Addendum to the
U.S. Army Corps of Engineers Environmental Assessment Entitled:
Below Piggott and Big Island Seepage Remediation St. Francis River Basin Clay and Greene Counties, Arkansas

Purpose and Need: The purpose of this Addendum is to address comments provided by a landowner of property on which a portion of the proposed project would place a berm and associated structures. This project is designed to decrease the likelihood of levee failure along the St. Francis River in Arkansas. After extensive engineering review of potential alternatives to reduce the potential for levee weakening and failure, an environmental Assessment (EA) was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and the Council on Environmental Quality's (CEQ) Regulations (40 CFR 1500-1508), as reflected in the USACE Engineering Regulation (ER) 200-2-2.

The Public Notice was issued on 17 December 2019 and expired on 17 January 2020. The Joint Public Notice, draft finding of no significant impact (FONSI), and the EA were distributed via the Regulatory Branch, Arkansas email lists and posted on the Memphis District Public Notices webpage (https://www.mvm.usace.army.mil/About/Offices/Regulatory/Public-Notices/). The public notice provided a 30-day review period during which the document could be reviewed and comments submitted. After the 30-day period had expired with no significant comments, the EA was finalized and a finding of no significant impact was signed by the District Engineer on 26 March 2020.

Subsequently, concerns were raised by a landowner on whose property a portion of the project was to be built regarding issues associated with the engineering, alternatives considered, and functionality of the proposed project.

Background: A 1973 Environmental Impact Statement (EIS), *St. Francis Basin Project, Arkansas and Missouri*, addressed flood control measures to be implemented along the St. Francis River. Since publication of the 1973 EIS, continued seepage and potential degradation of the St. Francis Levee has been observed, requiring additional flood control measures along the St. Francis River. In particular, U.S. Army Corps of Engineers (USACE) observed seepage issues at proposed project locations during recent high water events.

The proposed project involves implementing two seepage control measures along the St. Francis Levee in Clay and Greene Counties, Arkansas. Project features includes the construction of landside berms and modification of existing ditches to accommodate drainage. Access to the project area would be from county roads or from roads on top of the levee. Heavy construction equipment would be used to modify and fill the existing ditches and construct berms. Post-construction hydrology would be similar to pre-existing conditions for both proposed projects.

This addendum is intended to address the concerns raised by an engineering firm employed by the landowner(s), by providing responses from the subject matter experts that conducted the

investigations into vulnerabilities, risks and benefits associated with each alternative and designed the best practicable solution to ensure the continued safety of the existing levee system along the St. Francis River. These concerns are outlined in the letter as summarized from a report prepared by Daniel B. Stephens & Associates, Inc. (DBS&A).

1. Commenter alleged that the Corps failed to comply with the guidance in its own Engineer Manual for the Design and Construction of Levees (EM 1110-2-1913) based on (1) proposed design, (2) berm extension, and (3) inadequate data collection.

a. Design. DBS&A opined that the proposed design is not significantly different from "the existing design of the levee and seepage berm."

The existing flood mitigation consists only of a levee. Evaluation of the existing levee system indicated the flood protection did not meet USACE design requirements. As such, remedial measures were designed to provide a flood mitigation system that complies with USACE design requirements. The proposed mitigation of seepage berms and moving the drainage ditch further from the levee are different from the existing condition.

b. Berm extension. DBS&A alleges that the aquifer is relatively thick, approximately 150 feet. DBS&A claimed the Corps' project contains design flaw concerns related to the "thickness of the aquifer." DBS&A noted "with a thick aquifer, the proposed drainage trench will operate similarly to the existing drainage trench and that trench will attract only a small portion of the seepage flow and detrimental under seepage would bypass the trench." Additionally, DBS&A alleges that the proposed design will result in a concentration of seep water on the landward side of the seepage levee, flooding prime farmland and that the Corps' current proposal is an "incorrect" design in the EM citing EM 1110-2-1913, Fig. 5-1.

DBS&A misunderstands the overall purpose of the ditch, which is required and designed for surface water conveyance of precipitation falling on the protected side of the levee system. The ditch was not designed to function as a seepage remediation measure, such as a pervious toe trench, and therefore, it is not intended to intercept any underseepage. The thickness of the aquifer is precisely why a pervious toe trench was not considered to be a viable seepage remediation measure because the underseepage flow within the thick aquifer would simply bypass the pervious toe trench. The ditch design analysis as documented in the Design Documentation Report (DDR) also included examination of areas outside the berm footprint that drain to impacted ditches through the use of 1-meter LiDAR survey data obtained for the St. Francis Basin in 2016 and based on consultation with local landowners.

EM 1110-2-1913 provides that the "[t]he seepage berm needs to extend a sufficient distance landward to lap a thick clay deposit, if one exists." (USACE, 2000, p. 5-2). The discussion in the EM (page 5-2) relates to consideration of extending the seepage berm out to a thicker clay layer if one exists within a short distance (no specific distance given but can be assumed to be within 50-100 feet) of the design length of the seepage berm. This is based on past experience with seepage berm performance where seepage excess head and flow can be concentrated between the end of the seepage berm and thicker clay layer to cause excessive gradients and sand

boils. Figure 5-1 of EM 1110-2-1913, which labels 'correct' and 'incorrect' berm lengths, only applies to this very specific foundation case. There is no geologic evidence that a thicker clay layer exists within a distance from the levee such that this specific case would exist; therefore, the situation and discussion in EM 1110-2-1913 page 5-2 and Figure 5-1 do not apply to the design of the seepage berm in the area of Glen Farms.

c. Data Collection. DBS&A states that pertinent data that were not collected, including the saturated hydraulic conductivity (referred to as permeability in the USACE manual [USACE, 2000]), soil test borings, soil laboratory borings, specific yield, groundwater elevations, and river stage elevations along Glen Farms.

USACE performed the field investigation in accordance with EM 1110-2-1913, which does not require gathering data as to specific yield. Laboratory testing conducted on soil samples collected in the soil test borings included moisture contents, Atterberg limits, and sieve analyses. USACE developed correlations relating the grain size to permeability (see Figure 3-5 of the EM). Borings were spaced at 500-ft intervals along the project length at the landside and riverside levee toes and at 1500-ft intervals along the levee centerline, which meets the EM requirement of boring spacing in the range of 200-1,000 feet. The boring depths (30-190 feet) were adequate to characterize the subsurface conditions necessary for the seepage study. Groundwater elevations encountered during drilling operations for the soil test borings were measured and recorded on the boring logs previously provided to Glen Farm. The design groundwater elevations are a function of the design flood (100 years), which will be different than those measured during drilling. The Memphis District did not need to obtain river stages elevations of the St. Francis River as the under-seepage remediation measures are designed based on design flood elevations, not any particular daily river stage elevation.

2. Commenter states that the Corps should have analyzed seepage and provided modelling calculations. "[T]he project will concentrate seep water on the Property, inundating the 200 acres along the St. Francis River to a greater depth, for a longer period, and at a greater frequency each year compared to current conditions. Early in the growing season, this seepage will delay crop planting, resulting in lost productivity. Later in the growing season, the seepage will kill existing crops by creating saturated, anaerobic soil conditions. With the current Project design, [farmers] will be forced to delay planting each growing season and…will also experience reduced crop yields, extensive crop losses, and significant replanting costs each year."

The Memphis District conducted a seepage analysis and design, which occurred prior to publishing the draft EA and draft FONSI. The hydraulic and geotechnical engineering analysis and conclusions for this analysis can be found in Appendices A and B of the Below Piggott Seepage Remediation Design Documentation Report (DDR), St. Francis River Basin, Clay and Greene Counties, Arkansas available at the bottom of

https://www.mvm.usace.army.mil/About/Offices/Regulatory/Public-Notices/.[1] USACE design engineers have calculated that the total seepage flowing under the flood protection system during the Project Flood (100-yr flood event) will be reduced slightly as a result of the seepage berm construction, as the seepage water flowing under the protection system will travel a longer distance through the aquifer sands before emerging at the berm toe. As water travels through the sand, the hydraulic (excess) head dissipates due to the flow resistance provided by the soil particle matrix. Even though the total seepage flow under the flood protection system is less with the seepage berm in place than without, the excess head at any point beyond the seepage berm toe would be slightly greater with the berm in place than without the berm. This is because the berm reduces the ability of the excess pressure to be dissipated as it flows under the seepage berm. The excess head is what tends to drive the water up through the less permeable 'blanket' soils to emerge at the ground surface.

Specifically, USACE's calculations show that the change in total seepage flow under the levee at project flood will decrease by approximately 7% in the areas of Glen Farms compared to the current levee condition. The seepage berms will increase the excess head on the protected side of the levee; however, the calculations indicate that this increase in excess head at the project flood beyond the proposed seepage berm will be on the order of 2-3 inches. The resulting change in gradient beyond the seepage berm will be about 10%, but will still result in gradients less than those associated with concentrated seepage issues. The less permeable, near surface soils will effectively dissipate the total excess head in the aquifer such that any change due to the extra several inches of excess head caused by the new seepage berm will be unperceivable. The overall result is that the seepage berm will tend to slightly increase the potential for underseepage water to be forced to the ground surface; however, there will be less water available to be forced to the ground surface. These opposing conditions are considered to result in no net change in the amount of seepage water flowing to the ground surface when comparing the existing conditions and those which will exist after construction of the seepage berm. Therefore, there will be no perceivable difference in the quantity of underseepage flow emerging in the fields or the ability to conduct farming operations over what would occur in the current levee condition. Accordingly, there is no need to perform additional flood analysis across individual properties based on a detailed topographic survey (e.g., LIDAR survey of the levee, berm, and individual properties).

Based on this analysis, USACE determined that no flowage easement is required.

3. DBS&A recommends consideration of design alternatives such as relief wells and/or vertical cutoff walls below the seepage levee.

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[1] This release should not be viewed as precedential. Typically, the DDR is generally not releasable as it is not typically final "until after the plans and specifications and construction are completed." EC 1110-2-1150, para 8.2.

As discussed in Section 2.0 of the EA, the Environmental study considered six alternatives to the proposed action. These alternatives were: (1) No-action; (2) the filling in of the existing ditch along the levee toe only; (3) construction of landside seepage berms only; (4) construction of landside seepage berms and filling in of the existing ditches; (5) installation of impervious cutoff walls; and (6) the installation of relief wells. For environmental, cost, risk reduction, and constructability reasons, many of these alternatives were screened out early in the NEPA process. Additionally, a pervious toe trench was not considered to be a viable remediation alternative due to the thickness of the aquifer, and riverside blankets were not considered practical due to the adverse environmental effects and the close proximity to the St. Francis River. An impervious cutoff wall was not considered feasible or economical due to the extreme depth to the base of the aquifer. Relief wells were not considered economical because of the low landside heads which would require dropping the well discharge elevations below the ground surface in order to provide enough pressure head to drive artesian flow. The relief wells would also have to be very closely spaced to provide the required head dissipation. A test section of relief wells were constructed at the northern limit of this project (from approximately Levee Mile 15/52+00 to Levee Mile 17/14+00, or approximately 1.3-miles in length), and where the landside and riverside soil conditions are quite similar to those in this study area. The cost of the test reach of relief wells was in excess of $2 million compared to an estimated cost for landside berms of $1.3 million.

USACE specifically discussed the reason for berms instead of relief wells or seepage cutoff walls in a public meeting in Rector, AR on February 19, 2019 based on supporting technical review and analysis.

4. Glen Farms states that the EA fails to disclose, analyze, and mitigate the Project's significant environmental effects, particularly as to hydrology and agricultural lands. Glen Farms requests an EIS be performed and challenges the tiering of the EA to the 1973 EIS.

As discussed above, USACE found that there will not be significant environmental effects as to hydrology or agricultural lands warranting an EIS. Overall, the project will provide a benefit to agricultural lands as it will reduce risk of berm failure.

The 1973 EIS entitled *St. Francis Basin Project, Arkansas and Missouri*, addressed existing and anticipated flood control measures for the basin. A copy of the referenced EIS is available at the following location on the Memphis District website: https://www.mvm.usace.army.mil/Portals/51/EISstfrancisbasin.pdf or upon request. Over the intervening time period, additional areas of flood risk concern have arisen, and each new construction action has had the appropriate level of NEPA coverage (typically an environmental assessment) based on the extent of potential impacts to the natural and human environment and incorporated the findings of the overall EIS by reference.

This addendum to the final EA, entitled **Below Piggott and Big Island Seepage Remediation**, **St. Francis River Basin, Clay and Greene Counties, Arkansas** will remain available on the Memphis District website at the following location for a period not to exceed 30 days. https:// www.mvm.usace.army.mil/About/Offices/Regulatory/Public-Notices/

Any further correspondence regarding this Addendum to the final EA may be addressed to: Kevin Pigott, USACE biologist, U.S. Army Corps of Engineers, Memphis District, Regional Planning Division South, Environmental Compliance Branch, 167 North Main St., B-202, Memphis, TN 38103-1894.