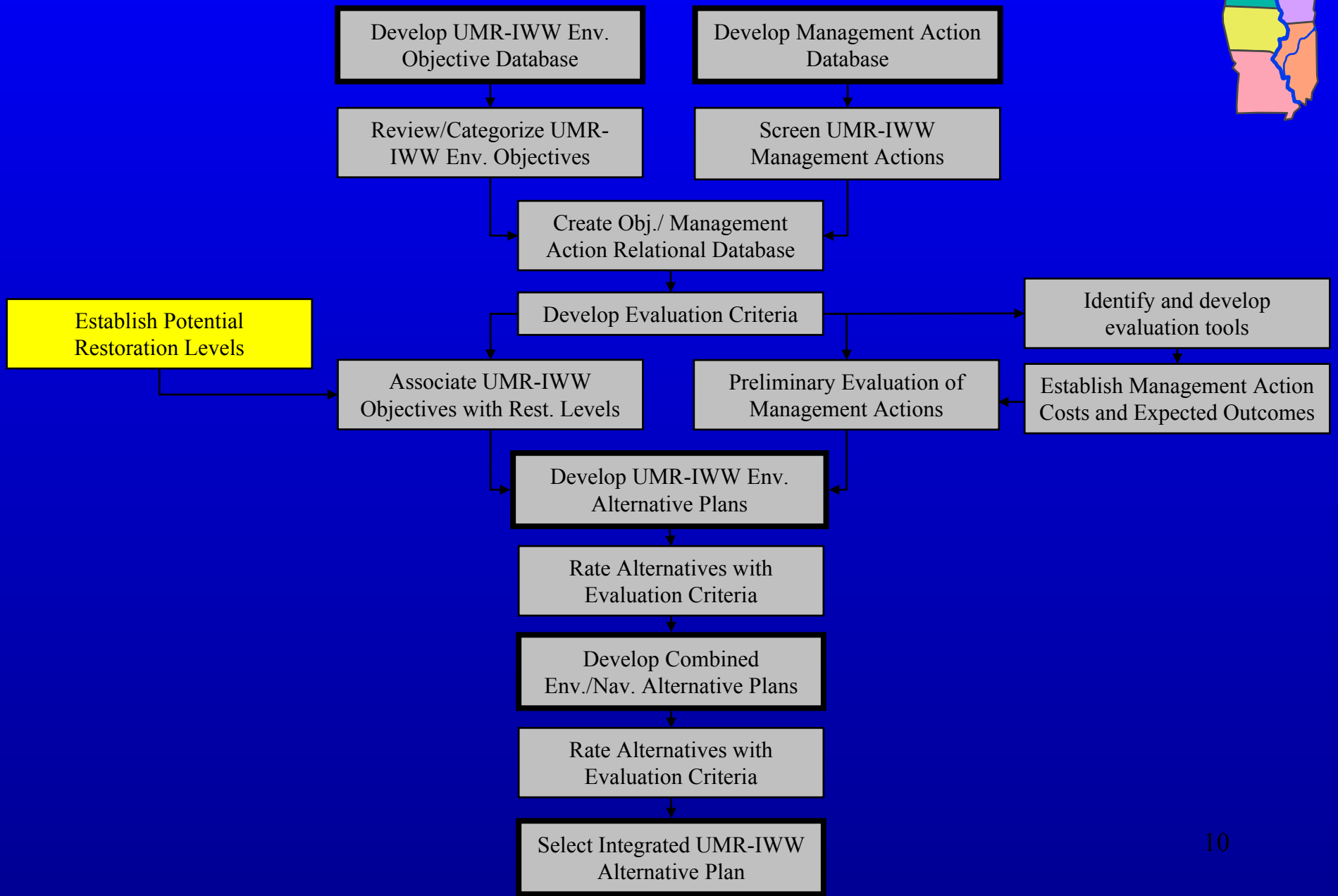
Ecosystem Objective/Management Action Relational Database

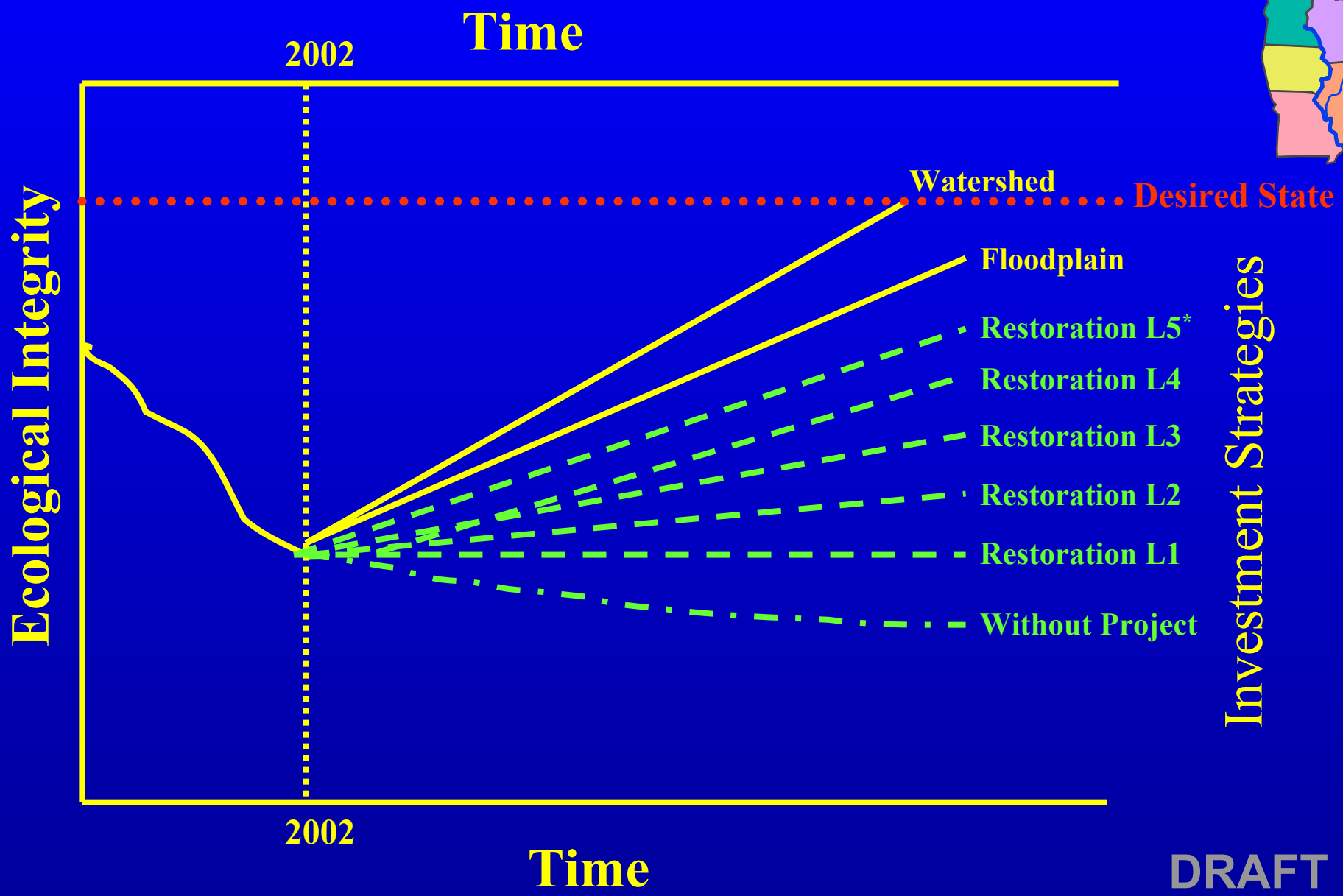


Management Actions	Ecological Objectives/Needs	Geomorphology	Restore secondary channels	Consolidate flocculent backwater sediment	Hydrology/River Hydraulics	Provide for low water period during the growing season to restore aquatic vegetation	Restore desirable hydraulic connections between the river and backwater or floodplain areas	Habitat	Increase extent, abundance and diversity of submersed aquatic plants	Restore and maintain large contiguous wetland patches (>1,000 acres) every 30 - 40 miles
Mainstem dam gate operation						3			3	3
Construct Islands			3				3			
Construct temporary structures to divert flow			3	3			3			
Small scale drawdown for vegetation				3		3			3	3
Construct wave breaks									3	2

UMR-IWW Ecosystem Sustainability Alternative Formulation/Evaluation Process







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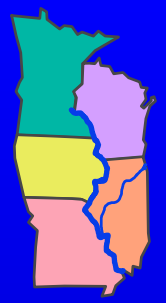
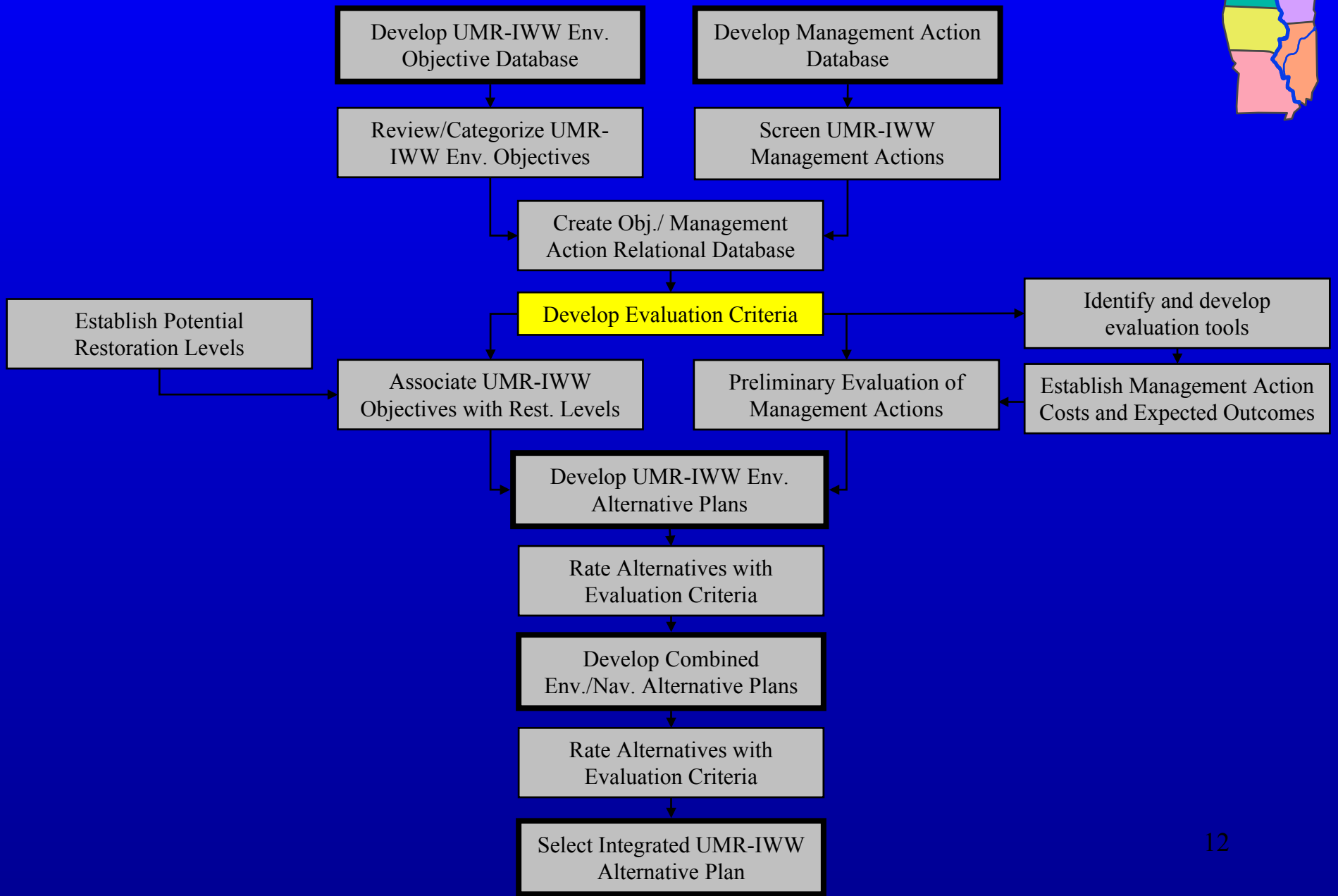
* Restoration Levels 1-5 occur entirely within the UMR-IWW Navigation System

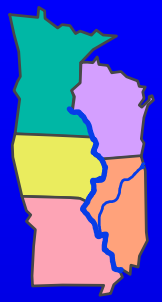
*** Not to Scale – Illustrative Purposes only*

UMR-IWW Ecosystem Sustainability Alternative Formulation/Evaluation Process



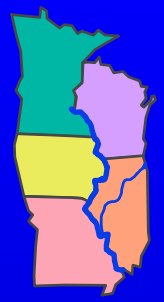


Ecosystem Alternative Evaluation Criteria



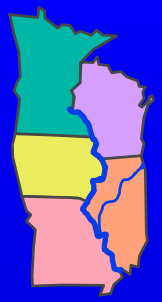
- **Completeness/Robustness**
  - Provide for all essential ecosystem needs
- **Effectiveness**
  - Contribute to achieving the objectives
- **Efficiency**
  - Cost effective means of achieving objectives
- **Acceptability**
  - Acceptable in terms of applicable laws, regulation, and public policy

Ecosystem Alternative Evaluation Criteria



- **Risk**
  - Consequence of selecting the wrong plan
- **Uncertainty**
  - Likelihood of success
- **Adaptability**
  - Ability to modify the alternative
- **Compatibility**
  - Navigation, ecosystem, and archeological impacts

Ecosystem Alternative Evaluation Criteria



Planning Guidance Criteria	Specific Criteria	Tools	Rating/Score				
			1	2	3	4	5
Completeness	Environmental Diversity: Robustness of alternative plan in addressing multiple types of objectives.	Conc. Model/ Obj. database	< 20%	20-40%	40-60%	60-80%	> 80%
Effectiveness	Environmental Benefit: Habitat units	Conceptual/predictive models	Low		Moderate		High
	Environmental Quality: Ability of alternative plan to address high priority objectives.	Obj. database, HNA, UMRCC	Low		Moderate		High
	Spatial scale of expected benefits	Conceptual/predictive models	< 1 mi^2	1-10 mi^2	10-100 mi^2	100-1000mi	>1000 mi^2
	Time required to obtain ecosystem benefits	Conceptual/predictive models	> 5 yrs	2-5 yrs	1-2 yrs	6 mo-1 yr	1-6 mo
	Durability: What is the average life expectancy of the alternative's management actions?	Conceptual/predictive models	< 1 yr	1-5 yrs	5-10 yrs	10-20 yrs	> 20 yrs
Acceptability	Stakeholder Acceptability	Workshops, NECC, UMRCC, HNA	Low		Moderate		High
	Social Acceptability	Public survey, HNA	Low		Moderate		High
Uncertainty	Likelihood of success	Conceptual/predictive models	Low		Moderate		High
Risk	Consequence of selecting the wrong plan	Conceptual/predictive models	Low		Moderate		High
Flexibility/Adaptability	Ability to modify alternative plan	USACE	Low		Moderate		High
Compatibility	Navigation Impacts	Conceptual/predictive models	Negative		None		Positive
	Ecosystem Impacts	Conceptual/predictive models	Negative		None		Positive
Efficiency	Cost Effectiveness: Compare cost to benefit scores summed from above. (Benefit Score/Cost) note: Cost includes construction/modification, O&M, and monitoring.	USACE					

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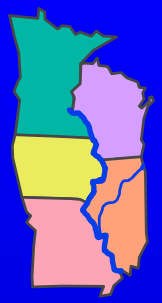
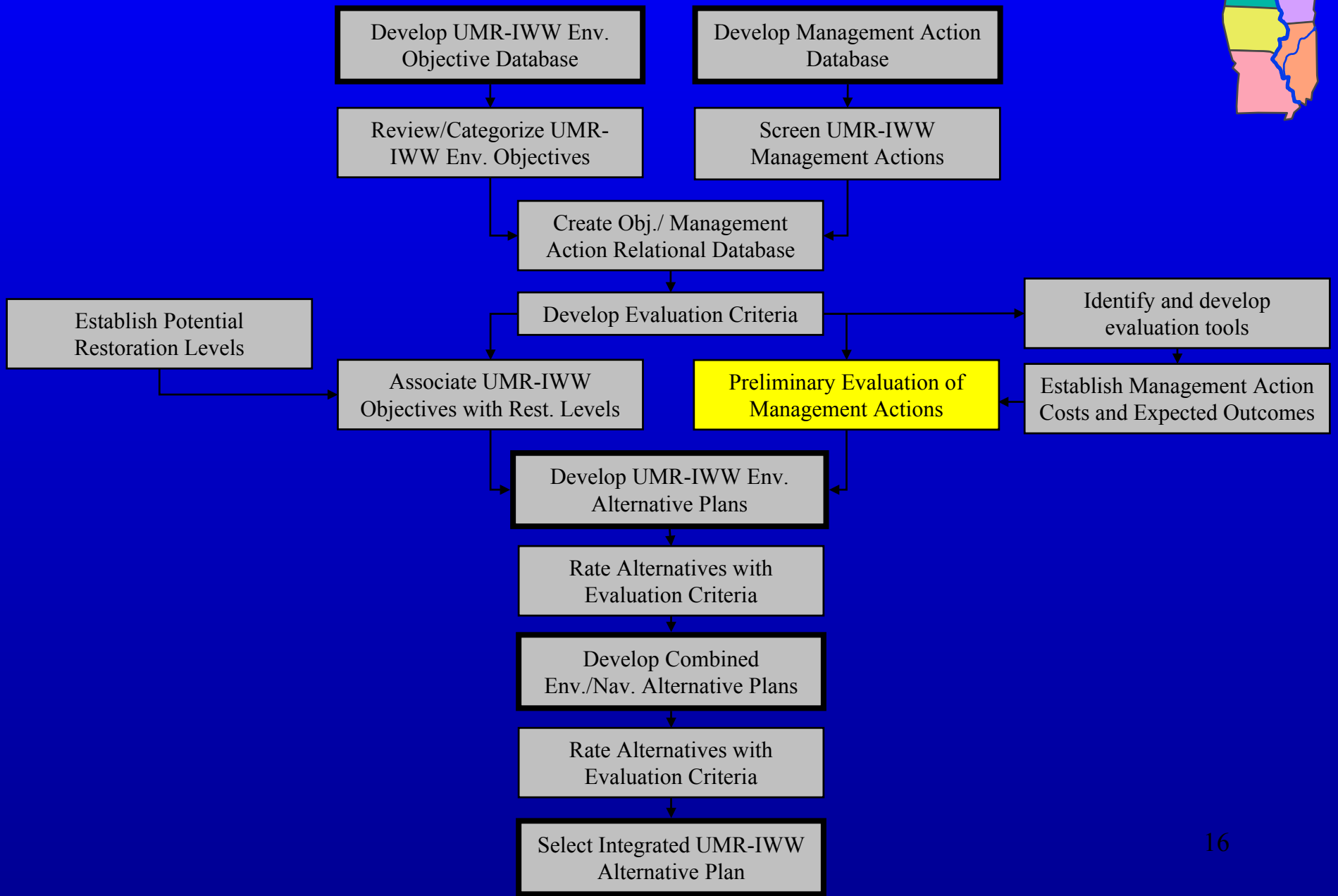
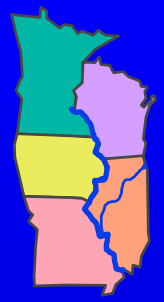
UMR-IWW Ecosystem Sustainability Alternative Formulation/Evaluation Process



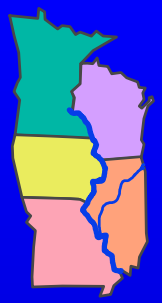


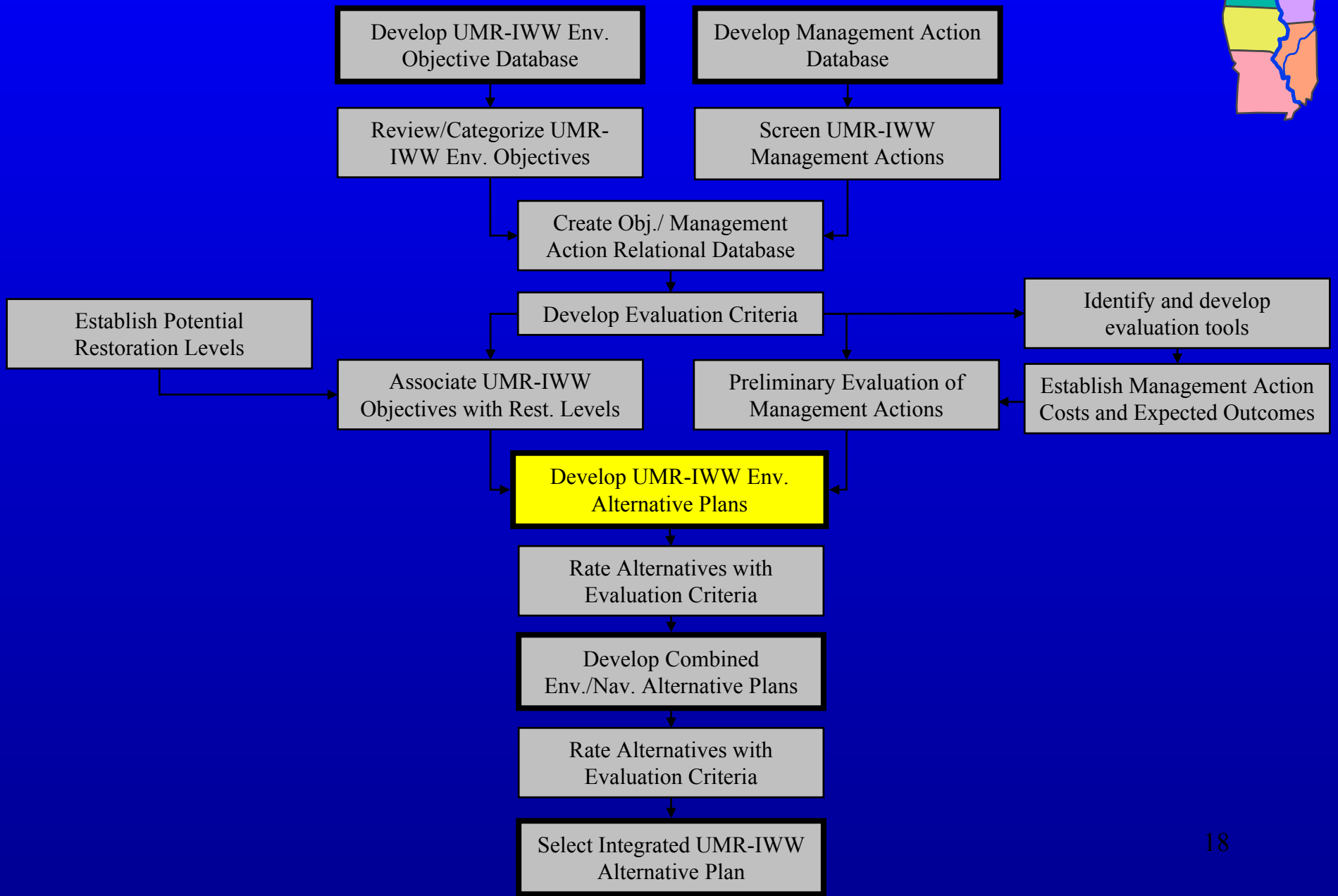
Ecosystem Objective/Management Action Preliminary Evaluation



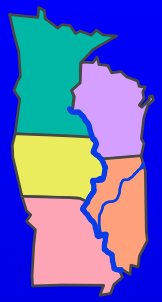
Environmental Objective	Management Action	Cost/Unit Effort	Environmental Benefit			
			Pools 1-11	Pools 12-22	P 24-Open Riv.	Illinois River
A	4					
	11					
	1					
	18					
B	8					
	15					
	4					
	2					
	13					
C	16					
	1					

UMR-IWW Ecosystem Sustainability Alternative Formulation/Evaluation Process



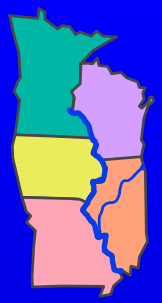


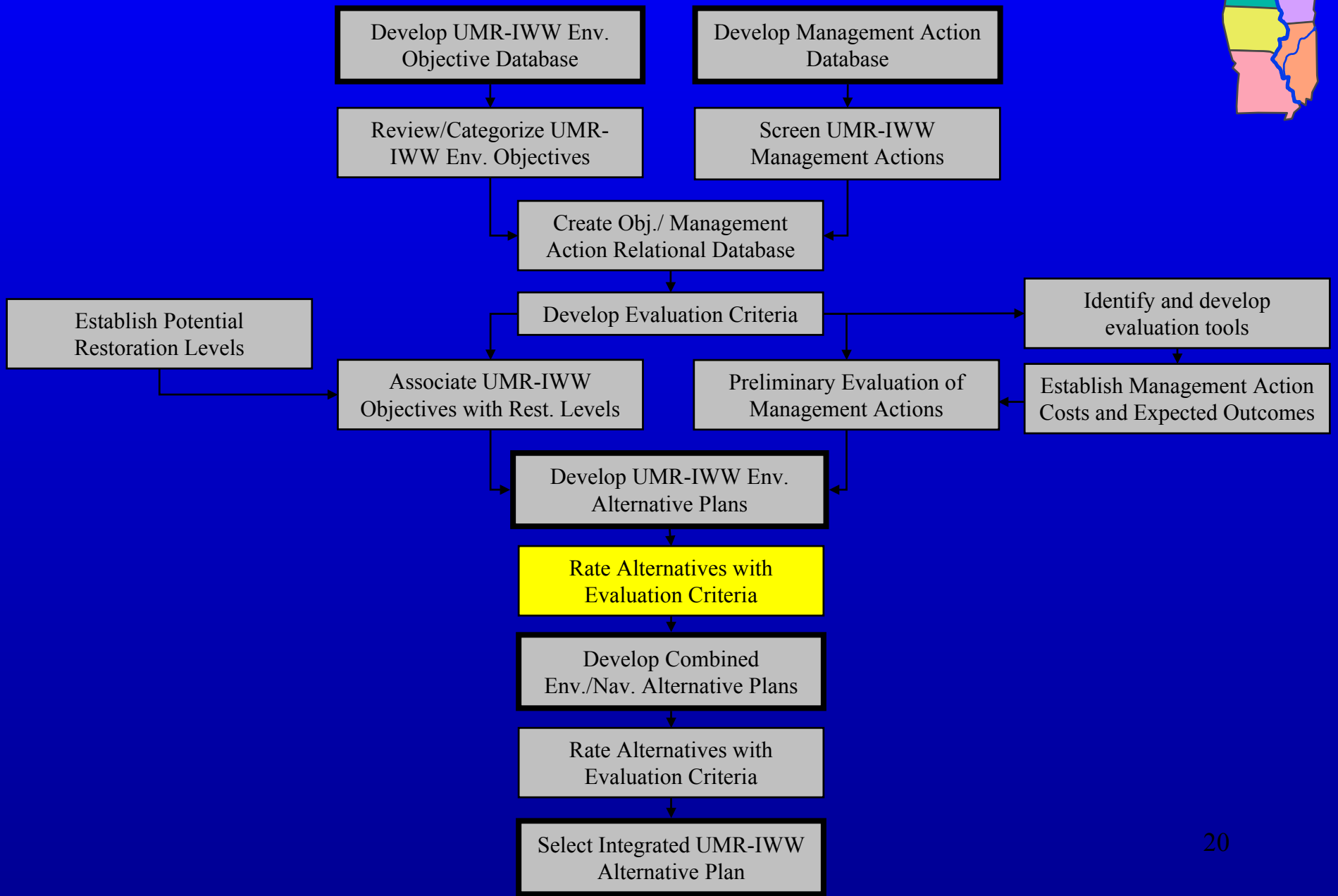
UMR-IWW Ecosystem Alternative Formulation



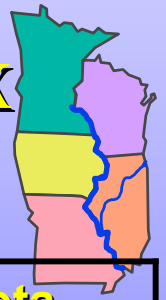
Essential Ecosystem Characteristic	Restoration Level 1	Restoration Level 2	Restoration Level 3	Restoration Level 4	Restoration Level 5
Hydrology **Geomorphology** **Water Quality** **Habitat** **Biota**	Alternative 1 (Management Actions)	Alternative 2 (Management Actions)	Alternative 3 (Management Actions)	Alternative 4 (Management Actions)	Alternative 5 (Management Actions)

UMR-IWW Ecosystem Sustainability Alternative Formulation/Evaluation Process



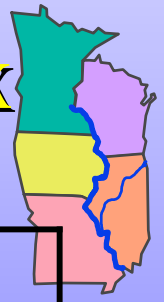


Ecosystem Alternative Assessment Matrix



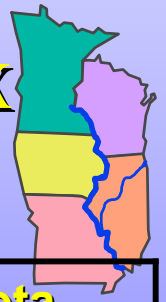
Alternative	Geomor-phology	Hydrology	Water Quality	Habitat	Biota
1					
2					
3					
4					
5					

Ecosystem Alternative Assessment Matrix



Alternative	Geomorphology
1	Ecosystem Conc. Model Relational Database H&H Models Sediment Models Habitat Models Population Models

Ecosystem Alternative Assessment Matrix

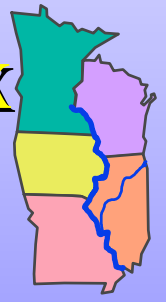


Alternative	Geomor-phology	Hydrology	Water Quality	Habitat	Biota
1					
2					
3					
4					
5					

Evaluate Distributional Characteristics

Risk Robustness Adaptability Acceptability

Ecosystem Alternative Assessment Matrix



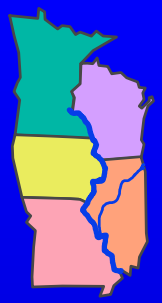
Alt.	Geomor-phology	Hydrology	Water Quality	Habitat	Biota	Total
1	Rating Score Cost	22 7 Million	12 4 Million	30 12 Million	15 7 Million	79 30 Million
2	7 3 Million	34 25 Million	18 5 Million	38 20 Million	15 7 Million	112 60 Million
3						135 120 Million
4						148 240 Million
5						153 350 Million

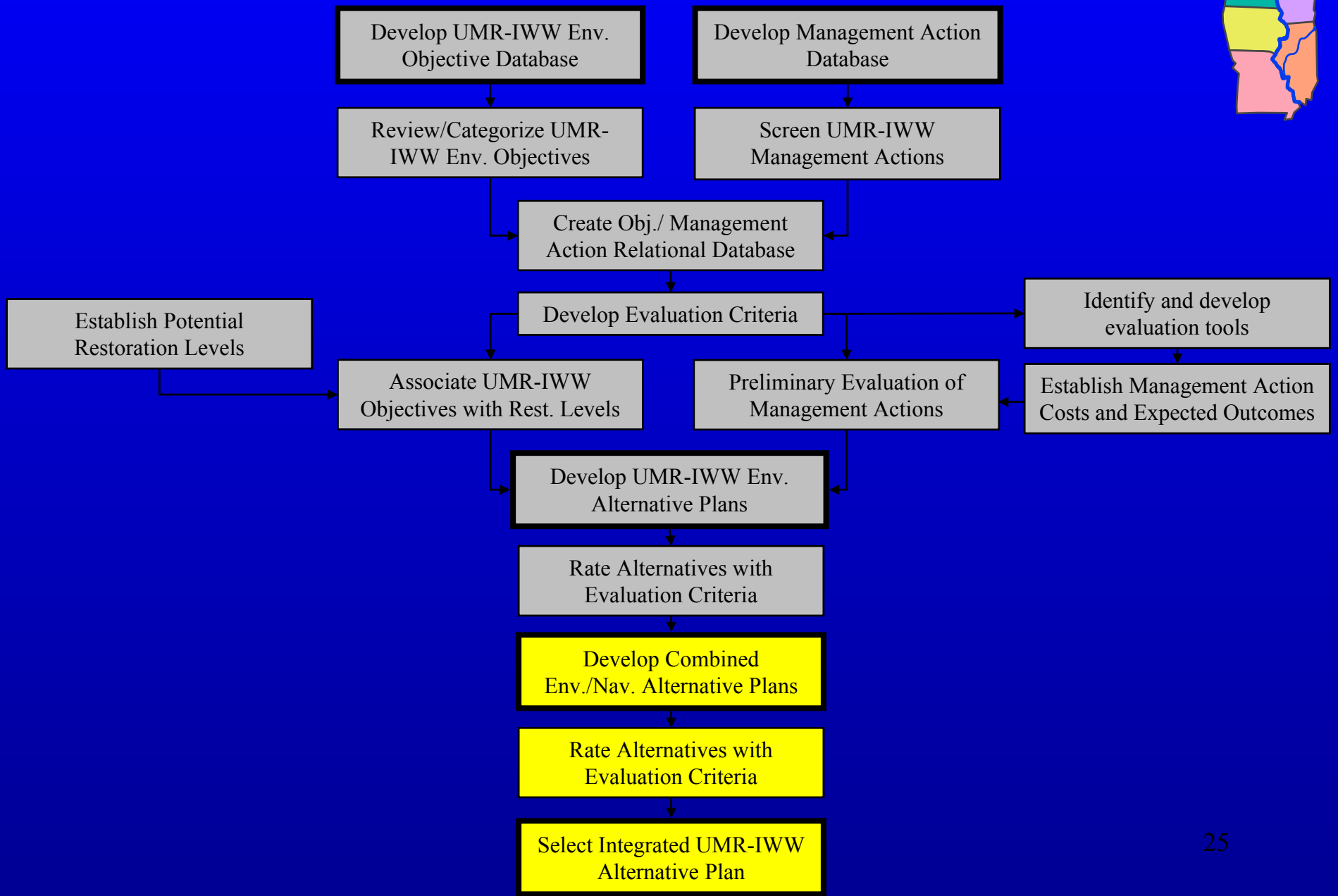
Evaluate Distributional Characteristics

Risk Robustness Adaptability Acceptability

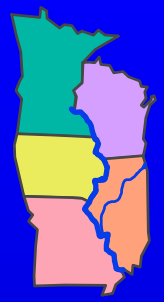
DRAFT

UMR-IWW Ecosystem Sustainability Alternative Formulation/Evaluation Process





Feasibility Study Schedule



•Alternative Evaluations	Sep 03
•Tentative Integrated Plans	Oct 03
•Public Meetings	Oct 03
•Alternative Formulation Briefing	Nov 03
•Draft Feasibility Report	Apr 04
•90 day Public Review	Apr-Jun 04
•Public Meetings	May 04
•Final Feasibility Report w/EIS	Aug 04
•Chiefs Report	Nov 04

Attachment 18

U.S. Army Corps of Engineers, Rock Island District

Continuing Authorities Program

March 2002

Section 206

Aquatic Ecosystem Restoration

These projects are for improving the quality of the environment by restoring habitat for fish and wildlife. A project is approved for construction after investigation shows engineering, economic and environmental feasibility. The investigation generally lasts 1 to 2 years. These projects are cost-shared 65% Federal and 35% Non-Federal. Each project is limited to a federal cost of $5 million.

Examples of Work

An example of this type of project might be deep water dredging to improve habitat conditions for the over-winter survival of fish in an otherwise shallow lake area.

Section 1135

Project Modification for Improvement of the Environment

These projects are for modifications to an existing Corps project and/or its operations. The work must improve the quality of the environment by restoring habitat for fish and wildlife. Justification is based on a comparision of monetary and non-monetary costs vs. benefits. The investigation generally lasts 1 to 2 years. These projects are cost-shared 75% Federal and 25% Non-Federal. Each project is limited to a federal cost of $5 million.

Examples of Work

An example of this type of project might be to construct water control structures within a wetland to better optimize conditions for the production and availabilty of waterfowl-preferred food plants near an existing Corps project.

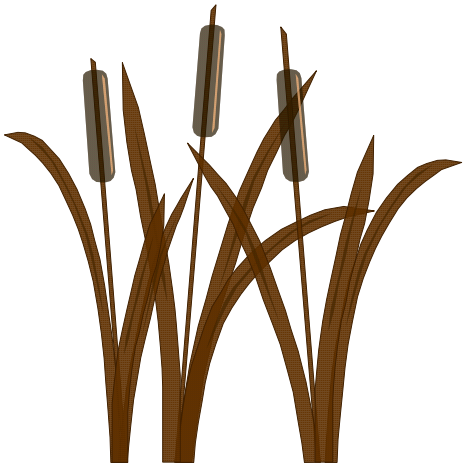
Section 204

Aquatic Habitat and Wetlands

These projects protect, restore and create aquatic and/or wetland habitats associated with dredging for authorized Federal navigation projects. A project is constructed after investgation shows engineering, economic and environmental feasibility. These projects are cost-shared 75% Federal and 25% Non-Federal.

Examples of Work:

The project would support placing dredged material from the deepening of a navigation channel at a specific location to support aquatic or wetland habitats.



An investigation of a small project under any of the above authorities can be initiated by the Corps of Engineers after receipt of a request from a potential project sponsor. Additional information or help can be obtained by calling the District's Continuing Authorities Program Manager, Dennis Hamilton, at (309) 794-5634.

	Environmental Management Program		Illinois River Basin Restoration
Purpose	To ensure the coordinated development and enhancement of the UMRS through a combination of Long-Term Resource Monitoring and habitat rehabilitation and enhancement projects. A long term program designed to protect and balance habitat resources and guide future river management.		To develop a comprehensive restoration plan and to implement restoration projects throughout the Illinois River Watershed.
Cost Share % (Federal/Non-Federal)	65/35 of TOTAL project costs		65/35 of TOTAL project costs
Work-in-kind	No more than 80% of sponsor cost share may be in-kind		No more than 80% of sponsor cost share may be in-kind
Sponsor Eligibility	Taxing entities qualify		Taxing entities qualify
Authorization	WRDA 1986 (P.L. 99-662)(Water Resources Development Act)		WRDA 2000 (P.L 106-541)
Eligibility criteria	P.L. 84-99 **ineligible**		P.L. 84-99 **ineligible**
Maximum individual project size ($)	No per project $ limit.		$5 Million Federal limit
Program Authorization limit	$33.3 million		$100 million (total)