Appendix I
Review of the Wetlands Value Assessment Process and Role in Coastal Wetlands Planning, Protection, and Restoration Act

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As additional restoration alternatives are developed and evaluated through the 30 percent design level, the question arises as to how to estimate the cost effectiveness of the new alternatives as compared to the earlier two proposals (2,000-cubic-feet-per-second [cfs] original proposal and the 1,000-cfs Optimized Alternative). For Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) projects, cost effectiveness is determined by a comparison of estimated project costs (present worth) divided by the benefits obtained from the project. This is usually expressed as a ratio of cost per average annual habitat unit (AAHU). The AAHUs are determined through a Wetlands Value Assessment (WVA). CWPPRA guidance documents detail the process and procedures for addressing cost benefits of new alternatives. This appendix provides an overview of the WVA process.

Summary of Approach

Outputs from the modeling activities to support the 30 percent design will be sufficient to characterize the area benefited, in terms of hydrologic regime and salinity. Specific data needed are as follows:

- The flow volume and distribution in the target marshes
- The salinity
- An estimate of mass transport of nutrients
- An estimate of the mass transport of fine sediment

The area benefited and the degree of benefit (total volume of flow, total mass of nutrients, and fine sediment) for each new alternative can be compared to the Optimized Alternative as follows:

1. Assume that if an area receives flow for any of the project alternatives, then it is considered part of the project benefit area.
2. Assume that the environmental benefits (the AAHUs) of a new alternative can be scaled proportionally in comparison to the Optimized Alternative using the hydrological and water quality outputs from the model.

If the benefit area changes more than 25 percent for any given project alternative, then the CWPPRA Environmental Work Group (EWG) would determine the appropriate method of determining environmental benefits. For instance, if the benefit area increases by 50 percent, the EWG could decide to simply inflate the current environmental benefits (AAHUs) by 50 percent. The EWG could also require the project sponsor to perform a new WVA on the newly proposed benefit area and use the resulting AAHUs as the environmental benefits of that project alternative.

Therefore, to estimate and compare the cost/benefit ratio for new alternatives at the Phase 1 preliminary engineering and design stage will be to compare cost/flow ratios for each alternative. Although the scaling factor is not available, project wetland benefits should scale positively with increased flows. That is, an increase in flow would mean an increase in wetlands benefits. This approach is considered sufficient for selecting alternatives for further consideration at the 30 percent design level. For those alternatives selected for the 30 percent design and engineering, the TABS-MD model (which is described in Section 3 of the main report) will be used to evaluate water distribution and benefited areas. The effect of each alternative on water distribution to the seven project subareas previously identified by the EWG will be evaluated, and any new potential benefited areas will be identified. These data will be used to develop size estimates of benefited areas for each alternative. The size of the benefited areas will be used in the cost/benefit analysis for selection of a preferred alternative at the 30 percent design level. Additional consideration might also be provided to changes in salinity and mass transport of nutrients and sediments predicted by the TABS-MD model when selecting a preferred alternative.

Finally, if the preferred alternative at the 30 percent design level exceeds the "change of scope" criteria described below, it is assumed that the CWPPRA Technical Committee might require a WVA. The *CWPPRA Project Standard Operating Procedures Manual* (SOP) (CWPPRA, 2003) defines the process, procedures, and responsibilities of local and federal sponsors for restoration projects. The SOP covers all aspects of a project from planning, selection, design, construction, and project closeout and de-authorization. The SOP states that, if during preliminary engineering and design a project undergoes a major change in scope or change in scope resulting in a variance of 25 percent from the original approved design, the local sponsor (e.g., Louisiana Department of Natural Resources) will submit a report to the CWPPRA Technical Committee explaining the reason(s) for scope change, impact on costs and benefits, and a statement from the local sponsor endorsing the change.

The SOP defines a major change in project to be at least a 25 percent variance from original approved design in either of the following:

- Total project cost
- Number of acres benefited
- Ratio of the total project cost to the number of acres benefited

Using these criteria, it is assumed that unless one of these three variance thresholds is triggered during the preliminary engineering and design, then a formal WVA application by the EWG will not be required. However, should these thresholds be triggered, the Technical Committee, at its discretion, could presumably require that a WVA be performed for the project using the new costs and benefited areas. If prior to the selection of a preferred alternative, the federal or local sponsor believes a change in scope will be realized at the 30 percent design level, the local or federal sponsor should, at their discretion, seek to compare costs and total benefited area for new alternatives relative to the Optimized Alternative. The working assumption is that the area benefited is proportional to the distributed flow in the three key marsh areas. The benefits of additional alternatives can be estimated by comparison of the distributed flows and mass transport of nutrients and sediment to key areas relative to the flow and mass transport in the Optimized Alternative.

Description of the WVA

The effectiveness of a CWPPRA project is determined almost entirely on the quantity and quality of wetlands to be gained or preserved if the project is implemented (U.S. Environmental Protection Agency ([EPA], 1998). The method of determining a project's effectiveness in this regard is known as the WVA methodology. WVA EWG, established by the CWPPRA Task Force, developed the WVA methodology.

This methodology is an adaptation of habitat assessment modeling that emphasizes the functional value of fish and wildlife habitat, and is a measure of the benefits that will be expected for these resources. Model variables were selected based on environmental variables considered important in characterizing habitat in coastal ecosystems. Variable selection was then further refined according to their relevance to fish and wildlife species known to inhabit Louisiana. Variables were then grouped and screened to remove variables that were not considered suitable for the WVA application. Some functional variables, such as hydrology, water quality, nutrient export, flood water storage, and storm surge protection, are not captured by the assessment (EPA, 1998).

The model combines both estimates of quantity and quality, assuming that an acre of healthy marsh is more valuable than an acre of degrading marsh. A series of variables are used in the model to capture the functional values of wetlands. These variables are as follows:

- Percent area covered by emergent marsh
- Percent of open water area dominated by submerged aquatic vegetation
- Marsh edge and interspersion
- Percent of open water that is shallow
- Salinity
- Aquatic organism access

Four different models have been developed that include these six variables. The four models represent the following major wetlands types found in Louisiana:

- Fresh/intermediate
- Brackish
- Saline
- Cypress swamp

Each model incorporates the six variables to some degree. The weight of a variable might differ between models, reflecting the importance of that variable on the quality of the wetland type being modeled. In all models, the percent area covered by emergent marsh has the greatest weight. This reflects on the primary focus of CWPPRA, which is on vegetated wetlands. For each variable, a suitability index (on the order of 0.1 to 1.0, with 1.0 being optimal habitat) is determined using multiple sources of information, including satellite imagery, aerial photography, field surveys, literature data, observed monitoring data, and professional judgement (EPA, 1998). Suitability indices are determined for existing conditions, the future with the project, and the future without the project. These suitability index values are then entered into the model to calculate overall Habitat Suitability Indices (HSI) for each target year desired; typically years 0, 1, and 20.

After HSIs for existing conditions and future target years have been determined, each index is multiplied by the project acres present in the given year to estimate Habitat Units. Habitat Units are considered acres of wetlands modified by the quality factor (EPA, 1998). Habitat Units are then averaged over the life of the project (20 years) to provide AAHU. The difference in AAHU for the future with the project and the future without the project represent the net wetlands benefits because of the project.

Results of Previous WVAs for Bayou Lafourche Projects

Two formal WVAs were performed for the Bayou Lafourche Diversion Project by the CWPPRA EWG. The first was performed in October 1995, and assumed a seasonal diversion of 2,000 cubic feet per second (cfs) (original project flow). The second was performed in 1998, and assumed a continuous diversion of 1,000 cfs (optimized project flow). Wetlands benefits for alternative project flows were estimated by EPA (1998) and U.S. Army Corps of Engineers (USACE) (2001) but have not been formally verified by the EWG. Included in these alternative flow benefit estimates was the potential synergistic effect of a proposed CWPPRA Project, TE-10 (Grand Bayou Marsh). Wetlands benefit analysis performed by the EWG for this project did not include synergistic effects, resulting in two different benefit estimates for the optimized project flow (with and without TE-10).

Water Distribution

The distribution of water assumed in the WVA for the original project was based on limited information on flows within Company Canal, Bayou Lafourche, Gulf Intracoastal Waterway (GIWW), and Bayou l'Eau Bleu. It was assumed that 70 percent of the water would be diverted southwest down Company Canal towards the GIWW, and 15 percent of that water would travel east down the GIWW and be diverted in the Grand Bayou marshes through Bayou l'Eau Bleu. No modeling of water distribution was performed for the 1995 assessment.

Modeling was performed for the 1998 assessment to determine the distribution of water for the optimized project. The USACE developed a UNET model for this purpose. The model inputs assumed that 185 cfs would be withdrawn from the Bayou for water supply use. Thus, 815 cfs would be available for marsh benefits. The modeling indicated that water distribution would be influenced by the boundary conditions of flow coming from the Atchafalaya River in the west and the Davis Pond Diversion (Barataria Basin) in the east. During periods of low boundary flows, 66 percent of the available diversion was projected to flow west down Company Canal. During high flows at the Atchafalaya, the effect is shifted eastward with flows increasing in channels that convey water to the south and east. During high Barataria flows, diversion has an opposite effect with water tending to stay in the Terrebonne Basin. When both the Atchafalaya River and Barataria Basin are high, water tended to shift slightly eastward compared to low flow conditions. Water distribution for a 1,000-cfs diversion under low- and high-flow conditions are summarized in Table I-1. The average annual distribution of estimated diverted water for the HVA assessment was

37 percent to the east (Barataria Basin), 35 percent to the west (primarily down the Houma Navigation Canal), and 28 percent to the south into marshes of southeast Terrebonne Basin.

TABLE I-1
Summary of Flow Distribution as Determined from Past UNET Modeling

Condition	East (%)	West (%)	South (%)
Low flow	37	35	28
High Atchafalaya River Flow	38	31	31
High Barataria Basin Flow	40	40	20
High Atchafalaya and Barataria Flow	46	31	23

Source: EPA, 1998.

Notes:

East is toward Barataria Basin.
West is toward Houman Navigation Canal.
South is toward marshes in Terrebonne Basin.

Size of Benefited Area

The size of the benefited area is identified as marshes likely to be benefited from the project. The WVA conducted in October 1995 was performed assuming the features and operations of the original project (2,000-cfs siphon). Using the assumed distribution of the water and interconnectedness of marsh areas with the distributory channels, the EWG identified three areas as benefit areas. Benefit areas are summarized in Table I-2. It was assumed that 28,843 acres of marsh over these three project areas would be benefited.

TABLE I-2
Summary of Benefited Areas from Original Project (2,000 cfs)

Area	Name	Marsh	Total Acres	Marsh Acres	Loss Rate (% per year)
1	Lake Fields to GIWW	Fresh	13,466	9,104	0.082
2	Grand Bayou	Intermediate	9,422	7,314	0.749
3	Delta Farms	Fresh	5,975	392	3.361

Note:

Adapted from EPA, 1998.

Subsequent to the original assessment, the CWPPRA WVA EWG defined modified project boundaries that would substantially benefit from the diversion according to the optimized project flow (continuous 1,000 cfs). Using the water distribution estimated by the UNET model, project areas that would receive the diverted Mississippi River water were identified. Project benefit areas are summarized in Table I-3. The extent of marsh included in each area was based on a determination by the EWG of the connectedness of the marsh areas to the distribution channels and how much water these areas were expected to receive. According to this analysis, 85,094 acres in the Terrebonne and Barataria Basins would benefit from diverted Mississippi River water from Bayou Lafourche.

TABLE I-3
Benefit Areas Identified for the Optimized Project Flow

Area	Name	Marsh Type	Total Area (acres)	Marsh Area (acres)
1-F	Lake Fields/GIWW	Fresh	13,057	8,722
2-1F	Grand Bayou	Fresh	4,793	3,879
2-1I		Intermediate	4,272	2,796
2-3B		Brackish	21,571	9,143
3-1F	Delta Farms	Fresh	3,974	2,700
3-2F		Fresh	6,041	413
3-3F		Fresh	2,549	2,284
4-B	Bayou Terrebonne	Brackish	2,442	904
5-1I	HNC	Intermediate	700	440
5-2B		Brackish	1,587	786
5-3B		Brackish	1,301	773
5-4B		Brackish	5,237	2,997
6-S	Tidewater Canal	Saline	6,180	3,403
7-I	Perot-Rigolets	Intermediate	11,390	9,721
Total			**85,094**	**48,961**

Source: EPA, 1998.

Average Annual Habitat Units

The CWPPRA Task Force WVA Workgroup developed AAHUs for a seasonal 2,000-cfs flow and a continuous 1,000-cfs flow. Each variable for the marsh models was defined for the future with and without the project, and HSIs were developed and applied. In both assessments, the future with the project would not result in a net increase in marsh area over the present conditions, but would mitigate marsh loss and degradation when compared to the future without the project. The total acres of marsh saved in 20 years by the original and optimized project were estimated at 425 and 988 acres, respectively. This variable, coverage of marsh (V1), is considered the most important variable and is weighted in the model. The EPA noted their 1998 review of the EWG’s WVA for the optimized project that the value of V1 is recorded and input into the HSI formulas as the percent coverage of emergent marsh and not the total acres of marsh created or saved (EPA, 1998). The EPA stated that, because the project has benefits distributed over such a large project area, the overall percentage difference with and without the project might be very small (EPA, 1998). This small percentage difference would enter the model without making a difference in the HSI. The EPA stated that the effect is that many of the acres saved by the project are not accounted for in the WVA model (EPA, 1998).

Another interesting result of the WVA model relates to the effect of the projects on salinity levels in the project area. One of the benefits frequently ascribed to this project is its potential to fight saltwater intrusion in the Terrebonne and Barataria Basins. Observed data and professional judgment were used to determine the average annual and average high salinities in the project areas. Salinity was predicted by the EWG to remain stable over 20 years without the project or to increase slightly, reflecting gradual saltwater intrusion. (It is unclear if the model developed by USACE was used in this determination.) The EWG predicted that salinity would slightly freshen the project area. However, current salinity determined by the EWG was considered within the optimal range of the marsh types present. Changes in salinity were predicted to have little effect in the HSI for the future with and without the project. Therefore, changes in salinity did not contribute to net project benefits. The EPA stated that because average annual and average high salinities were used to estimate this variable, the effect of a diversion on controlling salinity spikes and controlling salinity during times of low Mississippi River stage were not captured by the model (EPA, 1998).

Using the WVA model, the current, future without project, and future with project HSIs were determined. For the optimized project, the current HSI was 0.61 (out of 1.0). The future without project and with project were determined to be 0.56 and 0.58, respectively. The net result of the WVA model predicts that the average habitat suitability change as a result of the project was 3.6 percent.

Applying the HSIs for the project areas to the project acres present in the target year and averaging over the 20-year project life yields AAHU. The difference in AAHU for the future with and without the project estimates the net AAHU for wetlands habitat to the project. Using this methodology, the original project yielded 499 AAHU, and the optimized project yielded 705 AAHU.

Evaluation of Wetlands Benefits for New Alternatives

It is assumed that the results of the TABS-MD model described in Section 3 of the Phase 1 Design Report will be used to evaluate wetlands benefits for the project alternatives. Results of the modeling will be made available for the calculation of environmental and wetlands benefits. The following data are needed to sufficiently characterize each alternative:

- Flow distribution in the main channels
- Identification of marsh areas affected by changes in flow
- Changes in flow to marsh areas
- Changes in salinity in the distribution channels
- Changes in transport of nutrients and fine sediments in the distribution channels of the model

These parameters can contribute to estimates for each alternative of the following variables:

- Estimated size of benefited areas (including distribution to the seven subareas previously identified and any new potentially benefited marsh areas)

- Changes in salinity of marsh areas
- Potential changes in emergent marsh and submerged aquatic vegetation because of nutrient input and accretion for each benefited area

Presumably this information could be used to provide much of the information required to perform a WVA, if it is determined that one is needed or required. Similarly, this information could be used to provide a quantitative measure of wetlands benefits (e.g., size of benefited area) if a formal WVA is not considered necessary.

References

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