APPROVED MINUTES

24th Meeting of the NECC
January 11-12, 1999
Jumer's Castle Lodge – Bettendorf, IA

by

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Navigation Environmental Coordination Committee (NECC)

DRAFT January 11-12, 1999
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1. Welcome and Approval of Minutes of Last Meeting

The twenty-fourth meeting of the NECC was called to order by Ken Barr. An attendance list is provided as ***Attachment 1***. The minutes of the September 29-30, 1998 meeting were approved with suggested revisions provided by Dave Tipple, Steve Bartell, Kym Campbell, and Jon Duyvejonk. Ken introduced Gary Loss who was recently appointed as the new project manager for the Navigation Study. Gary will be replacing Dudley Hanson who served as project manager since ?? 1998. For the past 15 years Gary has served as the Assistant Chief of the Engineering Division at Rock Island. He has been involved with the Engineering side of the Nav Study since 1992.

John Duyvejonk: Has there been any new information concerning a revised schedule for completion of the Nav Study?

Gary Loss: A draft of the SACCER will be submitted to ?? tomorrow. At this point we are anticipating a completion date of December 2000.

2. Brad Thompson - *Update on Status of Economic Models*

Brad provided a brief update on the status of the economic models. While an additional review of the demand curves is ongoing, the best available information remains the November 1998 preliminary information release data. He reminded the group that release was provided to the NECC members, and is the same information which was discussed during a November 1998 NECC conference call and at the 18 November Governor's Liaison Committee meeting.

Brad briefly reviewed the preliminary economic information using slides showing the graphs provided in the release. As part of testing the economic model and to help obtain public input, a number of scenarios have been run to determine the sensitivity of the model outcomes to various economic assumptions (e.g. traffic levels and price sensitivity of demand for waterborne transportation). In general, this testing has revealed that the model results are very sensitive to the input assumptions, especially the price sensitivity of demand.

The economic evaluation includes four potential investment strategies. Two of these focused on small-scale investments, with the other two involving large-scale measures. These include:

1) Adjacent moorings (UMR Locks 12, 14, 18, 20, 22, 24, and 25 and LaGrange Lock on the IWW) and approach channel improvements (UMR Locks 15 and 22 and Marseilles Lock on the IWW)
2) Guidewall extensions at UMR Locks 20-25
3) Lock extensions at UMR Locks 20-25
4) Lock extensions at UMR Locks 20-25 and guidewall extensions at UMR Locks 14-18.

In combination with the four potential investment strategies, the study team looked at a limited set of future economic scenarios or assumptions to evaluate the potential benefits of making investments. The scenarios are based on variations in the traffic forecasts and price sensitivity of demand for waterborne transportation. Because of the high degree of uncertainty and extreme sensitivity of results to assumptions, a range of investment strategies and economic assumptions where evaluated to help frame the potential outcomes. The following is a summary of the scenarios analyzed.

Economic Scenarios

Scenario 1	Demand Curves: Most Elastic	Traffic: Faucett Mid-line
Scenario 2	Demand Curves: More Inelastic	Traffic: Faucett Mid-line
Scenario 3	Demand Curves: More Inelastic	Traffic: Faucett 95 % Confidence Limit
Scenario 4	Demand Curves: Completely Inelastic	Traffic: Faucett Mid-Line

In summary the preliminary model runs show that the results are extremely sensitive to the economic assumptions. As a result depending on the assumptions used the ultimate recommendations could range from no improvements to large scale improvements at multiple sites. The following table shows the relative timings of justification for different improvements based on the various scenarios (not including system environmental costs).

Potential Implementation Timing*

	Moorings/ Channels	Guidewall Extensions	Lock Extensions	Guidewalls/ Lock Ext.'s
Scenario 1	**2002****	**2019**	**>2050**	**>2050**
Scenario 2	**2002****	**2008****	**2039**	**2026**
Scenario 3	**2002****	**2008****	**2023**	**2013**
Scenario 4	**2002****	**2008****	**2012****	**2012****

*** Does not include consideration of potential system environmental costs.**
**** Estimate of earliest year to complete implementation**

Since, the release of the preliminary economic information the Corps has been working to gather additional information on demand curves. Progress since November 1998 includes contracting with Dr. Mark Burton, Marshall University, to conduct an analysis of commodity transportation demand curves. This effort is anticipated to result in a draft report by 26 January 1999 and a final report by 26 February 1999. The Corps will then take this information and use it along with information that has previously been collected to develop demand curves for the NED analysis. In addition to Dr. Burton's work, a letter was sent to the ECC and GLC members on 24 December 1999 requesting any additional data they may have that would assist the study team in better defining demand curves.

Regarding the overall study schedule. Brad stated that while no official decision has been made, an approximately one year schedule extension is anticipated. Gary Loss indicated that the following would be key dates:

20 Jan ECC meeting (discussion of demand curve evaluation)
26 Jan and 26 February Draft and Final Reports from Dr. Burton

Ken Barr added that the study team anticipates that on or shortly after 26 February, the Corps will finalize the demand curves information that will be used in the NED analysis. The economics work group will then use the spatial equilibrium model to identify a preliminary NED plan from an economic perspective and its associated traffic (number of barges per day) within 2 months. This information will then be provided to the environmental work group to determine potential incremental impacts using the system environmental model. The environmental modeling effort is anticipated to take roughly three months to complete. These runs will be in addition to the analysis of the various scenarios the Corps is now contracting with CADMUS to run.

Questions/Comments:

***Gretchen Benjamin*:** When will the next Nav Study Newsletter be released?

***Ken Barr*:** We anticipate distribution of the next news letter by the end of January, 1999. In the newsletter we will present the scenarios for the economics models and revised schedule.

***Steve Johnson*:** Based on the time frames presented, we should be anticipating outputs from the environmental models by the end of July 1999?

***Ken Barr*:** That is correct. However, I think we need to have the next NECC meeting in early to mid May to finalize discussions regarding the avoid, minimize, and mitigation options after we have had a chance to review the economics handoffs information.

3. Scott Whitney - *Independent Technical Review*

A summary of the current status of various Nav. reports are included with the minutes as **Attachment 2**. Just before Christmas, twelve Nav. Study Environmental reports were signed off by Dudley Hanson after having completed the Independent Technical Review (ITR) process. Two of those reports, Hydraulic Classifications (Rpt. # 19/22) and Fish Model (Rpt. #17) were subsequently mailed to NECC members for their review, extra copies of these reports were distributed to NECC members attending the meeting. The other ten reports have already been through the NECC review and are ready for publication. Final Nav Study Environmental reports 1 through 5 were distributed in mid December.

4. Jon Duyvejonck / Rich Fristik – *Mitigation Planning*

Once impacts are identified we need to seriously consider how to mitigate for various resources. The USFWS ranks resources and specifies how each is to be mitigated for. In the past, the Service has used four resource categories to help determine mitigation (i.e. used recently for second lock at L/D26). Currently looking for feedback from agency biologists as to ways to modify or improve the draft resource categorization. One drawback to the current process is that some species may overlap resource categories due to shift in habitat needs through their life cycle (i.e. Gizzard shad live in main channel as adults but depend on backwaters for reproduction). Does not include Endangered Species since FWS does not mitigate for Endangered Species, entirely separate process. The following is an outline description for the proposed Resource Categories:

A. **<u>Resource Category 1</u> - Habitat is of high value and is unique and irreplaceable in the nation or ecoregion**. Goal - no loss of existing value. The Service will recommend that all losses of existing habitat be prevented as these habitats cannot be replaced. Habitats included in this category include:

- **a.** habitat within officially designated natural areas and natural landmarks
- **b.** essential or documented habitat of state listed endangered species
  - **1.** mussel beds containing state listed species, mussel sanctuaries
- **c.** nesting colonies of herons, egrets and terns (including 1/4 mile buffer)
- **d.** Critical Fishery habitat including: paddlefish and lake sturgeon spawning or staging areas, backwater fish overwintering locations
- **e.** submergent vegetation in areas of historical importance to canvasback ducks (e.g. Pool 8 and Pool 19)

B. **<u>Resource Category 2</u> - Habitat is of High value and is relatively scarce or becoming scarce in the nation or ecoregion**. Goal - no net loss of in-kind habitat value. Losses that cannot be otherwise avoided, minimized, rectified, or eliminated over time can be compensated by replacement with the same kind of habitat so that the total or net loss is zero.

- **a.** open river dike fields used by overwintering fish
- **b.** habitat of state listed, threatened, and rare species
- **c.** wetlands not included in category 1, including emergent and submergent macrophytes
  - **1.** northern pike spawning habitat
- **d.** main channel (except as noted in Resource Category 3) habitat with structure
- **e.** main channel border
  - **1.** mussel beds
  - **2.** walleye, sauger spawning habitat
- **f.** tailwaters
  - **1.** paddlefish, sturgeon spp., channel catfish
  - **2.** walleye, sauger
- **g.** side channels in open river
- **h.** any remaining non-channel (e.g. backwaters) habitats
- **i.** any remaining bottomland forested wetlands

C. **<u>Resource Category 3</u>. - Habitat is of high to medium value and is relatively abundant in the nation.** Goal - no net loss of habitat value while minimizing loss of in-kind habitat value. Losses that cannot be otherwise avoided, minimized, rectified, eliminated over time or compensated by in-kind replacement can be compensated by replacement with other habitat types so that the total or net loss is zero.

- **a.** main channel and thalweg habitats that contain no other habitat structures (freshwater drum, redhorse, sturgeon, catfish).
- **b.** terrestrial herbaceous habitats
- **c.** typical wing-dike and dike field habitat
- **d.** forage fish spawning habitat (gizzard shad, emerald shiner)
- **e.** mudflats and sand (except beaches)
- **f.** general spawning habitat for Centrarchid and buffalo fish species
- **g.** side channels in pooled river

D. **<u>Resource Category 4</u> - Habitat is of medium to low quality**. Goal - minimize loss of habitat value. The Service will make recommendations to avoid, minimize, rectify or eliminate losses over time depending upon the significance of the loss. Such areas are good candidates for mitigation of Resource category 2 and 3 losses by management or enhancement to increase their habitat value.

- **a.** all developed floodplain areas
- **b.** agricultural lands that are not included above.
- **c.** dredged material beaches, thalweg disposal areas

Policy aspects were presented at last meeting, next step will be to evaluate resource categories and potential mitigation measures. April to June timeframe will be an important period for mitigation planning. The significance question still needs to be resolved. Specific species impacts will depend on model outputs. Definition of "what is a significant loss" will likely be species specific. Overlay of bank erosion study 'at-risk' sites with the updated resource inventory maps produced by USFWS is nearly complete. Includes mussel beds, rookeries, and bald eagle nest locations (all are Res. Category 1 habitats).

Questions/Answers:
Ken Barr: If we determine there is an impact to larval freshwater drum,would favor habitat mitigation as opposed to in-kind mitigation. Sequence habitat projects according to the projected traffic scenarios.
Jon Duyvejonck: Reiterated that the mitigation planning would primarily focus on systemic impacts and not those associated with the operation and maintenance of the nine-foot channel project.
Bernie Schonhoff: Where would cut-bank habitat fall into the scheme?
Jon Duyvejonck: Provide documentation as to the status of this habitat type as well as it's importance and will determine where it would fall in the categorization scheme. Once we send out the resource inventory maps look for these specific areas where you know cut bank habitat occurs. Then it will be documented.
Bernie Schonhoff: What is spatial resolution of maps?
Jon Duyvejonck: All shown as point information, attribute map give rivermiles right /left bank. Not presented in polygons since this bed does not exist. Should have enough information to identify where they fall on the GIS maps.
Ken Brummett: Concerned about the classification of side channels and macrophytes which are relatively scarce in lower pools but are classified as a Category 3 in upper pools.
Jon Duyvejonck: We will give it some consideration.
Steve Bartell: Some of the items listed in the resource categories may not be addressed by nav study (i.e. terrestrial woody).
Ken Barr: We may have to depend on other sources for such information.
Jon Duyvejonck: There may be a need to redefine some categories.

5. **Steve Bartell** – *Ecological Modelling*

Tables and figures covering specific points of Steve's presentation can be found in Attachment 3. Within the following paragraphs these items will be referred to by their specific page numbers (ie. SB1, SB2, SB3,......etc.).

A. FISH MODELS

1.) Larval Fish Entrainment

The Conditional Entrainment Mortality (CEM) model report has recently completed the ITR process. Reviewers were Al Jensen, a modeling expert and professor from University of Michigan, and Glen Cada, a noted larval fish expert from Oak Ridge National Lab. The reviews were generally favorable and we were able to satisfactorily address each of the reviewers' comments. The revised copy received by NECC members a few weeks ago includes revisions resulting from the ITR process. In addition, we continued to perform model runs under various "% traffic increases" and improve on existing computations while we were awaiting the ITR reviews. A notable improvement was our calculation for computing entrainment volumes for each of the 108 possible tow configurations. For each of the 108 vessel configurations we calculated an average +/- standard deviation of entrainment volume. For this model we are using 1992 as our baseline for traffic intensity (mean vessels/day) (**SB1**). Test runs of the model were conducted at 25%, 50%, 75%, and 100% of this baseline traffic.

2.) Equivalent Adult Loss (EAL) and Recruitment Forgone (RF) Models

Output from the CEM model is fed into the Equivalent Adult Loss (EAL) and Recruitment Forgone (RF) models. The EAL model computes the expected number of fish lost over an entire life span. The RF model computes the expected loss up through the recruitment stage. If a species has a relatively short lifespan then the two models will give fairly similar results. A key difference in the two models is the use of average mortality. The RF model computes the number of recruits in stable population by multiplying by average % mortality. The EAL model breaks average mortality down by several life stages. To demonstrate how the model works Steve showed the results of several test runs for various fish species using larval entrainment information from power plants. The following information was provided for power plant entrainment of Freshwater Drum:

Pool	Number of Larval Fish Entrained
Pool 2	23,937
Pool 5	8,205,239
Pool 9	3,088,783
La Grange	750
UMR Total	11,317,959
IWW Total	750
UMR-IWW Total	11,318,709

Using the Equivalent Adults Lost Model :

System	Total Lost Future Adults
UMR	92
IWW	0
UMR-IWW	92

Questions/Answers:

Bill Bertrand: Have you compared your outputs for these models to other studies or estimates from other sources? I am especially concerned by your projections of Channel Catfish (CCF) losses in Pool 4 which are shown to be much higher than losses in the La Grange Pool, where CCF abundance is 10X greater. Observations like this cause distrust of the model. Apparently these differences are due to the datasets used to determine larval densities.

Steve Bartell: We could identify input parameters (larval densities) as a statistical range and use a Monte Carlo selection technique to provide more realistic scenarios. We encourage the agency representatives to point out these deficiencies. Currently determining what kinds of numbers are the most useful for assessing the impacts of traffic? Suggested next steps: Develop more realistic model of larval distributions, possible shift to event oriented calculations.

Bill Bertrand: Look at LTRMP datasets to serve as a check to see if your distributions are realistic.

Steve Bartell: We have been working closely with Gutreuter and have relied on LTRMP information.

B. PLANT MODELS

1.) Physical Forces Model (Direct Impacts)

A rule based model was developed to assess the direct physical impacts on submerged aquatic plants caused by currents and waves resulting from commercial navigation (**SB2**). Direct physical damage starts at current velocities of 0.5 m/sec in the natural environment. GIS coverages in trend pools indicates no rooted aquatic plants where water velocity exceeds 1 m/sec. Therefore we chose a mid point of 0.75 m/sec. for assessment of current velocity. Wave heights >0.2m were also determined to cause direct physical damage to plants. The results of the screening for direct impacts on submerged aquatic plants due to direct physical forces suggested that less than 1.5% of the possible vessel type, location in relation to sailing line, and pool stage height would produce plant breakage for locations with a depth of 1.5 m or less. For all pool stage heights, the greatest physical impacts were associated with vessels located on the left edge of the navigation channel. More than 95% of the possible plant breakage resulted from secondary wave heights that exceeded the 0.2-m criteria.

2.) Growth and Reproduction (Indirect impacts)

An existing physiological process model was modified for sago pondweed and wild celery to assess the indirect impacts on plant growth and reproduction resulting from reduced light penetration (increase in suspended sediments) in UMRS Pools 4, 8, and 13. Suspended sediment concentrations associated with the 108 vessel types for selected cells (1/2 mi. long, 10 m wide, and <1.5-m deep) in Pools 4, 8, and 13 were estimated using a combination of NAVEFF and NAVSED models. Using calculations of current velocity, bed shear stress, and wave heights produced by NAVEFF, the NAVSED model calculated a time series of suspended sediment concentrations for each vessel type and location within a pool. These suspended sediment concentrations were used to develop correspondingly increased light extinction coefficients that were input to the plant growth models (**SB3**) These models estimated the magnitude of reduced growth and tuber production for the scenarios of 25, 50, 75, and 100% increases in commercial navigation (**SB4** and **SB5**). The results of increased traffic on suspended sediments produced increases in light extinction coefficients (LEC) on the order of 1 to 31%, depending on the combination of month, pool, and traffic scenario. What does this mean in terms of plant Growth? Total annual plant production was decreased by as much as 38% for a 100% traffic increase in Pool 8.

In Pool 4, the 25% increase in traffic scenario actually resulted in an increase in plant production as compared to the 1992 baseline. The growth dynamics of sago pondweed indicate minimal impact of traffic in Pool 4; however, impacts on the growth of this species were apparent for Pools 8 and 13. On average, the traffic scenarios resulted in ~1-3% reductions in total annual tuber formation for sago pondweed. The greatest impact was a ~9% decrease for the 100% increase in traffic scenario in Pool 8. The plant growth model simulations indicated no impact on vegetative reproduction of wild celery for all traffic scenarios.

Questions/Answers:

Gretchen Benjamin: What was the year that these models were run?

Steve Bartell: 1992 was the baseline for models.

Gretchen Benajmin: You indicate that you chose high flows when in fact the greatest potential for plant impacts comes at low flows.

Steve Bartell: Inspection of the suspended sediment concentrations calculated by the NAVSED under different stage heights does not support this contention. While the highest suspended sediments in the vicinity of the tow occur consistently at low stage heights, the suspended sediments at depths of <1.5 m are not consistently observed at low stage heights. We will continue to examine this aspect of the NAVSED calculations.

Steve Bartell: Stolons or ramets are not represented in current model. ITR reviewer, Anne Kimber has strong feelings regarding this omission. We plan on having a conference call with Dr. Kimber in which we can resolve this issue.

C. Mussel Model

A bioenergetics mussel model was originally developed by David Schaeffer using a modeling program known as STELLA. Unlike other models developed for the Nav. Study, the STELLA software was not compatible and could not incorporate the array of projected traffic scenarios to model the effect of increased navigation traffic on mussel populations. Subsequently, Steve is re-coding the mussel model using Fortran-90, the language his other models were created in. The basis of the mussel model is that mussels assimilate food material converting it into tissue energy which can then be used for reproduction, shell growth, excretion, and respiration (**SB6**). The model was developed largely from data on a single species, *Fusconia cerina*, and calibrated against growth data reported for *Fusconia ebena* from the lower Ohio River. In general the model draws almost exclusively from data obtained by Miller and Payne from the Corps Waterways Experiment Station. Velocity (turbulence) and turbidity were the primary factors modeled to assess navigation related effects. From the model output tables/figures presented, it appears that mussel growth decreases with an increase in barge traffic due to more frequent period of above ambient turbidity levels.

Once the mussel model is re-coded in Fortran-90 Steve will begin model runs using the selected percent increases in traffic (e.g., 25, 50, 75, 100) and for selected locations of known mussel beds in Pool 4, Pool 8, and Pool 13. Steve anticipates having test runs completed by the end of January. A Draft report will hopefully be ready by mid-February.

Questions/Answers

Scott Whitney: Will the revised Fortran-90 model address concerns that were previously raised concerning the validity of data and assumptions of Schaeffer's Stella model?

Steve Bartell: Re-coding the mussel growth model provides an opportunity to evaluate the concerns raised by previous reviews of this modeling effort. We plan to examine each concern and revise or modify the model accordingly.

6. Tom Pokrefke – *Hydraulic Classification*

For this analysis the Upper Mississippi River was initially divided into three obvious segments - (a) the pooled portion of the Mississippi River from Pool 4 to Pool 27, (b) the open river portion from Pool 27 to the confluence of the Mississippi and Ohio Rivers at Cairo, Illinois, and (c) Illinois Waterway from Lockport through Alton Pools. The purpose of this separation was to associate similar existing hydraulic conditions to attributes determined within the hydraulic classification. Also, the pooled portion of the river was significantly different from the open river and the sediments in the Illinois Waterway were significantly different than the pooled portion of the Mississippi River.

A. Hydraulic Classification Attributes

1) **Main Channel** - Includes the main navigation channel and channel border areas (**TP1**). Limits are the land-water interface at apparent natural river bankline and straight lines across the secondary channels, mouth of tributaries, entrances to backwaters, and pooled stretches upriver from dams. For the overall hydraulic

classification, the main channel was divided into separate segments of reaches containing bends, river crossings, or straight stretches. Crossings are short straight sections in the main channel between opposing bends where the thalweg crosses from one side of the river to the other. Straights are straight sections of the main channel between non-opposing bends or long sections between opposing bends where a definite shifting of the thalweg can not be defined.

(a) *Navigation Channel* **-** navigation channel limits were defined as 300-ft wide centered on the sailing line.

(b) *Channel Borders* **-** areas along and immediately adjacent to the navigation channel that separate it from the other aquatic areas. Most of the channel-training structures are found in channel border (i.e. wing dams, revetments, islands, etc.).

2) **Secondary Channels -** connected directly to the river flow and adjacent to the main channel (**TP2**). Length is approximately equal to that of the navigation channel and has a definate entrance and exit with no emergent closing structures.

3) **Backwaters -** areas that are beyond the banks of the main channel or secondary channels. All inlets and outlets were numbered, if opening to channel border aimed upstream then considered inlet, if downstream then it was considered an outlet. Calculations included the total area of water and land encompassed in the backwater complex. The backwater classification was then sub-divided to take into consideration at least 4 different types that hydraulically would be impacted differently as a result of navigation in the main channel and flow conditions associated with a particular type of backwater.

(a) *Contiguous Backwater* **-** areas that are hydraulically connected by surface gravity flow to the main channel at normal pool levels (**TP3**).

(b) *Contiguous, Single Opening Backwater* **-** connected to the main channel by only one surface gravity flow opening which serves as both the inlet and outlet (**TP4**).

(c) *Impounded Backwater* **-** area immediately upstream of the lock and dam where most of the features are now submerged (**TP5**).

(d) *Isolated Backwater* **-** pools or lakes located on the overbanks that have no hydraulic connection by surface gravity flow at normal pool levels (**TP4**).

4) **Tributary Channels -** channels of tributary streams and rivers. Landward limit is the line where the tributary crosses the study area boundary. Riverward limit is the line where it crosses the limit of the main channel, secondary channel or backwater. In this classification the tributary channel will assume the attributes of the hydraulic classification to which it connects.

Numerous quantities were measured for the various attributes. In the main channel: reach type (bend, straight, or crossing) was denoted, sailing line length, sinuosity; minimum and maximum channel width; degree of bend and bend radius where applicable; and number of islands, wing dams, and revetments. On backwaters: the number of inlets, outlets, and through channels; total area; area covered with water; length; and other characteristics. On secondary channels main and secondary channel lengths; sinuosity; minimum and maximum channel width; channel area; diversion angle; number of islands, revetments, or wing dams; and distance from the sailing line to the upstream inlet. Such characteristics are what were used in this analysis to link similar attributes.

Questions/Answers:

Bill Bertrand**:** Why are what the resource agencies consider as side channels classified as backwaters or main channel borders and not as secondary channels?

Tom Pokrefke**:** We were looking at strictly planform maps and did not attempt to evaluate water depth. We only had those planview maps to go on. Throughout the entire system there is a significant variation in how backwaters appear. The key for this study was that within the main channel towboats would be operating normally somewhere within the navigation channel. The movement of the tows and reactions created had the potential for impacting attributes outside of the main channel. We had to put together a scheme that would allow us to address the entire system and give us the capability to make some major extrapolations in to areas such a non-trend pools where data are pretty skimpy.

Doug Blodgett**:** I am still unclear on the designation as a secondary channel and backwaters without flow information. It appears the basis for classification is unidirectional flow. By definition a backwater is an area of the river that are filled by water "backing" up into them. Inclusion of secondary channels in a backwater complex is not consistent with our current terminology or understanding of these areas.

Ken Brummett**:** Concur with Blodgett as to definition of a backwater.

Tom Pokrefke**:** Hydraulic engineers deal with the river in this manner. Secondary channels, from up to down stream, would be the same distance whether you travel in the main channel or the secondary channel. In what we have called contiguous backwaters, the velocities are significantly lower than secondary channels and would have to go a significantly longer distance to get back to the main channel. This was the key defining variable to distinguish secondary and contiguous channels.

***Ken Barr*:** Are we still looking at flow?

***Tom Pokrefke*:** Yes our classification scheme does consider flow.

***Bill Bertrand*:** We need to look at the classification scheme and help out in our specific areas to assist in the designation.

***Doug Blodgett*:** There is a huge difference between some of these aquatic areas which you are combining.

Ron Benjamin: Tertiary channels are in the LTRMP classification may be a better definition for some of these areas.

***Tom Pokrefke*:** We tried to reduce the number of classification schemes, hydraulically we were interested in identifying what was going in and coming out of the area. By providing an association that was at least consistent, even though in reality the specifics may be highly variable, this classification would in turn fit in with other models to calculate sediment delivery to the doorstep of the backwaters.

***Ken Brummett*:** Closing structures over some secondary channels may prevent species movement into some areas.

***John Barko*:** In general, there is insufficient data on flow and sediment transport within backwater areas. Subsequently, we can not determine the distribution or retention capacity of sediments in such areas. For the hydraulic classification we are only interested in moving water and sediment from the main channel to the interface.

***Bill Bertrand*:** This effort will not be measuring the increase or decrease in specific habitat types?

***Ken Barr*:** Cumulative impacts study used this information as well as others to analyze habitat loss or creation.

***Tom Pokrefke*:** This exercise will tell us what is delivered to the door, hydraulically we do not know what is happening in the backwater, hydraulically we cannot calculate what is happening. Obviously there are areas you are personally aware of that may not necessary fit in the classification we used. We evaluated the entire system without any personal knowledge of specific areas, rather we developed a set of rules based on planform analysis that were applied to the entire system. The world changes dramatically around Pool 18, there are a whole lot more secondary channels than in the upper reach

***Bill Bertrand*:** I am concerned about applying this classification scheme to the calculation of habitat acreage.

***Steve Bartell*:** WEST Consultants (contractor for Cumulative Impacts) came up with a third classification scheme. Rather than digitizing these folks looked at maps and made measurements using a planimeter.

***Tom Pokrefke*:** Based on my experience on this study, after spending hours and hours with these maps, and relative to areas of interest to various resource agencies, the only way this information can be used is to have a hard copy of the map and look at the GIS coverage and not depend on the numbers kicked out by the GIS maps.

***David Soong*:** Is there any consideration of the severity of hydraulic events (i.e. flood, low flow) and the changing of how your classified areas will react? Readers need to understand these assumptions.

***Tom Pokrefke*:** Our classification was based on Normal pool elevation. Once you get outside of the main channel the amount of elevation data available, even in the trend pools, decreases significantly. Therefore, the information just is not available to be able to address the issue of increased river stage and/or discharge. It definitely happens, but at this point in time the magnitude on its impacts just cannot be quantified.

***Bill Bertrand*:** I think we need to make sure classifications jive from one report to the next, ie UNET model described backwater as one without an outlet, here you are describing backwaters with inlets and outlets. There does not appear to be any consistency within the Navigation Study products. The key is what the information will ultimately be used for, if it is used for biological habitat availability then we need to seriously evaluate the classification scheme

***Ken Barr*:** The important point is that we have been consistent from one area to the next based on a set number of criteria. We are relying on professional judgement for both this study and the cumulative impacts.

***Tom Pokrefke*:** Trend pools are going to be used as representative of the system, if we can not apply what we learned in the trend pools to other areas in the non-trend pools then we have a problem.

***Bill Bertrand*:** Flow is the most important criteria that is missing in this classification scheme (from a biological standpoint).

***Tom Pokrefke*: :** I agree that flow is important. The problem is if you use impounded backwaters as an example, which are 95-99% water with very little ground above the waters surface, very little if any flow computations can be made there. From planform analysis we don't know if the area is 10 feet deep or 10 inches deep. On the Illinois Waterway which is a very different river than the Mississippi River, very little information exists (i.e bathymetry).

ACTION ITEM: Need to find out what Arcview version Rose Kress used to generate the GIS coverage. The state resource agencies are unable to open the files with their 2.0 version of Arcview.

B. Bed Material Analysis

Resuspension of bed material is highly dependent on the size and degree of cohesiveness of the sediments. To characterize the UMRS, sediment samples were collected at 5-mile intervals. At each interval a sediment profile was created by analysis of nine samples. The first and ninth samples were collected at the river bank 0.5 meters above normal flat pool; the fourth and sixth samples were collected at a depth of 1 meter; the second and eighth samples were obtained at the water's edge; the third and seventh samplers were collectedmidway between the 1-meter site and the water's edge location; and the fifth sample was taken in the navigation channel.

Bed material samples were categorized based on their cohesive properties:

1. *Group 1 Cohesive* - $D_{70} \leq 4$ microns, no samples of this type were collected in the UMRS
2. *Group 2 Cohesive* - $D_{70} \leq 62$ microns or $D_{16} \leq 4$ microns, those with 70% of the sample finer than sand-size material with a meaningful amount (16%) of clay to provide cohesion.
3. *Group 3 Non-cohesive* - $D_{70} > 62$ microns or $D_{16} > 4$, no significant amount of clay, comprised mostly of fine to coarse sand.

Further analysis were performed to determine the erodability of a sample based on its organic content and bulk density. Erodability labels were soft, medium, and hard. No samples were collected in the UMRS that could be labeled as hard, all were either soft of medium.

Two items were important for the analysis of sediment delivery to backwaters

1. Area of water within a backwater
2. Type of sediment that was available at the entrance to the backwater. This is also required for the wave model and sediment model. This was based on the sediment analysis taken at 5-mile intervals

Tom provided a summary of the characteristics, numbers, and acreage of various backwater types in the Illinois Waterway and two reaches of the Mississippi River. Discussed the importance of number of inlets and outlets; distance and angle to inlet; path material would have to take; and amount of flow or wave energy required to carry sediments X distance. A summary for each of the four reaches of the UMRS are provided as handouts: (1) **TP6** = Pools 4 -17; (2) **TP7** = Pools 18 - 27; (3) **TP8** = Open River; and **TP9** = Illinois Waterway.

Encountered problems with linkage between trend pools and non-trend pools due to limited data. The lack of at least one example of all of the hydraulic classification attributes in the "trend" pool reach limited linkages. Lack of trend pool data for certain attributes prevented the reliable linkage with non-trend pools. Based on area and sediment type, finding specific linkages at times required having to go to another area that may or may not be very similar. For instance, some attributes in the open river portion of the Mississippi did not have those attributes in the “trend pool” portion of the open river. In that case we had to go to Pool 26 (the closest trend pool upstream of the open river reach) to get some attributes. While not perfect, that at least gave us some linkages that hydraulically we could use to address the entire system.

Questions/Answers:

***Ken Barr*:** Ultimately this info will be use to create maps with 4 colors that identify areas with high, moderate, and the least susceptibility for sediment delivery.

Tom Pokrefke: My personal inclination is to use 2 colors, say blue and yellow, rather than 4 colors. Where a blue would be an area that did not appear to be subjected to significant, long-term loading due to tows and the yellow areas would be backwaters or secondary channels that need to be monitored more closely to document the impacts of the tows.

***Bernie Schonhoff*:** Cannot understand why we are only using area to evaluate and not the width of inlets because these two areas will not behave the same just because they have the same surface area.

***Tom Pokrefke*:** Numerically we were not able to compute what percentage of the 800,000 tons of material delivered to a backwater would be retained and how much would pass directly through or have a short residence time.

***John Barko*:** We can look at calculated gross sediment delivery to the mouth, but the natural process of removing those sediments cannot be addressed.

***Bill Bertrand*:** is the sailing line computation assuming that all tows will pass directly on the sailing line

***Tom Pokrefke*:** our model runs were based on towboats that were moving 90% right down the middle 5% on right hand side, and 5% on left hand side

7. Tom Pokrefke - *Traffic Induced Sediment Delivery to Backwaters*

A. REVIEW: Tom provided a quick review of a few important studies that have been conducted and models that have been developed to evaluate traffic induced sediment suspension and transport from the main channel to backwaters:

1. *HIVEL model* is a two dimensional flow model created by WES (Stockstill and Berger) to calculate velocities and depth throughout the numerical grid as a tow with a designated path and speed moved through the study reach. This model was able to account for tow induced drawdown and return currents.). The HIVEL model provides visual outputs that showing change in water surface elevation as the barge passes, this was demonstrated in a series of color slides from various parts of the UMRS.
2. *SED2D model* calculates changes in sediment concentration (entrainment) and transport as a function of depth, grain size, and shear stress. Maynord experimentally determined shear forces for various barge configurations and vessel speeds. Grain size was determined from extensive cross-sectional sediment analysis conducted by Rogala at 5-mile intervals throughout the UMRS. Water depth was evaluated based on extensive bathymetric surveys.
3. *NAVEFF* is an analytical/empirical model for estimating the maximum return velocity and drawdown that occurs across a river section during passage of a commercial vessel. NAVEFF uses a computational cell to evaluate waves shear, velocity, ect. Cell size for NAVEFF modeling in trend pools ½ mile long by 10 m wide, in non trend pools 1 mile long and 10 m wide.

***Ron Benjamin*:** Why use 10-m wide cells and not ones more the width of the barge, which would be around 30 m?
***Tom Pokrefke*:** The model does take into account the width and length of a passing barge by totaling values obtained from numerous cells occupied by the barge.

Tom showed a slide series demonstrating the effect of a 60 cm wave in water with a depth less than 1.5 m having a soft sediment such as that encountered in La Grange Reach of the Illinois River. The sediment sediments (turbidity) peaked at 2 minutes reaching 220 mg/L and required about 1 hour to fall back to normal ambient levels.
***David Soong*:** What does soft bed refer to?
***Tom Pokrefke*:** A soft bed consists of cohesive material with little organic material (bulk density also used in designation of soft hard)

Showed results from run conducted under same wave height and depth over a medium bed. The result was an increase in suspension concentration up to 7.5 mg/L which then leveled off at this level for an extended period of time. Over a hard substrate the suspension concentration increased to 0.3 mg/L and again leveled off at this level.

Final link for the sediment work is to run a series of traffic scenarios based on the NED plan. While awaiting this information we have been using a ratcheting approach using 25%, 50%, 75%, and 100% traffic level increases. baseline traffic was based on levels observed in 1992. There are 108 possible tow combinations that may be used along with the relative frequency of their passage for any given month. Tom used the highest probability of occurrence to select which condition and tow would be selected for each month to get to the total number of tows that would pass that month. Tom showed the results from a model run in Pool 13 with a 50% increase in traffic (i.e. 252 barges *.50=126+252 = 378 barges). This level of increased traffic was fed into the model to compute the amount of sediment (tons/year) delivered to the backwaters and the number of years it would take to fill the backwater completely in . Showed table that compared April and August, due to differences in flow rate at these two periods the rate of sediment delivery was sig. (4x) greater in April than in August
***Ken Barr*:** This is important in identifying which sites are most likely to encounter sediment problems resulting from commercial navigation.
Tom reported that of the 57 Backwater complexes evaluated in Pool 13, only 13 were found to have fine cohesive material near their inlets.
***Bertrand*:** Are these sites generally near the impounded areas
***Tom Pokrefke*:** At this point I have only modeled Pool 13.

Total annual delivery to backwaters has been estimated in the cumulative impacts report. WEST calculated the annual sediment input to Pool 13 is currently about 5.5 tons (**TP10**). Under baseline traffic (1992) they estimated that 324,276 tons/year of sediment (6% of the total load) were distributed to the backwaters from barge entrainment and transport. By ratcheting, this would increase to 407,085 tons/year (7% total load) with 25% increase in traffic and 479,505 tons/year (9% total load) with 50% increase in traffic. Tom also provided a spreadsheet (**TP11**) which used the WEST information to calculate the number of years to fill various backwaters in Pool 13. As an example, Backwater (BW) 10, with an average depth of 2-ft, would fill in completely in 104, 706 years under base conditions, 84,400 years with 25% increase in traffic, and 70, 412 years with 50% increase in traffic. These calculations assume all material entering a backwater will be retained and the input will remain constant throughout this period. In Toms' opinion, if sediment delivery remains below 10%, should not have to worry about it

Questions/Answers:

***John Barko*:** 90% of the material delivered to backwaters is from other sources, on the whole a towboat only contributes 10% of the sediment load to a backwater

***Ken Barr*:** Will this type of information will be calculated for all the trend pools?

***Tom Pokrefke*:** Yes. We are currently running all the trend pools. We are not computing the intervals between tows in this test, will likely use a Monte Carlo technique to select what towboat is used.

***David Soong*:** I think it is reasonable to assume that floods will transport larger materials into the backwaters, core analysis of backwaters should give credence to the claim that forces rather than towboats distribute material to backwaters

***Tom Pokrefke*:** Yes. Towboats are only transporting the finer materials attributable to wave resuspension

***John Barko*:** We should be able to take total ambient sediment concentration and deposition rate and compare that add increase with net sedimentation studies to see if we are in the ballpark. present day net sediment deposition rates

8. Agency Reports

***Steve Bartell*:** Fish spawning report is written up to the results section awaiting the computations may be in by next month

***Ken Barr*:** reiterated Bertrand's earlier comment that the agency representatives get together with the classification folks to evaluate all the different schemes presently being used in the Nav Study. Ken indicated that he would contact Dan Wilcox and Rose Kress to see if they could set something up or address the agency concerns in some other manner.

***Jon Duvejonck*:** Draft chapters for coordination act report have received draft copies of the exotic species, Chuck Theilings' report, others will be coming in the next few months. Expect to have preliminary draft of Coordination Act report by late spring. Resource inventory maps will be going out in next few months.

9. Next Meeting

The 25th meeting of the NECC will be held at the Holiday Inn, Moline on 4-5 May 1999. A block of 15 sleeping rooms is reserved for the night of 4 May at a rate of $59 + 11% tax. Cutoff date is 12 April. When making reservations, please ask your meeting attendees to identify their group as U.S. Army Corps of Engineers/NECC Meeting.

Attachment 1

Attendence List

NECC Meeting 11-12 January 1999
Jumer's Castle Lodge, Bettendorf, IA

Name	Affiliation	Address	Phone	E-mail
Ken Barr	CEMVR-PM-R	P.O. Box 2004, Clock Tower Bldg. Rock Island, IL 61204-2004	(309) 794-5349	Kenneth.A.Barr@usace.army.mil
John Barko	CEWES-ES	3309 Halls Ferry Road Vicksburg, MS 39180-6199	(601) 634-3654	John.W.Barko@usace.army.mil
Steve Bartell	Cadmus Group	136 Mitchell Rd. Oak Ridge, TN 37830	(423) 425-0401	sbartell@cadmusgroup.com
Gretchen Benjamin	WI DNR	3550 Mormon Coulee Rd. La Crosse, WI 54601	(608) 785-9982	benjag@dnr.state.wi.us
Bill Bertrand	IL DNR	P.O. Box 149, 2106 SE Third Aledo, IL 61231	(309) 582-5611	dnrbrp@netins.net
Doug Blodgett	TNC	301 S.W. Adams St., Suite 1007 Peoria, IL 61602	(309) 673-6689	dblodgett@fgi.net
Ken Brummett	MO DNR	Box 428 Hannibal, MO 63401	(573) 248-2530	brummk@mail.conservation.state.mo.us
Jon Duyvejonck	USFWS	4469 48th Ave. Ct. Rock Island, IL 61201	(309) 793-5800	Jon_Duyvejonck@fws.gov
Rich Fristik	CEMVR-PM-R	P.O. Box 2004, Clock Tower Bldg. Rock Island, IL 61204-2004	(309) 794-5308	Richard.Fristik@usace.army.mil
Steve Johnson	MN DNR	500 Lafayette Road St. Paul, MN 55155-4032	(612) 296-4802	Steve.Johnson@dnr.state.mn.us
Kevin Landwehr	CEMVR-ED-HH	P.O. Box 2004, Clock Tower Bldg. Rock Island, IL 61204-2004	(309) 794-5578	Kevin.J.Landwehr@usace.army.mil
Gary Loss	CEMVR-PM-P	P.O. Box 2004, Clock Tower Bldg. Rock Island, IL 61204-2004	(309) 794-5355	Gary.L.Loss@usace.army.mil
Tom Pokrefke	CEWES-HR	3309 Halls Ferry Road Vicksburg, MS 39180-6199	(601) 634-2650	Thomas.J.Pokrefke@usace.army.mil
Don Swensson	QCCA	2621 4th Ave. Rock Island, IL 61201	(309) 788-5912	QCCA@aol.com
Bernard Schonoff	IA DNR	3390 Hwy. 22 Muscatine, IA 52761	(319) 263-5062	fishiowa@muscanet.com
David Soong	ISWS	2204 Griffith Drive Champaign, IL 61822	(217) 333-1495	dawei@sparc.sws.uiuc.edu
Brad Thompson	CEMVR-PM-MW	P.O. Box 2004, Clock Tower Bldg. Rock Island, IL 61204-2004	(309) 794-5256	Bradley.E.Thompson@usace.army.mil
Scott Whitney	CEMVR-PD-E	P.O. Box 2004, Clock Tower Bldg. Rock Island, IL 61204-2004	(309) 794-5386	Scott.D.Whitney@usace.army.mil
Dan Wilcox	CEMVP-PE-M	190 Fifth Street East St. Paul, MN 55101-1638	(612) 290-5276	Daniel.B.Wilcox@usace.army.mil

Attachment 2

Miss-IWW Navigation Study Technical Reports

Indicates ITR commitment has been satisfied (shaded)

Study Leader	Report No.	TITLE	Primary Author	ITR Reviewers		NECC Review
KEEVIN	1	*Computer model for transport of larvae between barge tows in rivers.*	HOLLEY	MAYNORD	SCHNEIDER	YES
	2	*Effects of propeller entrainment on riverine ichthyoplankton.*	KILLGORE	CADA	VANWINKLE	YES
	3	*Inflow zone and discharge through propeller jets.*	MAYNORD	MARTIN	GARCIA	YES
	4	*Shear stress on the hull of shallow draft barges.*	MAYNORD	MARTIN	GARCIA	YES
	5	*Hull shear mortality of eggs and larval fish.*	MAYNORD	CADA	GARCIA	YES
	6	*Physiological effects on freshwater mussels (Family: Unionidae) of intermittent exposure to physical effects of navigation traffic.*	PAYNE	CUMMINGS DOWNING	WATTERS	YES
	7	*Determination of the fate of fish displaced from low-velocity habitats at low temperatures.*	SHEEHAN	THOMERSON	SCHAEFFER	YES
	8	*Determination of the tolerance of fish in low-velocity habitats to hydraulic disturbance at low temperatures.*	SHEEHAN	THOMERSON	SCHAEFFER	YES
	9	*Effects of pressure changes induced by commercial navigation traffic on mortality of fish early life stages.*	KEEVIN	CADA	MAYNORD	YES
	10	*Stranding potential of young fishes.*	ADAMS	CADA	THOMERSON	YES
	11	*Mortality of fish early life stages resulting from hull shear associated with passage of commercial navigation traffic.*	KEEVIN	CADA	VANWINKLE	YES
	12	*Abundance of fishes in the navigation channels of the Mississippi and Illinois Rivers, and estimation of entrainment mortality caused by*	GUTREUTER	SCHAEFFER JENSEN	VANWINKLE	NO
	13	*Mortality of animals due to highway and railroad collisions*	SCHAEFFER	GEHRT		YES
	14	*Effects of commercial Traffic on Freshwater Mussels in the Upper Mississippi River System. (STELLA MODEL)*	SCHAEFFER	Will be Incorporated into Rpt. 18		YES
	15	*Water velocities behind wing dams (Flume Study)*	MAYNORD	Davinroy	Pokrefke	YES
	16	*Water velocities behind wing dams (Field Study)*	MAYNORD	Study not Started		NO
	16B	*Ecological Models and Approach to Risk Assessment*	BARTELL	JENSEN KIMBER WHITNEY	CADA CARPENTER WATTERS	NO
	17	*Ecological risk assessment of the effects of the incremental increases of commercial navigation traffic on larval fish entrainment*	BARTELL	JENSEN	CADA	NO
	18	*Ecological risk assessment of the effects of the incremental increases of commercial navigation traffic on mussels*	BARTELL	Awaiting Report		NO
POKREFKE	19 & 22 (will be combined)	*Definitions, Boundary Delineations, and Measurements of Attributes for the Hydraulic Classification of Aquatic Areas*	NICKELS	POKREFKE	GAUGUSH	NO
		Hydraulic Classification Analysis (Appendix to Classification Definitions Report)	POKREFKE	BIEDENHARN	GAUGUSH	YES
	20 (C11)	*Application of UNET Model to Vessel Drawdown in Backwaters of Navigation Channels*	MAYNORD	MARTIN	SOONG	YES
	21 (C14)	*Comparison of NAVEFF Model to Field Return Velocity and Drawdown Data*	MAYNORD	MARTIN	SOONG	YES
	23 (Reprint)	*Users Manual for Application of HIVEL Hydrodynamic Model on the Upper Mississippi River*	STOCKSTILL	BERNARD	HUDDLESTON	NA
	24 (C10)	*A two-dimensional flow model for vessel-generated currents*	STOCKSTILL	BERNARD	HUDDLESTON	YES
	25	*Entrainment and Transport of Sediments by Towboats in the Upper Mississippi River and Illinois Waterway, Numerical Model Study*	COPELAND	HOLLEY	HALL	NO
	26	*Wave-Induced Sediment Resuspension Near the Shorelines of Upper Mississippi River Study*	PARCHURE	MEHTA	GAILANI	NO
	27	*Wave height predictive techniques for commercial tows on the UMRS*	MARTIN	MAYNORD	KIMBER	YES
	28 (C13)	*Data collection methodology for bathymetry and sediment data used in navigation feasibility studies*	ROGALA	AIDALA	GAUGUSH	YES
	28B	*Physical Forces Near Commercial Tows*	MAYNORD	MARTIN	GARCIA	NO
WILCOX	29 (C12)	*Effects of Sediment Resuspension and Deposition on Plant Growth and Reproduction*	DOYLE	KIMBER	BEST	YES
	30	*Effects of Rec. Boating: Traffic Allocation and Forecasting Model*	CARLSON	WARD		NO
	31	*Ecological risk assessment of the effects of the incremental increase of commercial navigation traffic on submerged aquatic plants.*	BARTELL	KIMBER	CARPENTER	NO
BECKERT	32	*Cumulative Impacts*	WEST	POKREFKE BAYLEY	BARKO THORTON	NO
COMPLETED REPORTS	C1	*Flume study investigations of the direct impacts of navigation-generated waves on submersed aquatic macrophytes in the Upper Miss. River.*	STEWART	MADSEN	SKOGERBOE	YES
	C2	*Rates of net fine sediment accumulation in selected backwater types of Pool 8, Upper Mississippi River.*	ROGALA	SOONG		YES
	C3	*Physical Forces Study, Kampsville, Illinois Waterway*	MAYNORD	NA - Data Report		YES
	C4	*Prediction of vessel-generated waves with reference to vessels common to the Upper Miss. River System.*	SORENSEN	NA - Literature Review		YES
	C5	*Physical Forces Study, Clarks Ferry, Upper Mississippi River*	MAYNORD	NA - Data Report		YES
	C6	*Upper Mississippi River navigation and sedimentation field data collection summary report.*	PRATT	NA - Data Report		YES
	C7	*Site Specific Habitat Assessment*	FRISTIK	BURKS	SCHROEDER	YES
	C8	*Bank Erosion Field Survey Report of the Upper Mississippi River and Illinois Waterway*	ISWS/IIHR	HAGERTY	MELLEMA	YES
	C9	*Identification of Potential Commercial Navigation Related Bank Erosion Sites*	LANDWEHR	CHAMBERLAIN	MAYNORD	YES

Attachment 3

Biological Response Modeling and Risk Assessment
(Fish, Plants, and Mussels)

24th Meeting of the NECC
January 11-12,1999

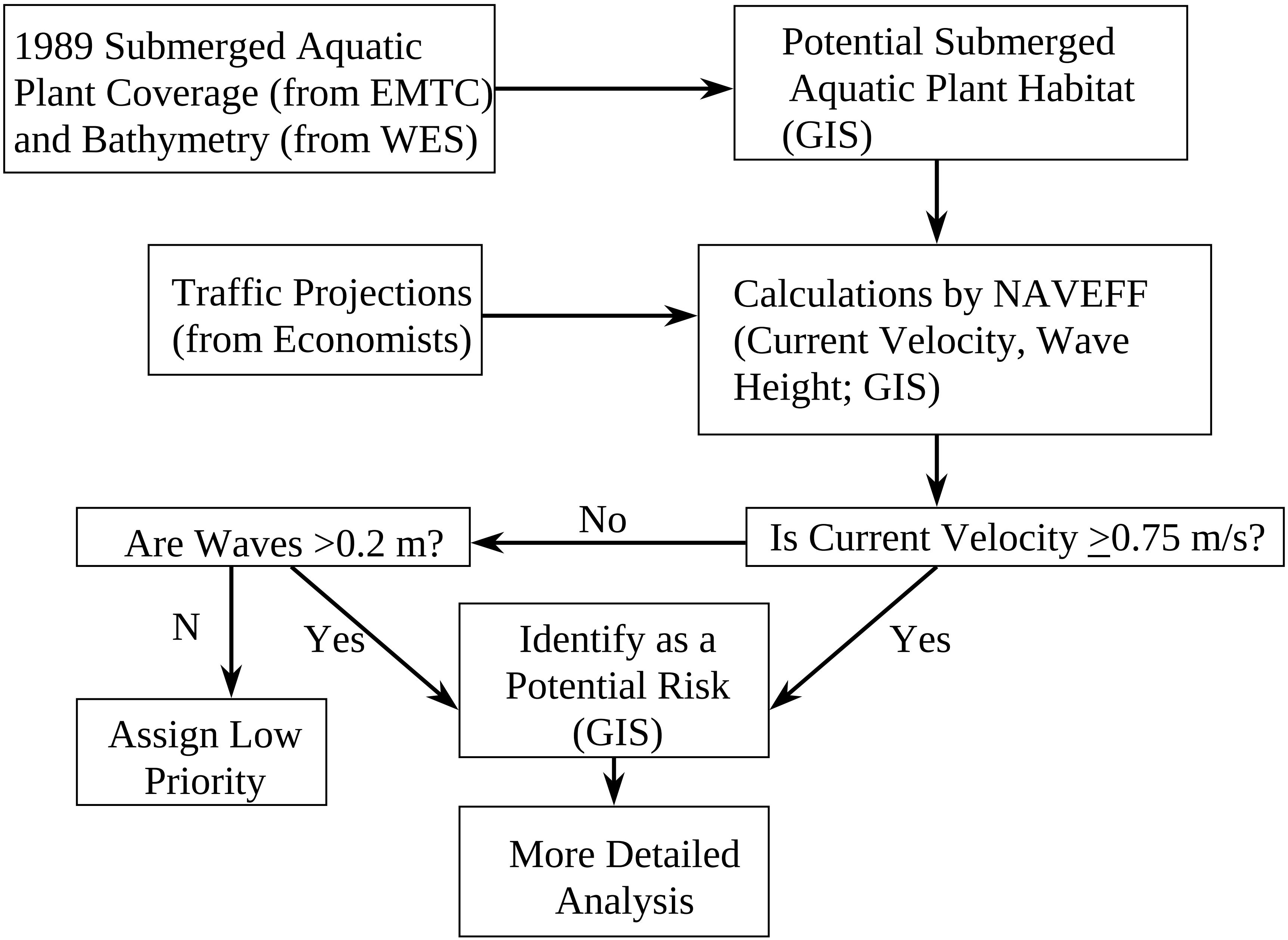
by

Steve Bartell
The Cadmus Group, Inc.

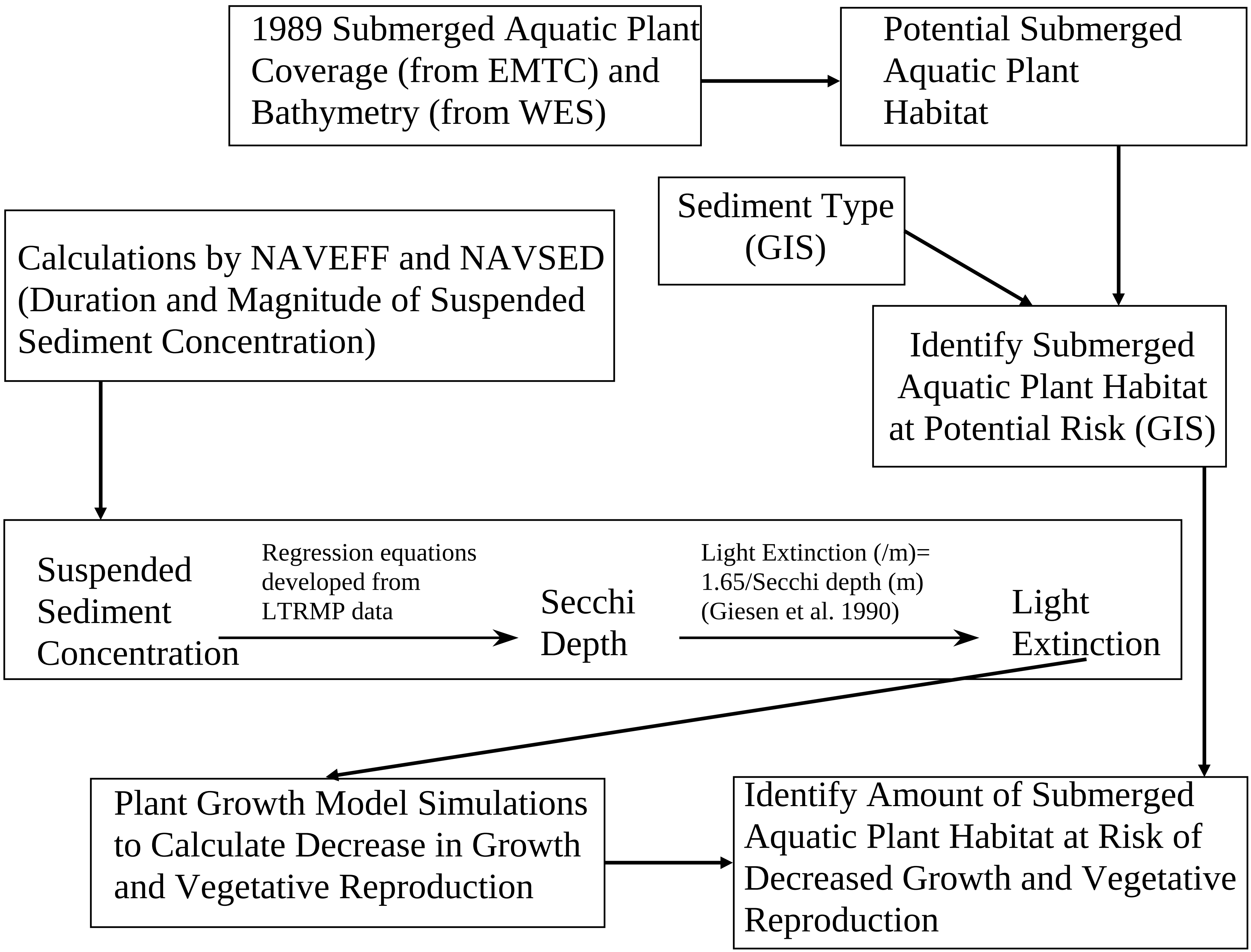
Handout SB1. Baseline Traffic used in fish models.

Baseline Traffic Intensity (mean vessels/day) for UMRS-IW Long Term Resource Monitoring Pools Based on 1992 Data					
Month	**UMRS 04**	**UMRS 08**	**UMRS 13**	**UMRS 26**	**La Grange**
January	0.0	0.0	0.0	12.9	10.1
February	0.0	0.0	0.0	14.6	11.0
March	1.9	2.2	5.2	21.3	9.4
April	4.8	5.3	8.4	22.8	9.1
May	5.7	6.2	8.9	22.3	8.5
June	5.4	6.1	8.3	21.7	7.8
July	5.9	6.7	9.2	23.3	8.7
August	5.8	6.4	8.3	21.4	8.2
September	4.7	5.2	6.9	20.7	8.6
October	4.7	5.0	7.0	21.7	9.4
November	3.3	3.8	6.0	20.5	9.4
December	0.0	0.0	0.7	17.8	12.3

Handout SB2. Flowchart for Plant Model (Direct Impacts).



Handout SB3. Flowchart for Plant Model (Indirect Impacts).



Handout SB4. Plant Model Output for Wild Celery.

Table 15
Impacts on Total (Living + Dead) Biomass (g dry mass/m²) of Wild Celery for the Percentage Increase Traffic Scenarios for the UMR-IWW System. Values in Parentheses are Percent Changes in Production Referenced to the 1992 Baseline Impacts.

Pool	Baseline 1992	Percent Traffic Increase 25	50	75	100
Pool 4					
Annual Sum	14,56	14,126 (-3.0)	13,892 (-4.6)	13,706 (-5.9)	13,470 (-7.5)
Mean Biomass	39.	38.7 (-3.0)	38.1 (-4.5)	37.6 (-5.8)	36.9 (-7.5)
Maximum Biomass	111.	108.2 (-3.2)	106.5 (-4.7)	104.8 (-6.3)	103.1 (-7.8)
Pool 8					
Annual Sum	10,20	10,135 (-0.7)	10,039 (-1.7)	9,971 (-2.3)	9,907 (-2.9)
Mean Biomass	39.	39.1 (-0.8)	38.8 (-1.5)	38.5 (-2.3)	38.3 (-2.8)
Maximum Biomass	79.	78.3 (-0.9)	77.6 (-1.8)	77.0 (-2.5)	76.5 (-3.2)
Pool 13					
Annual Sum	17,37	15,228 (-12.3)	14,304 (-17.7)	13,263 (-23.6)	12,944 (-25.5)
Mean Biomass	47.	41.7 (-12.3)	39.2 (-17.6)	36.3 (-23.7)	35.5 (-25.4)
Maximum Biomass	134.	117.7 (-12.7)	109.8 (-18.6)	101.8 (-24.5)	98.9 (-26.7)

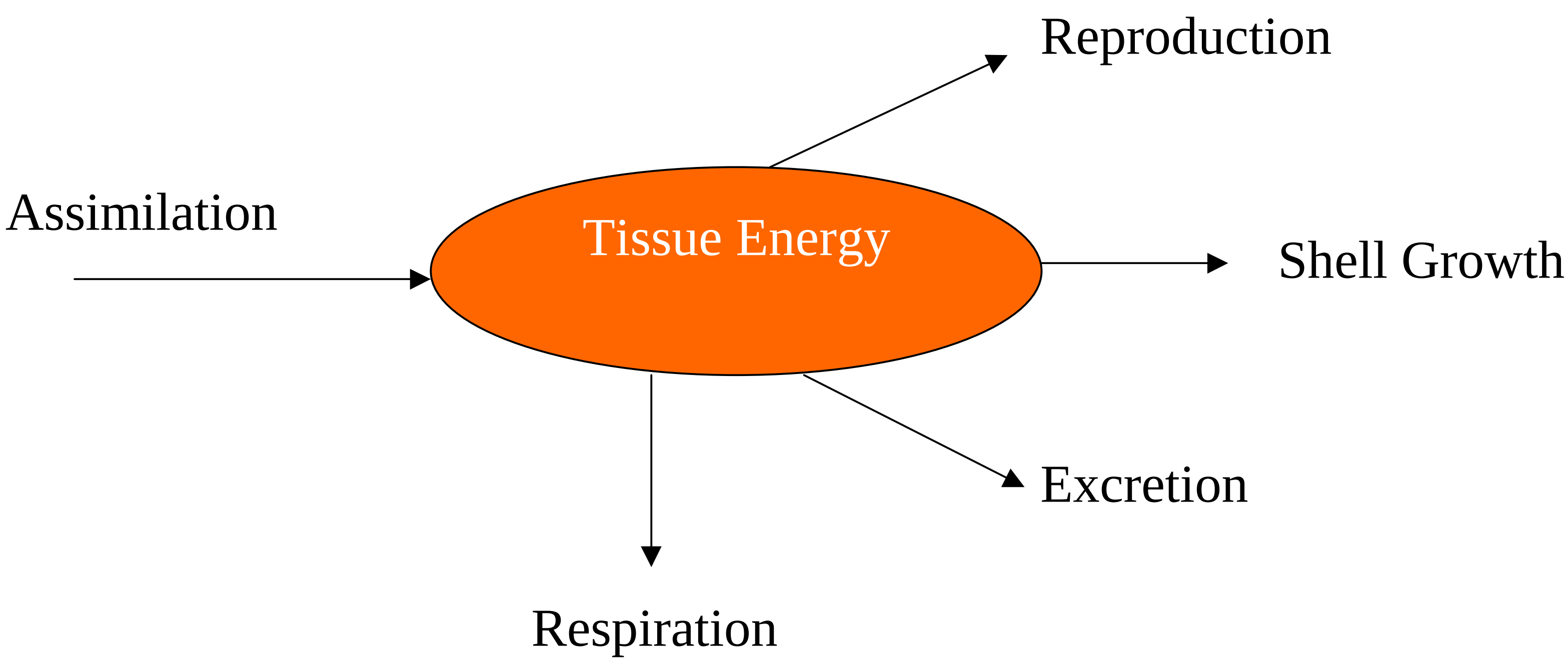
Handout SB5. Plant Model Output for Sago Pondweed.

Table 17

Impacts on Total (Living + Dead) Biomass (g dry mass/m²) of Sago Pondweed for the Percentage Increase Traffic Scenarios for the UMR-IWW System. Values in Parentheses are Percent Changes in Production Referenced to the 1992 Baseline Impacts.

		Percent Traffic Increase			
Pool	**Baseline 1992**	**25**	**50**	**75**	**100**
Pool 4					
Annual Sum	25,905	25,660 (-0.9)	25,524 (-1.5)	25,378 (-2.0)	25,272 (-2.4)
Mean Biomass	71.0	70.3 (-1.0)	69.9 (-1.5)	69.5 (-2.1)	69.2 (-2.5)
Maximum Biomass	164.6	162.9 (-1.0)	162.3 (-1.4)	161.0 (-2.2)	160.5 (-2.5)
Pool 8					
Annual Sum	23,047	22,992 (-0.2)	22,925 (-0.5)	22,873 (-0.8)	22,820 (-1.0)
Mean Biomass	81.2	80.9 (-0.4)	80.7 (-0.6)	80.5 (-0.9)	80.4 (-1.0)
Maximum Biomass	149.8	149.4 (-0.3)	148.9 (-0.6)	148.6 (-0.8)	148.2 (-1.1)
Pool 13					
Annual Sum	26,910	25,922 (-3.7)	25,464 (-5.4)	24,804 (-7.8)	24,599 (8.6)
Mean Biomass	73.7	71.0 (-3.7)	69.8 (-5.3)	67.9 (-7.9)	67.4 (-8.5)
Maximum Biomass	170.3	163.9 (-3.8)	160.4 (-5.8)	156.7 (-8.0)	154.9 (-9.0)

Unionid Mussel Bioenergetics Model



Schaeffer et al., 1998

Attachment 4

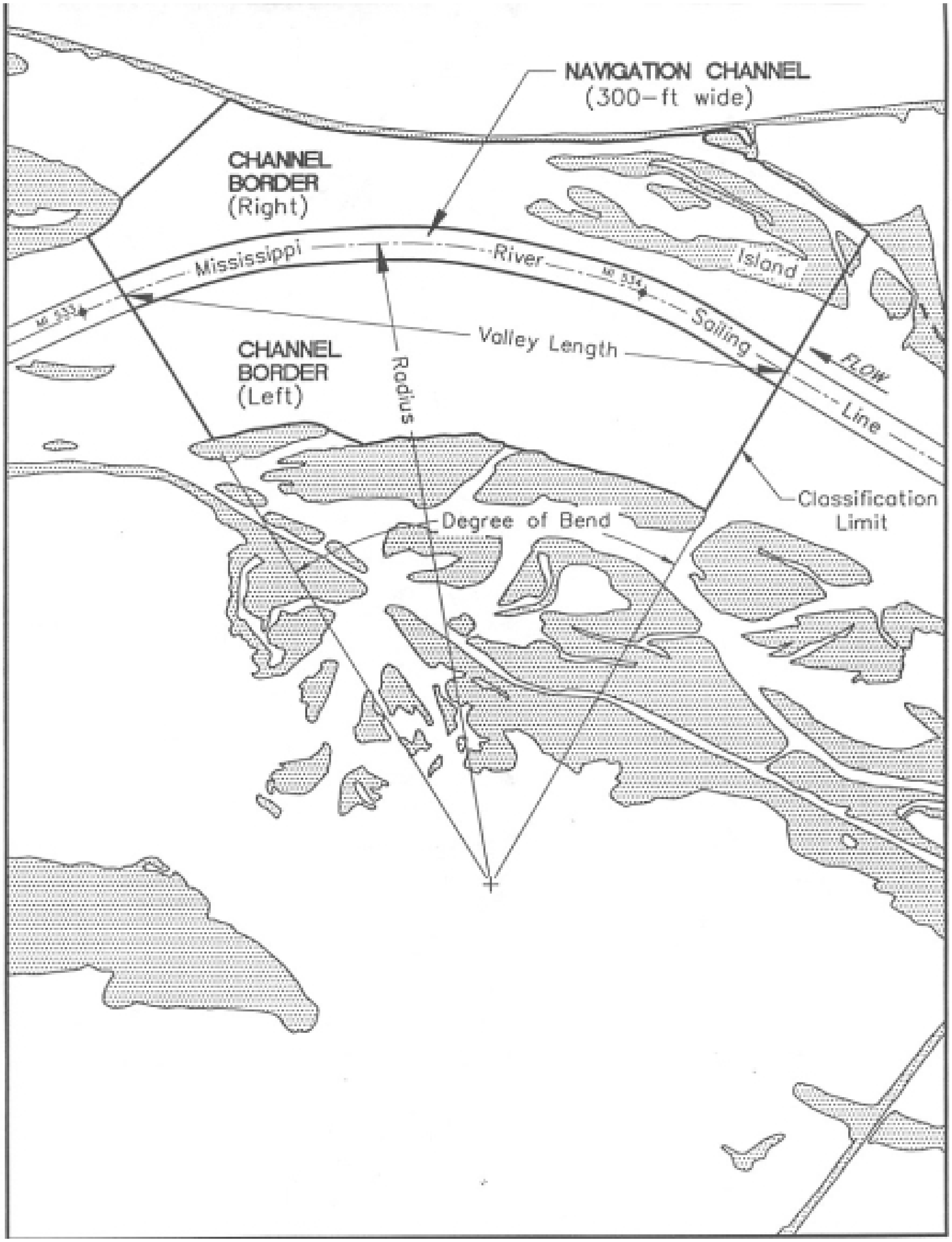
Hydraulic Classification of Aquatic Areas
and
Traffic Induced Sediment Delivery to Backwaters

23[st] Meeting of the NECC
September 29-30,1998

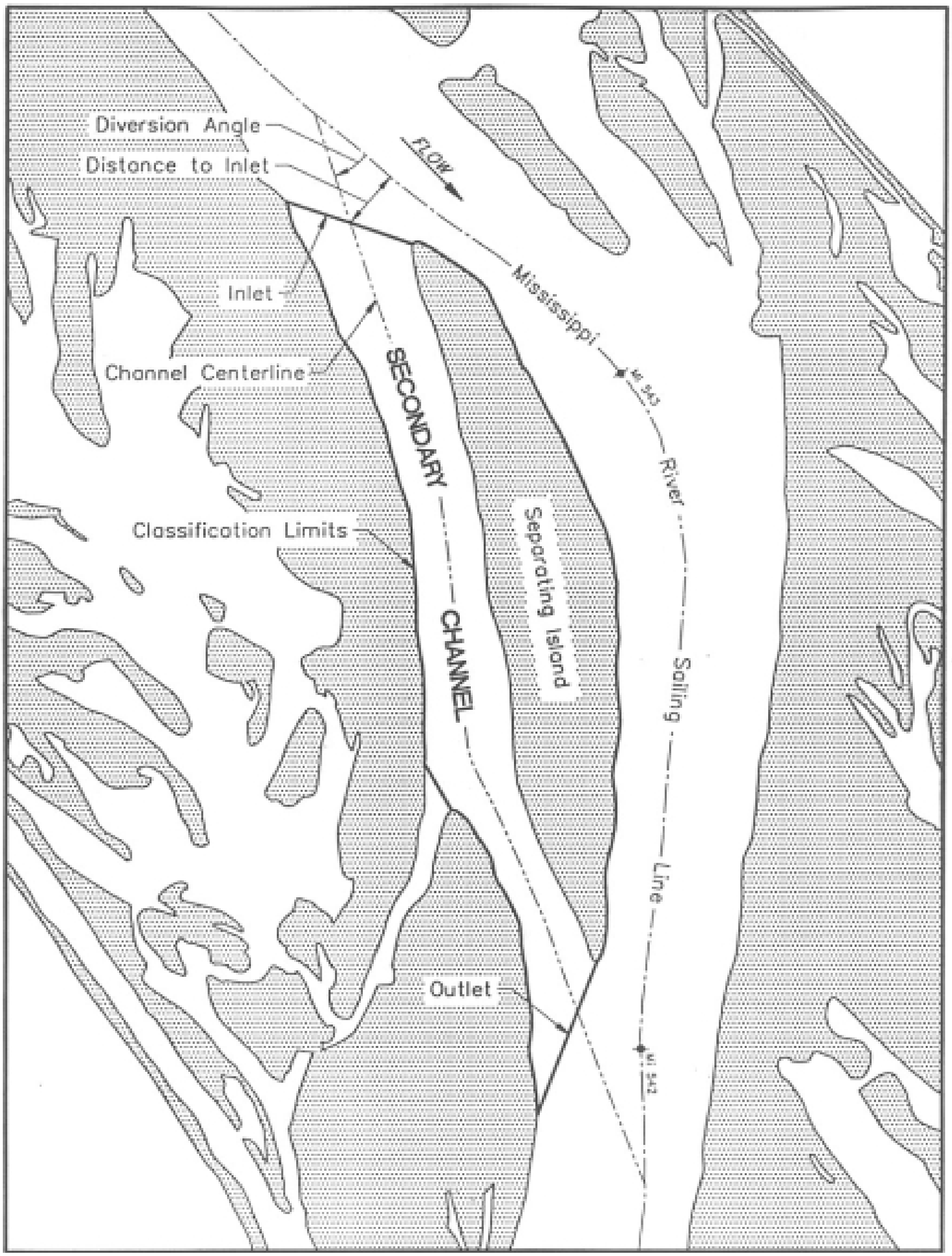
by

Tom Pokrefke
US Army Corps of Engineers
Waterways Experiment Station

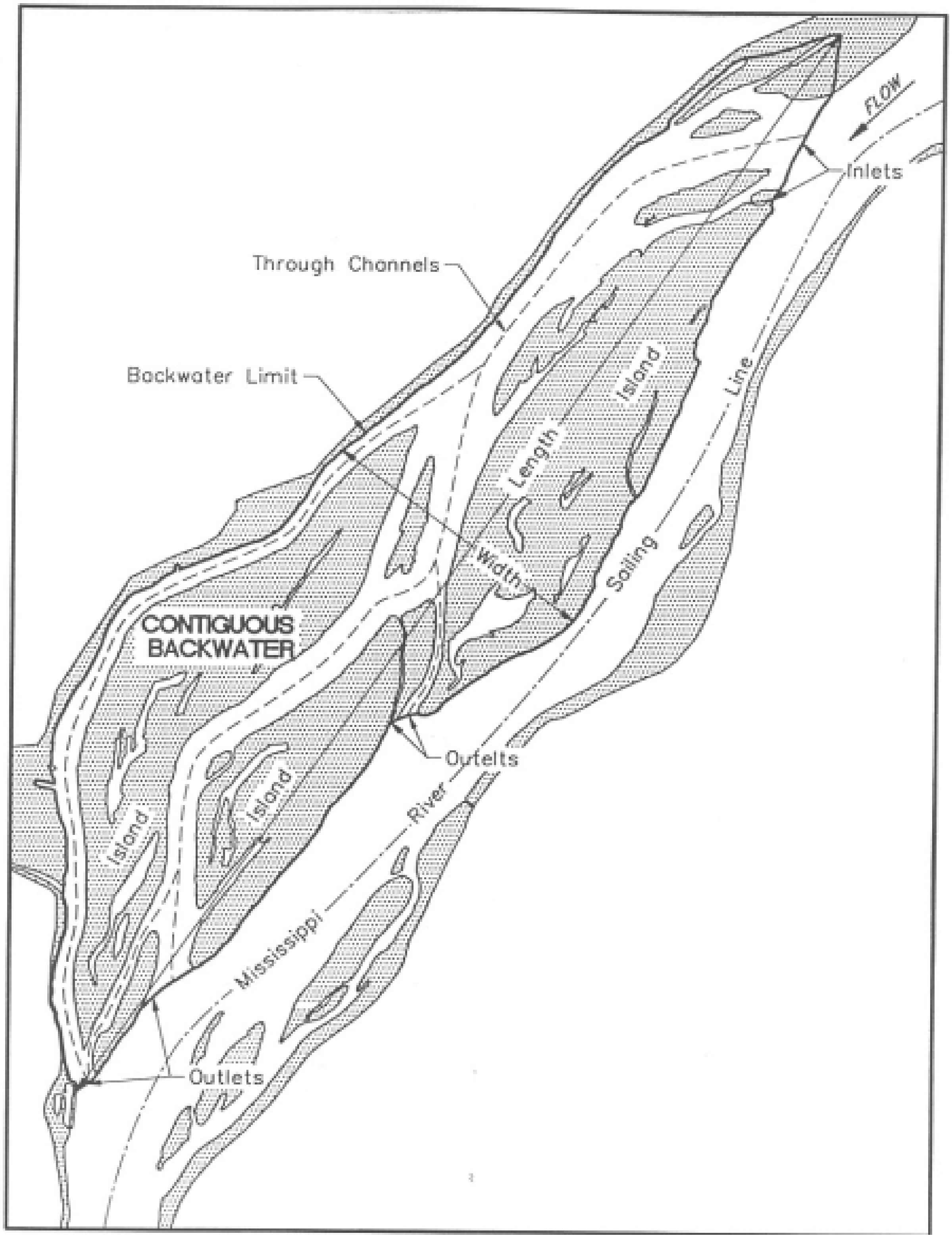
Handout TP1. Hydraulic Classification Analysis - Main Channel Bend.



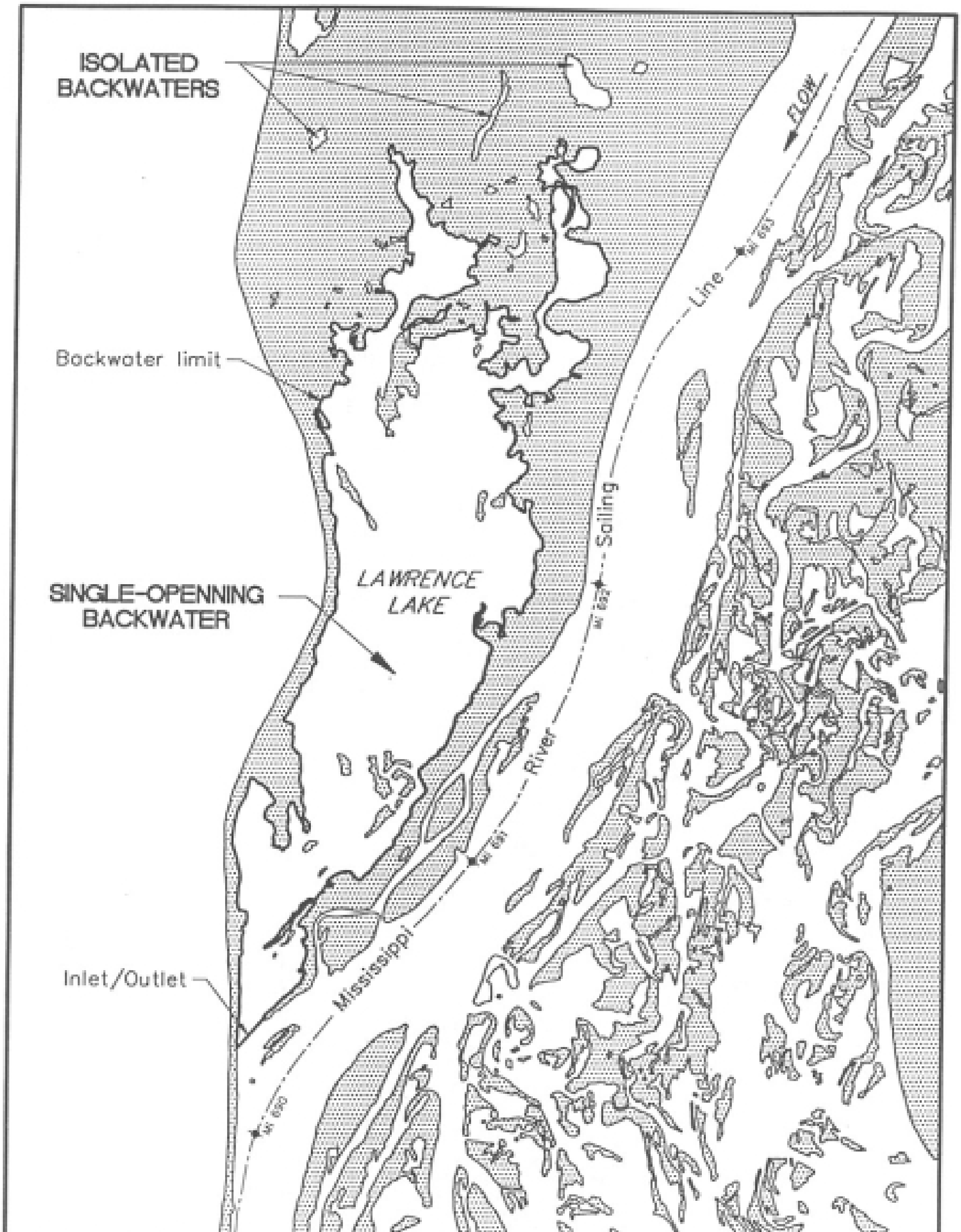
Handout TP2. Hydraulic Classification Analysis - Secondary Channel.



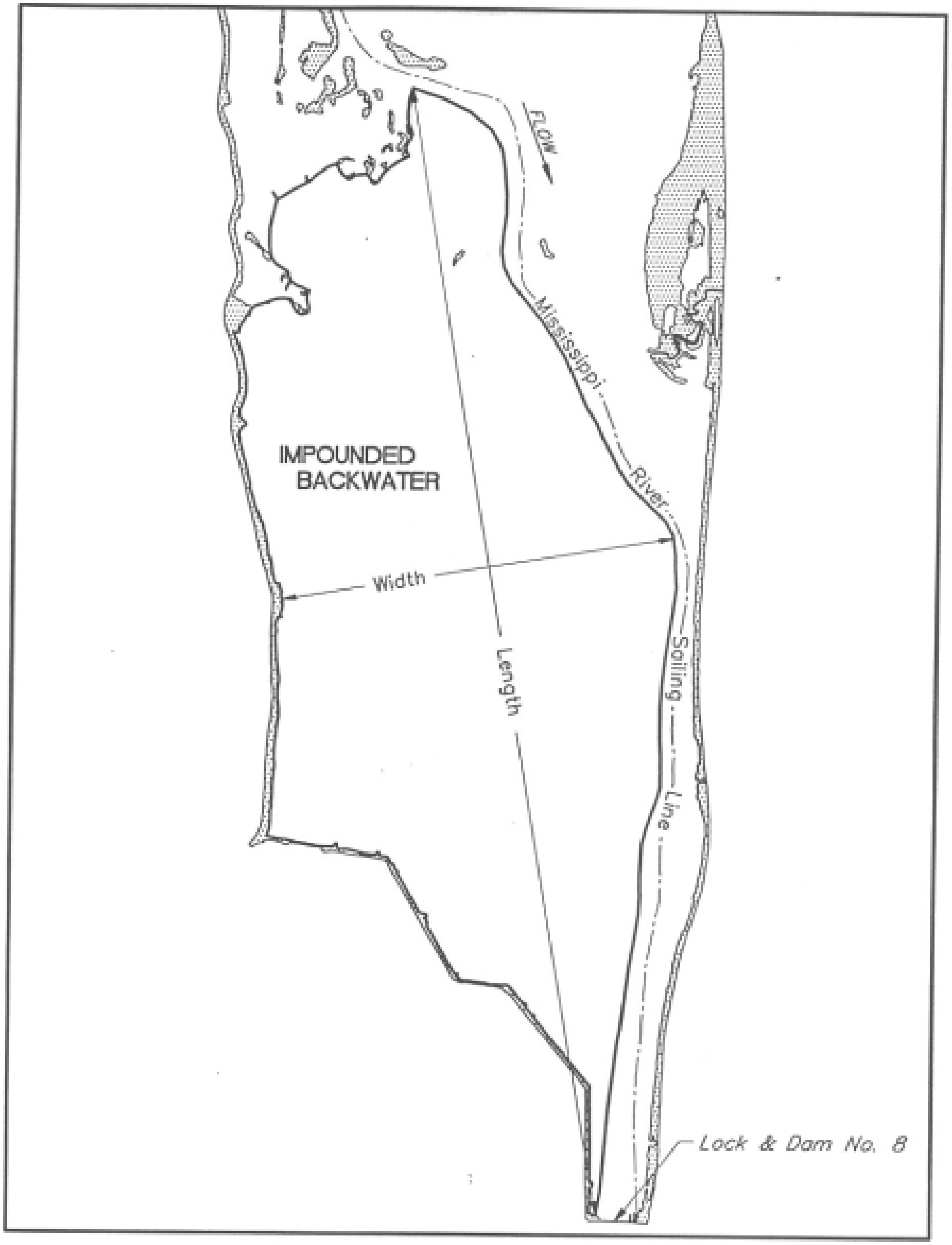
Handout TP3. Hydraulic Classification Analysis - Contiguous Backwater.



Handout TP4. Hydraulic Classification Analysis - Contiguous Single Opening Backwater and Isolated Backwater.



Handout TP5. Hydraulic Classification Analysis - Impounded Backwater.



Handout TP6. Summary of Hydraulic Classification Analysis of Pools 4 through 17

a. 11 contiguous backwaters have single inlet and outlet

1. Average total area is 660 acres.
2. Total area ranges from 112 to 2,771 acres.
3. Average area covered by water is 416 acres.
4. Area covered by water ranges from 42 to 2,328 acres.
5. 1 backwater is adjacent to Group 2 soft cohesive bed material, 3 are adjacent to Group 2 medium cohesive bed material, and 7 are adjacent to noncohesive bed material,

b. 9 contiguous backwaters have multiple inlets and single outlet

1. Average total area is 1,305 acres.
2. Total area ranges from 53 to 5,471 acres.
3. Average area covered by water is 527 acres.
4. Area covered by water ranges from 24 to 2,517 acres.
5. 1 backwater is adjacent to Group 2 soft cohesive bed material, 2 are adjacent to Group 2 medium cohesive bed material, and 6 are adjacent to noncohesive bed material,

c. 7 contiguous backwaters have single inlet and multiple outlets

1. Average total area is 1,187 acres.
2. Total area ranges from 85 to 4,116 acres.
3. Average area covered by water is 461 acres.
4. Area covered by water ranges from 39 to 1,235 acres.
5. No backwater is adjacent to Group 2 soft cohesive bed material, 2 are adjacent to Group 2 medium cohesive bed material, and 5 are adjacent to noncohesive bed material,

d. 50 contiguous backwaters have multiple inlets and outlets

1. Average total area is 2,201 acres.
2. Total area ranges from 54 to 8,246 acres.
3. Average area covered by water is 1,166 acres.
4. Area covered by water ranges from 23 to 4,143 acres.
5. 2 backwaters are adjacent to Group 2 soft cohesive bed material, 22 are adjacent to Group 2 medium cohesive bed material, and 26 are adjacent to noncohesive bed material,

e. 20 single channel contiguous backwaters.

1. Average total area is 208 acres.
2. Total area ranges from 8 to 653 acres.
3. Average area covered by water is 146 acres.
4. Area covered by water ranges from 5 to 633 acres.
5. No backwater is adjacent to Group 2 soft cohesive bed material, 6 are adjacent to Group 2 medium cohesive bed material, and 13 are adjacent to noncohesive bed material.
6. One backwater was created by a railroad embankment and not included.

Handout TP6 (continued)

f. 16 Impounded contiguous backwaters.

1. Average total area is 3,683 acres.
2. Total area ranges from 377 to 8,042 acres.
3. Average area covered by water is 3,466 acres.
4. Area covered by water ranges from 366 to 7,946 acres.
5. No backwater is adjacent to Group 2 soft cohesive bed material, 8 are adjacent to Group 2 medium cohesive bed material, and 8 are adjacent to noncohesive bed material,

g. 28 secondary channels.

1. Average channel length is 9,179 ft.
2. Range of channel length is 3,474 to 22,449 ft.
3. Average minimum width is 406 ft.
4. Range of minimum width is 123 to 763 ft.
5. Average deflection angel is 39 degrees.
6. Range of deflection angle is 2 to 84 degrees.
7. Average distance from navigation channel to inlet is 881 ft.
8. Range of distance to inlet is 263 to 1,734 ft.
9. 1 secondary channel is adjacent to Group 2 soft cohesive bed material, 11 are adjacent to Group 2 medium cohesive bed material, and 16 are adjacent to noncohesive bed material,

h. No sediment samples comprised of Group 1 cohesive bed material were identified.

i. All sediment samples obtained in the navigation channel were noncohesive bed material.

j. Collectively 211 miles of channel borders have Group 2 cohesive bed material.

k. Of 211 miles, 191 miles have backwaters or secondary channels adjacent to the channel border with Group 2 cohesive bed material.

l. Of 77 contiguous backwaters with at least one inlet and outlet

1. All or part of 4 are adjacent to Group 2, soft cohesive bed material.
2. All or part of 29 are adjacent to Group 2, medium cohesive bed material.
3. All or part of 44 are adjacent to noncohesive bed material.

m. Of 20 single channel contiguous backwaters

1. All or part of 6 are adjacent to Group 2, medium cohesive bed material.
2. All or part of 14 are adjacent to noncohesive bed material.

n. Of 16 impounded contiguous backwaters

1. All or part of 8 are adjacent to Group 2, medium cohesive bed material.
2. All or part of 8 are adjacent to noncohesive bed material.

o. Of 31 secondary channels

1. All or part of 1 is adjacent to Group 2, soft cohesive bed material.
2. All or part of 11 are adjacent to Group 2, medium cohesive bed material.
3. All or part of 16 are adjacent to noncohesive bed material.
4. All or part of 3 have not been completely delineated in the hydraulic classification.

Handout TP7. Summary of Hydraulic Classification Analysis of Pools 18 - 17.

a. 16 contiguous backwaters have single inlet and outlet

1. Average total area is 285 acres.
2. Total area ranges from 8 to 1,342 acres.
3. Average area covered by water is 101 acres.
4. Area covered by water ranges from 2 to 631 acres.
5. 1 backwater is adjacent to Group 2 soft cohesive bed material, 8 are adjacent to Group 2 medium cohesive bed material, and 7 are adjacent to noncohesive bed material,

b. 16 contiguous backwaters have multiple inlets and single outlet

1. Average total area is 740 acres.
2. Total area ranges from 125 to 2,128 acres.
3. Average area covered by water is 311 acres.
4. Area covered by water ranges from 50 to 979 acres.
5. No backwaters are adjacent to Group 2 soft cohesive bed material, 6 are adjacent to Group 2 medium cohesive bed material, and 10 are adjacent to noncohesive bed material,

c. 3 contiguous backwaters have single inlet and multiple outlets

1. Average total area is 1,305 acres.
2. Total area ranges from 336 to 2,574 acres.
3. Average area covered by water is 538 acres.
4. Area covered by water ranges from 262 to 849 acres.
5. No backwater is adjacent to Group 2 soft cohesive bed material, 1 is adjacent to Group 2 medium cohesive bed material, and 2 are adjacent to noncohesive bed material,

d. 12 contiguous backwaters have multiple inlets and outlets

1. Average total area is 2,859 acres.
2. Total area ranges from 369 to 7,218 acres.
3. Average area covered by water is 1,030 acres.
4. Area covered by water ranges from 114 to 3,753 acres.
5. No backwaters are adjacent to Group 2 soft cohesive bed material, 7 are adjacent to Group 2 medium cohesive bed material, and 5 are adjacent to noncohesive bed material,

e. 17 single channel contiguous backwaters.

1. Average total area is 180 acres.
2. Total area ranges from 11 to 701 acres.
3. Average area covered by water is 96 acres.
4. Area covered by water ranges from 10 to 338 acres.
5. No backwater is adjacent to Group 2 soft cohesive bed material, 7 are adjacent to Group 2 medium cohesive bed material, and 10 are adjacent to noncohesive bed material,

f. 5 impounded contiguous backwaters.

1. Average total area is 1,306 acres.
2. Total area ranges from 684 to 1,923 acres.
3. Average area covered by water is 1,163 acres.
4. Area covered by water ranges from 684 to 1,728 acres.
5. No backwater is adjacent to Group 2 soft cohesive bed material, 4 are adjacent to Group 2 medium cohesive bed material, and 1 is adjacent to noncohesive bed material, but was not included in this analysis.

Handout TP7 (continued)

g. 18 secondary channels.

1. Average channel length is 11,637 ft.
2. Range of channel length is 4,486 to 19,702 ft.
3. Average minimum width is 552 ft.
4. Range of minimum width is 173 to 1,209 ft.
5. Average deflection angel is 38 degrees.
6. Range of deflection angle is 17 to 82 degrees.
7. Average distance from navigation channel to inlet is 1,044 ft.
8. Range of distance to inlet is 546 to 1,758 ft.
9. No secondary channel is adjacent to Group 2 soft cohesive bed material, 11 are adjacent to Group 2 medium cohesive bed material, and 7 are adjacent to noncohesive bed material,

h. No sediment samples comprised of Group 1 cohesive bed material were identified.

i. All sediment samples obtained in the navigation channel were noncohesive bed material.

j. Collectively 205 miles of channel borders have Group 2 cohesive bed material.

k. Of 205 miles, 175 miles have backwaters or secondary channels adjacent to the channel border with Group 2 cohesive bed material.

l. Of 47 contiguous backwaters with at least one inlet and outlet

1. All or part of 1 is adjacent to Group 2, soft cohesive bed material.
2. All or part of 22 are adjacent to Group 2, medium cohesive bed material.
3. All or part of 24 are adjacent to noncohesive bed material.

m. Of 17 single channel contiguous backwaters

1. All or part of 7 are adjacent to Group 2, medium cohesive bed material.
2. All or part of 10 are adjacent to noncohesive bed material.

n. Of 5 impounded contiguous backwaters

1. All or part of 4 are adjacent to Group 2, medium cohesive bed material.
2. All or part of 1 is adjacent to noncohesive bed material.

o. Of 18 secondary channels

1. All or part of 10 are adjacent to Group 2, medium cohesive bed material.
2. All or part of 8 are adjacent to noncohesive bed material.

Handout TP8. Summary of Hydraulic Classification Analysis of Open River Reach.

a. All segments of the reach have noncohesive (sand) bed material in the channel borders and navigation channel.

b. 13 contiguous backwaters with at least one inlet and one outlet

1. Average total area is 206 acres.
2. Total area ranges from 30 to 579 acres.
3. Average area covered by water is 32 acres.
4. Area covered by water ranges from 10 to 268 acres.

c. 16 single channel contiguous backwaters.

1. Average total area is 163 acres.
2. Total area ranges from 15 to 1,141 acres.
3. Average area covered by water is 82 acres.
4. Area covered by water ranges from 12 to 227 acres.

d. 3 secondary channels.

1. Average channel length is 12,997 ft.
2. Range of channel length is 10,542 to 16,945 ft.
3. Average minimum width is 635 ft.
4. Range of minimum width is 130 to 1,165 ft.
5. Average deflection angel is 51 degrees.
6. Range of deflection angle is 35 to 77 degrees.
7. Average distance from navigation channel to inlet is 1,114 ft.
8. Range of distance to inlet is 828 to 1,509 ft.

e. All sediments in the navigation channel and channel borders were noncohesive.

Handout TP9. Summary of Hydraulic Classification Analysis the Illinois Waterway.

a. 12 contiguous backwaters have single inlet and outlet

1. Average total area is 851 acres.
2. Total area ranges from 29 to 6,055 acres.
3. Average area covered by water is 750 acres.
4. Area covered by water ranges from 18 to 5,873 acres.
5. No backwaters are adjacent to Group 2 soft cohesive bed material, 8 are adjacent to Group 2 medium cohesive bed material, and 4 are adjacent to noncohesive bed material,

b. 1 contiguous backwater has multiple inlets and single outlet

1. Average total area is 131 acres.
2. Average area covered by water is 527 acres.
3. Backwater is adjacent to noncohesive bed material,

c. 7 contiguous backwaters have single inlet and multiple outlets

1. Average total area is 2,953 acres.
2. Total area ranges from 84 to 11,095 acres.
3. Average area covered by water is 1,159 acres.
4. Area covered by water ranges from 71 to 2,762 acres.
5. No backwaters are adjacent to Group 2 soft cohesive bed material, 6 are adjacent to Group 2 medium cohesive bed material, and 1 is adjacent to noncohesive bed material,

d. 2 contiguous backwaters have multiple inlets and outlets

1. Average total area is 914 acres.
2. Total area ranges from 353 to 1,476 acres.
3. Average area covered by water is 322 acres.
4. Area covered by water ranges from 311 to 334 acres.
5. 1 backwater is adjacent to Group 2 soft cohesive bed material, 1 is adjacent to Group 2 medium cohesive bed material, and none are adjacent to noncohesive bed material,

e. 24 single channel contiguous backwaters.

1. Average total area is 479 acres.
2. Total area ranges from 17 to 3,490 acres.
3. Average area covered by water is 425 acres.
4. Area covered by water ranges from 15 to 3,420 acres.
5. 1 backwater is adjacent to Group 2 soft cohesive bed material, 15 are adjacent to Group 2 medium cohesive bed material, and 8 are adjacent to noncohesive bed material,

f. 2 Impounded contiguous backwaters.

1. Average total area is 2,264 acres.
2. Total area ranges from 816 to 3,712 acres.
3. Average area covered by water is 2,130 acres.
4. Area covered by water ranges from 808 to 3,452 acres.
5. No backwater is adjacent to Group 2 soft cohesive bed material, 2 are adjacent to Group 2 medium cohesive bed material, and none are adjacent to noncohesive bed material,

g. 14 secondary channels.

1. Average channel length is 6,432 ft.
2. Range of channel length is 2,654 to 10,779 ft.
3. Average minimum width is 204 ft.
4. Range of minimum width is 74 to 380 ft.
5. Average deflection angel is 40 degrees.
6. Range of deflection angle is 19 to 64 degrees.

Handout TP9 (continued)

7. Average distance from navigation channel to inlet is 413 ft.

8. Range of distance to inlet is 230 to 582 ft.

9. No secondary channel is adjacent to Group 2 soft cohesive bed material, 8 are adjacent to Group 2 medium cohesive bed material, and 6 are adjacent to noncohesive bed material,

h. No sediment samples comprised of Group 1 cohesive bed material were identified.

i. The navigation channel sediment samples were noncohesive bed material except for 10 miles in the Alton Pool, 5 miles in the La Grange Pool, and 20 miles in the Peoria Pool.

1. In the Alton Pool, RM 27.5 to 32.5 and 57.5 to 62.5, samples were medium cohesive bed material.
2. In the La Grange Pool, RM 147.5 to 152.5, samples were medium cohesive bed material.
3. In the Peoria Pool, RM 162.5 to 177.5, samples were soft cohesive bed material, and RM 197.5 to 202.5 the samples were medium cohesive bed material.

j. Collectively 312.5 miles of channel borders have Group 2 cohesive bed material.

k. Of the 312.5 miles, 167.5 miles have backwaters or secondary channels adjacent to the channel border with Group 2 cohesive bed material.

l. Of 22 contiguous backwaters with at least one inlet and outlet

1. All or part of 1 is adjacent to Group 2, soft cohesive bed material.

2. All or part of 15 are adjacent to Group 2, medium cohesive bed material.

3. All or part of 6 are adjacent to noncohesive bed material.

m. Of 24 single channel contiguous backwaters

1. All or part of 1 is adjacent to Group 2, soft cohesive bed material.

2. All or part of 15 are adjacent to Group 2, medium cohesive bed material.

3. All or part of 8 are adjacent to noncohesive bed material.

n. Of 2 impounded contiguous backwaters, part or all of both are adjacent to Group 2, medium cohesive bed material.

o. Of 14 secondary channels

1. None are adjacent to Group 2, soft cohesive bed material.

2. All or part of 8 are adjacent to Group 2, medium cohesive bed material.

3. All or part of 6 are adjacent to noncohesive bed material.

Handout TP10. Sediment allotment to Pool 13 backwaters, based on WEST Cumulative Effects Report (Table 6-3) sediment input is 5,444,112 tons/year

CELL ID	Backwater Number	WATER AREA (acres)	BASE LOAD into BW (tons/year)	PERCENT TOTAL LOAD in POOL 13	BASE+25% LOAD into BW (tons/year)	PERCENT TOTAL LOAD in POOL 13	BASE+50% LOAD into BW (tons/year)	PERCENT TOTAL LOAD in POOL 13
345R5455	BW4	876	0	0%	0	0%	0	0%
265L5370	BW7	399	0	0%	0	0%	0	0%
315R5335	BW10	1181	30	0%	33	0%	39	0%
235R5315	BW10		3	0%	3	0%	3	0%
325R5305	BW10		90	0%	114	0%	135	0%
685R5300	BW10		51	0%	60	0%	75	0%
475L5310	BW11&13	6315	102	0%	126	0%	135	0%
15L5290	BW11&13		324,276	6%	407,085	7%	479,505	9%

Handout TP11. Calculated number of years to fill various backwaters in Pool 13.

ASSUMPTIONS:
1.) Backwater (BW) 4, 7, and 10 are 2-ft deep
2.) BW 11 and 13 are 4-ft deep
3.) Material to BW has specific weight of 96.3 lbs/cu.ft.

APRIL FLOWS AND TOWS

CELL ID	Backwater Number	WATER AREA (acres)	BASE LOAD in April (kg)	LOAD into BW (tons/year)	YEARS to FILL	BASE+25% LOAD in April (kg)	LOAD into BW (tons/year)	YEARS to FILL	BASE+50% LOAD in April (kg)	LOAD into BW (tons/year)	YEARS to FILL
345R5455	BW4	876	22	0	12,906,728	22	0	10,344,610	31	0	8,851,268
265L5370	BW7	399	4	0	33,917,074	5	0	27,927,304	5	0	23,646,857
315R5335	BW10	1,181	574	8		710	9		850	11	
235R5315	BW10		58	1		72	1		88	1	
325R5305	BW10		1,990	26		2,424	32		2,948	39	
685R5300	BW10		954	13	104,706	1,231	16	84,400	1,432	19	70,412
475L5310	BW11&13	6,315	1,954	26		2,534	34		2,801	37	
15L5290	BW11&13		1,380,635	18,266	2,896	1,642,231	21,727	2,435	1,916,756	25,359	2,086
TOTAL			1,386,165			1,649,229			1,924,911		

AUGUST FLOWS AND TOWS

CELL ID	Backwater Number	WATER AREA (acres)	BASE LOAD in April (kg)	LOAD into BW (tons/year)	YEARS to FILL	BASE+25% LOAD in April (kg)	LOAD into BW (tons/year)	YEARS to FILL	BASE+50% LOAD in April (kg)	LOAD into BW (tons/year)	YEARS to FILL
345R5455	BW4	876	15	0	18,106,440	18	0	15,252,761	22	0	12,870,843
265L5370	BW7	399	1	0	238,699,407	1	0	214,424,891	1	0	166,461,429
315R5335	BW10	1,181	84	1		102	1		113	1	
235R5315	BW10		7	0		7	0		9	0	
325R5305	BW10		124	2		199	3		229	3	
685R5300	BW10		137	2	1,064,439	151	2	816,936	189	3	692,122
475L5310	BW11&13	6,315	285	4		265	4		294	4	
15L5290	BW11&13		3,394,778	44,913	1,180	4,307,177	56,984	930	5,082,271	67,238	788
TOTAL			3,395,415			4,307,920			5,083,128		