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OU-4 Sediment Stability Technical Memorandum

June 2010

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Acronyms and Abbreviations

ASM	Adaptive Site Management
BBL	Blasland, Bouck & Lee, Inc.
CD	Partial Consent Decree
cfs	cubic feet per second
CSM	Conceptual Site Model
EPIC	Environmental Photographic Interpretation Center
FS	Feasibility Study
FSP	Field Sampling Plan
fps	feet per second
ft	feet
HEC- RAS	Hydrologic Engineering Centers River Analysis System
mg/kg	milligrams per kilogram
mi	mile
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PCB	polychlorinated biphenyl
P/S	Pharmacia Corporation and Solutia Inc.
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RI	Remedial Investigation
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

1. Introduction

This Technical Memorandum describes the approach that will be used for evaluating sediment stability and transport in Operable Unit 4 (OU-4) of the Anniston PCB Site (the Site) including the data and information that will be used in the evaluation. The Technical Memorandum was developed by Pharmacia Corporation and Solutia Inc. (collectively referred to as P/S) as signatory parties to the Partial Consent Decree (CD) for the Site (USEPA 2003) in response to a comment from the United States Environmental Protection Agency (USEPA) on the now-approved *Phase 2 Field Sampling Plan for Operable Unit 4, Revision 2* (Phase 2 FSP; ARCADIS 2010).

1.1 Description of the Site and OU-4

The Anniston PCB Site includes the Anniston Facility (the Facility), which opened as a manufacturing plant in 1917. A variety of organic and inorganic chemicals – including polychlorinated biphenyls (PCBs) – were produced at the Facility. P/S and its predecessors have carried out a series of investigations and remedial actions at the Site over the past two decades. These investigations have been conducted in the three OUs that comprise the Site (Figure 1). Summary descriptions of the Site and OU-4 are included here to provide general context for this Technical Memorandum. Detailed descriptions of the Site and three OUs are provided in previous documents and reports, including the *Remedial Investigation/Feasibility Study Work Plan for the Anniston PCB Site* (RI/FS Work Plan; BBL 2004); the *Phase 1 Field Sampling Plan for Operable Unit 4 of the Anniston PCB Site* (Phase 1 FSP; ARCADIS BBL 2006), and the Phase 2 FSP (ARCADIS 2010).

OU-4 is the most geographically expansive of the three OUs delineated at the Site and encompasses the length of Choccolocco Creek and its floodplain from the confluence with Snow Creek downstream to the confluence of the Coosa River. OU-4 also includes the Backwater area of Choccolocco Creek at its confluence with Snow Creek, as well as the lower end of Snow Creek and its floodplain between Highway 78 and its confluence with Choccolocco Creek. The Anniston Facility, which is defined as OU-3, is situated along State Highway 202 in Anniston and is located upstream of both OU-1/OU-2 and OU-4. OU-1/OU-2 is one OU and generally consists of the residential and non-residential areas upstream of Highway 78, up to and surrounding the Facility. The area currently defined as OU-1/OU-2 was initially defined as two OUs with the same overall geographic footprint. OU-1 was designated as the residential portions of the OU, and OU-2 included the non-residential portions of the OU. The two OUs were later combined into a single OU to streamline the RI/FS process and to provide decisional consistency for non-residential and residential properties that are often located next to one another.

1.2 Background

For nearly 20 years, investigations have been carried out to assess the nature and extent of environmental impacts in and around the Site, located in Calhoun County in north-central Alabama (Figure 1). These data have been used to develop and refine the Conceptual Site Model (CSM) for the Site including the *Phase 1 - Conceptual Site Model Report* (Phase 1 CSM Report; Blasland, Bouck & Lee, Inc. [BBL] 2003). Sediment stability was initially discussed in the Phase 1 CSM Report, but was further evaluated in the Phase 2 FSP (ARCADIS 2010). The earlier sediment stability evaluations focused on the Backwater area located near the confluence of Snow and Choccolocco Creeks. The evaluation included in this Technical Memorandum expands beyond the Backwater area to downstream portions of Choccolocco Creek. While the RI/FS for OU-4 will include a refined CSM that considers sediment stability in accordance with Office of Solid Waste and Emergency Response (OSWER) Directive 9285.6-08 dated February 12, 2002 (*Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites;* USEPA 2002), this Technical Memorandum was developed to ensure that data or information needed to conduct the sediment stability and transport evaluations are collected as part of the site investigation process. This includes how sediment stability and transport will be evaluated under pre- and potential post-remedial conditions.

1.3 Report Organization

Section 2 further describes the technical approach used to identify whether additional data or information are needed to evaluate sediment stability or transport. Section 3 presents the evaluation conducted to identify those portions of Choccolocco Creek where sediments are not stable and those areas where the sediment appears to be stable. A more detailed evaluation of the stable areas is presented in Section 4 and a summary of the findings for this evaluation is presented in Section 5. References used for this evaluation are included in Section 6.

2. Technical Approach

This section presents the technical approach used to evaluate sediment stability and transport in OU-4. The overall approach to prepare this Technical Memorandum is presented in Section 2.1. Data sources for the sediment stability evaluation are identified in Section 2.2 along with a discussion of the different considerations used in assessing whether sediment in a portion of the creek is stable.

2.1 Overall Approach

Over the past 20 years of scientific investigation at the Site, a significant amount of data has been generated. These available data were used to initially identify portions of Choccolocco Creek that are not stable, and portions of the creek that appear to be stable. Portions of the creek that appeared to be stable were then further evaluated using a weight-of-evidence approach including an assessment of whether additional data are needed to conduct the final sediment stability and transport analysis in the RI. The potential evaluation of sediment stability and transport during the FS was also considered in this evaluation.

2.2 Data Used and Sediment Stability Considerations

The data used in this assessment were presented in the *Off-Site Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report* (Off-Site RFI Report; BBL 2000), the Phase 1 CSM Report (BBL 2003), the OU-4 *Data Summary Report for Operable Unit 4* (BBL 2005) and the Phase 2 FSP (ARCADIS 2010). Additional sediment PCB data collected under ongoing Phase 2 FSP investigations were also included in this evaluation.

A weight-of-evidence approach was used to evaluate sediment stability in the different portions of Choccolocco Creek. Sediments in the Snow Creek portion of OU-4 are not considered to be stable due to the high energy nature of the creek and are not further evaluated in this memorandum. The weight-of-evidence approach looked at a range of considerations including the bathymetry profile of the creek. This included the slope of the creek bed in terms of feet of elevation drop per mile of creek length. Creek bed elevation data were compared to the surface water elevations to estimate water depths along the creek. Measured and modeled surface water velocities of the creek were assessed including the identification of high flow events dating back to the general time frame when PCB manufacturing began in the Anniston area. The thickness of the sediment deposits as a general indicator of depositional environments and radioisotope data to estimate sediment deposition rates were also used as lines of evidence. Other considerations included the type of sediment based on visual classification of sediment cores and grain size distribution data for samples from these cores. Fine-grained sediments are general indicators of sediment deposition areas. Finally, sediment PCB concentration profiles were evaluated as potential indicators of sediment stability. PCB concentration and mass, while not direct indicators of sediment stability, were considered from the perspective of stability, and transport risk. For example, a portion of the creek may or may not be stable, yet if the PCB concentrations and/or PCB mass of these sediments are not significant relative to the system as a whole, then the stability and/or transport of these sediments may not be of concern. Alternatively, areas that have questionable stability and elevated PCB concentrations may require additional evaluation.

3. Evaluation of Sediment Stability

Available data were evaluated using an integrated approach to assess whether sediment in OU-4 areas are known to be stable or, based on the available data, are likely to be stable. In these latter areas, additional data are identified that may be needed to further verify areas of apparently stable sediment. Multiple lines of evidence were used independently and in combination to determine whether data support the premise that the sediment is stable in certain areas along Choccolocco Creek. In this process, areas with stable sediment, potentially unstable sediment, and data gaps were identified. This section describes the process used to assess the data and identifies areas where OU-4 sediment appears to be stable or unstable. Section 4 provides a detailed analysis of the stable areas.

3.1 Sediment Stability Indicators

Several lines of evidence were used to assess sediment stability. These lines of evidence are based on the general characteristics listed below. These seven general characteristics listed below are further segmented into the 12 lines of evidence presented on Table 1. Table 1 also identifies areas where OU-4 sediment appears to be stable.

- Bathymetry and gradient
- Water velocity and flow
- Sediment thickness
- Sediment texture and grain size distribution
- PCB data
- Radioisotope dating
- Channel alignment

Section 3.2 provides a discussion of each of these indicators. Section 4 details the available data and substantiates the definitions of each of the identified stable areas.

3.2 Evaluation of Sediment Stability

An evaluation of how each of the various lines of evidence was used to assess stability is described below and summarized in Table 1.

Bathymetry and gradient: Water depths and spatial changes in sediment and water surface elevations were considered in assessing sediment stability. In general, deeper water is an indication of depositional areas where the sediment is expected to be more stable than in shallower areas. The sediment in deeper water areas is less likely to be disturbed during typical flows and periodic high flows. Spatial changes in sediment and surface water elevations were also considered in assessing stability. Areas with rapid changes in bed and water surface elevations (steeper slopes) tend to correlate with areas of higher velocities and lower bed friction and, consequently, are most likely to be areas of less stable sediment. Areas with little change in bed and water surface elevations (shallow slopes and, thus, lower water velocities) are an indication of potential deposition and sediment is expected to be more stable in these areas. Available bathymetry data were reviewed to assess potential sediment stability. The results of this assessment are summarized in Table 1. In addition, sediment bed elevation data for Choccolocco Creek are plotted on Figure 2, water surface elevation data are plotted on Figure 3, and water depths are plotted on Figure 4.

Water Velocity and Flow Events: Areas with higher water velocities and high velocities during high flow events increase the potential for sediment to be less stable. Water velocities were measured during base flow conditions as part of the Off-Site RFI program and are shown on Figure 5. Flows were also modeled for a 2-year flow event as a part of the Off-Site RFI using the Hydrologic Engineering Centers River Analysis System (HEC-RAS) model (U.S. Army Corps of Engineers 1998). The 2-year flow event was selected for this evaluation as out-of-bank flow typically occurs during this event and, at higher flows, much of the additional surface water conveyance occurs outside of the defined channel. During these higher flow conditions, the in-creek surface water velocities are generally on the same order as the 2-year event. The estimated water velocities for the modeled 2-year flow event are also shown on Figure 5. The measured and modeled water velocities for Choccolocco Creek are summarized in Table 1. In addition, actual flow data and measured peak flow events from United States Geological Survey (USGS) gauging stations in Lincoln, AL and at Jackson Shoals were reviewed and are shown on Figure 6. As shown on Figure 6, flows in the Choccolocco Creek are highly variable and several flow events have been documented exceeding 2-year and 10-year return intervals which indicate that the creek has been subject to several events at flows with the potential to cause erosion.

Sediment Thickness: Sediment thickness is a general indication of whether areas are depositional. Areas with thicker sediment are more likely to be depositional in nature and are most likely to be stable. Sediment thickness data from probing conducted at 769 locations are plotted on Figure 7. Average sediment thicknesses in the various areas are summarized in Table 1.

Sediment Texture and Grain Size Distribution: In general, finer grained materials will settle from surface water more quickly than coarser grained material. Therefore, depositional areas generally tend to be comprised of more fine-grained material than coarse-grained material. Finer grained materials also offer a larger surface area for organic and other constituents to bind with. Consequently, in addition to being more stable, depositional areas with finer grained materials also tend to be associated with higher concentrations of PCBs. Texture and grain size were characterized in 769 cores collected from Choccolocco Creek in OU-4. Sediment from these cores were visually characterized (as coarse- or fine-grained) and quantitatively analyzed based on grain (sieve) size analysis. The results from the evaluation of sediment texture and grain size are summarized in Table 1 and are discussed in more detail in Section 4.

PCB Data: PCB data and overall sediment thickness (discussed above) were also assessed to evaluate sediment stability. Based on our knowledge of the site and distribution patterns in OU-4 as described in the CSM, a simplistic approach is to expect that older, deeper deposits of finer grained material will correlate with higher PCB concentrations. More recently deposited material closer to the surface would generally be expected to have lower concentrations of PCBs. This simplistic approach is important in evaluating sediment stability in areas upstream and closer to the source. However, it does not fully recognize the complex dynamics of transport downstream. In actuality, constituents are transported downstream in conjunction with sediment particles, and more with finer grained particles, in a continuous and gradual process of desorption, dissolution, and re-adsorption. This process may contribute to different sediment profiles farther downstream from the source area than upstream areas closer to the source area. PCB profiles are summarized in Table 1 and are discussed in more detail in Section 4.

Radioisotope Dating: The presence and concentration of radioisotopes can be used to evaluate the approximate age (year of deposition) of sediment and whether the sediment layers appear to correlate with the time of deposition or whether sediment layers are continuously mixed over time. These data were used in conjunction with PCB data as indicators of when and how sediment was deposited and as an indicator of overall sediment stability. The radioisotope results are summarized in Table 1 and are discussed in more detail in Section 4.

Channel Alignment: Both man-made and natural changes to the creek bed alignment are evident from a review of historical aerial photographs from 1940 through 2008, some of which are documented in the Environmental Photographic Interpretation Center (EPIC) Study (Mack 2005). These changes may have affected the way sediment is or was deposited in several ways. Areas that were formerly and are no longer part of the creek bed may be former areas of deposition that are currently stable. Naturally occurring geologic processes can change and slow stream flow and increase sediment stability through the creation or enlargement of oxbows. These can also alter where sediments are deposited within that region of the creek bed. Anthropogenic sources of stream bed changes include temporary or permanent changes to the channel for irrigation or other purposes and the construction or demolition of dams. These factors are considered in more detail in Section 4.

Based on evaluation of the above-referenced lines of evidence, much of the Choccolocco Creek sediment bed is not stable due to the higher stream gradients and associated water surface velocities in those portions of the creek. The conclusion that sediment deposits in most of Choccolocco Creek are unstable is not a concern. Sediment deposits in these unstable portions of the creek are relatively thin (average of 9 inches) and have average PCB concentrations below 1 mg/kg. As a result, these deposits do not represent a significant risk from the perspectives sediment stability and transport. However, three specific areas were identified where sediment appears to be stable (Figure 8). These three areas include portions of the Backwater area, the area upstream of Jackson Shoals, and the embayment area. Each of these areas is characterized by multiple indicators of sediment stability as summarized in Table 1. A detailed evaluation of these three areas is presented in Section 4.

4. Sediment Stability and Transport Evaluation

As discussed in Section 3, much of the Choccolocco Creek sediment bed is not stable due to the higher stream gradients and associated water surface velocities in those portions of the creek. The three primary depositional areas along Choccolocco Creek identified in Section 3 are shown on Figure 8 and further discussed below relative to sediment stability and the potential transport of sediment. In addition to sediment stability and transport, data and information needed to support a final evaluation of sediment stability and transport in the RI for OU-4 are discussed.

This evaluation is based on a weight-of-evidence approach using the lines of evidence listed in Table 1 and discussed in Section 3. A weight-of-evidence approach is appropriate for this evaluation because no single line of evidence provides enough certainty upon which the decision of sediment stability should be made. The weight-of-evidence approach provides multiple lines of evidence to balance the uncertainties associated with analytical chemistry data, field measurements, empirical or mechanistic models, or the physical system itself.

4.1 Backwater Area

The Backwater area is located at the confluence of Snow and Choccolocco Creeks (Figure 9). This area includes a portion of Choccolocco Creek where the flow is divided between a northern and southern branch that reunites just downstream of the confluence at Friendship Road. As shown on Figure 10, the Backwater area has the highest reported PCB concentrations in Choccolocco Creek and some of the highest average sediment thickness (Figure 11). Over 50% of the sediment cores collected from this area were characterized as fine-grained (Figure 12). The overall bottom gradient in this half-mile long portion of Choccolocco Creek is very low at 0.25 feet per mile. Downstream of the Backwater area, the creek bed gradient from the Friendship Road Bridge to a point about 2 miles upstream of Jackson Shoals is approximately 20 times steeper (approximately 5 feet/mile).

A review of aerial photographs from 1940, the 1960s, and 1977 indicate that two small portions of the creek channel in the Backwater area have changed. A channel (acting as a continuation of Snow Creek) that was present between 1940 and 1977 (Figure 13) appears to no longer exist. A new channel now exists from the southern branch of the creek to the confluence point that was not present prior to 1977. This new channel appears to be manmade based on the shape of the new channel, the construction of two gas pipelines in this area, and the relatively low PCB concentrations present in the new channel. The adjacent small piece of older channel appears to have filled in over time as the result of natural deposition after the new channel became the preferred hydraulic routing for the creek. Given that the changes in channel configuration appear to be the result human activity, sediments in the Backwater area are considered stable under this line of evidence.

The Backwater area was evaluated as part of the Off-Site RFI program (BBL 2000) and Phase 1 investigation (ARCADIS 2010) and included the collection of 40 sediment cores from 10 transects as well as two cores for radioisotope dating. A review of the PCB data from this area was conducted to evaluate changes in PCB concentrations with depth. Figure 14 presents PCB data as a function of sample depth for cores collected in the Backwater area with PCB concentrations greater than 5 milligram per kilogram (mg/kg). As shown on this figure, PCB concentrations at the surface were less than those at depth, and the maximum PCB concentrations typically occurred at depths greater than 6 inches. The maximum PCB concentration from these cores (approximately 500 mg/kg) was for a sample collected from the 3- to 4-foot interval.

In addition to the cores collected for standard chemical analysis, two cores were collected for radioisotope analysis (Be-7, Cs-137 and Pb-210). The locations for these cores are shown on Figure 9. A usable Cs-137 profile was generated for core CU-GEO-02. Using the Cs-137 profile for this core, a corresponding date was assigned to each sampling interval based on fixing the 1954 horizon to the first detectable Cs-137. Figure 15 depicts the corresponding PCB concentration to sample depth and year deposited based on this dating. Based on these data, the peak PCB concentration in the core corresponds approximately to the 1948 horizon. Since 1948, there have been eight flow events with an approximate 10-year return frequency or greater (Figure 6). These high flow events included a near 50-year return interval peak flow of 49,300 cubic feet per second (cfs) in 1952 (measured at the Lincoln station near Jackson Shoals). The creek flow during the 1952 event likely produced a shear stress on the sediment similar to a 100-year event (55,000 cfs) as the additional surface water conveyance during these higher flow events typically occurs outside of the defined creek channel (i.e., the flow within the creek bank reaches a maximum plateau when the banks overflow) . Since sediments in the area of core CU-GEO-02 have been stable through these high flow events, it is expected they will remain stable in the future and do not represent a transport risk unless otherwise disturbed through activities such as dredging. Further evidence of stability for Backwater area sediments includes positive indicators for nine of the sediment stability indicators summarized on Table 1 and described in Section 3.

In terms of post-remedial conditions, a 2-D hydraulic flow model for this area will be considered for use to assess sediment stability in the FS as warranted by various remedial alternatives to be evaluated. This approach is consistent with the *Technical Memorandum on Modeling of Site Characteristics for the OU-1/OU-2 Area, OU-3, and OU-4* (BBL 2005). No additional data or information are needed for the evaluation of sediment stability and transport for the Backwater area in the RI and FS.

4.2 Area Upstream of Jackson Shoals Dam

This area of Choccolocco Creek is located just upstream of Jackson Shoals (Figure 16) and includes the base structure for the former hydroelectric dam that was constructed sometime prior to 1913. This hydroelectric facility operated until at least the mid-1930s. The dam structure appears to rise approximately 5 feet from the sediment bed based on profiles in the 1980 Flood Insurance Study for the unincorporated areas of Talladega County (Federal Emergency Management Agency Federal Insurance Administration 1980). The impounded water combined with the elevation drop at Jackson Shoals provided 22 feet of head for power generation at one of the oldest hydroelectric facilities in the United States. Most of the 22 feet of head was from the 2,000-foot long flume that extended from the dam to the turbine. Following the cessation of power generation, the power generation equipment was removed and under normal flow conditions, surface water flow appears to by-pass the dam on its side. The alignment of the creek in this area has not changed visibly since 1940 (Figure 17) and the dam structure likely impounds surface water to some degree. As a result, surface water velocities in this section of creek are somewhat lower than they would be if the dam structure was not present, especially under base flow conditions..

As discussed above, the overall stream gradient in this area is very low at 0.35 feet/mile (Figure 3) and water depths are significantly deeper than the rest of the creek (9.6 feet vs. 3.7 feet for the rest of the creek, Figures 4 and 11). As expected with the deeper waters, the water velocities measured during the Off-Site RFI, under base flow conditions, were lower than those measured in the rest of the creek. In general, PCB concentrations in this area were less than 3 mg/kg with an average concentration below approximately 1 mg/kg (0.73 mg/kg).

Despite the relatively low surface water velocities, sediment thickness in this portion of the creek is approximately 1 foot (Figures 7 and 11). Only two cores from this section of creek had at least 1 foot of recovered sediment and PCB concentrations over 1 mg/kg. These two cores are depicted on Figure 18, which shows that the maximum PCB concentrations are less than 1.5 mg/kg and the higher PCB concentrations are near the surface. Given that PCBs have not been manufactured at the Facility for nearly 40 years, these data indicate relatively low sediment deposition rates over time for this portion of the creek. A low sediment deposition rate is also consistent with the relatively thin sediment deposits measured in this portion of the creek. The thin sediment deposits, in combination with the low sediment PCB concentrations, result in relatively low total PCB mass for this section of the creek (approximately 3% of the total PCB mass for Choccolocco Creek).

Further evidence of stability of sediment in the area upstream of the Jackson Shoals Dam includes positive indicators for seven of the sediment stability indicators summarized on Table 1 and described in Section 3. These include the creek characteristics described above, that the creek channel has not moved over the past 70 years and the predominance of fine-grained sediment in this area. Sediments in this portion of the creek are considered stable and do not represent a significant risk from the perspectives of sediment stability and transport. Even if the foundation of the former dam structure were to be removed in the future, these sediments do not represent a significant risk based on their low PCB concentration and mass. As a result, additional data to complete the sediment stability and transport evaluation for this portion of Choccolocco Creek in the RI or FS are not needed.

4.3 Embayment Area

This portion of Choccolocco Creek includes the area of the creek affected by the installation of the Logan Martin Dam on the Coosa River and the subsequent impoundment of Lake Logan Martin (Figure 19). The Logan Martin Dam was completed in 1964 and is still in use for power generation today. Figure 20 shows a comparison of Choccolocco Creek in the embayment area with the creek channel alignment prior to 1964. The effects of the impoundment of the lake extend approximately 7 miles upstream Choccolocco Creek from the original confluence point with the Coosa River at Ogletree Island. Within this stretch of Choccolocco Creek, there is no gradient in the surface water elevation or sediment bed. Base flow surface water velocities measured during the Off-Site RFI averaged 0.5 feet per second. The wide cross sectional area and low velocities in this area of the creek create conditions for the deposition of solids transported from upstream reaches of the creek. The results of sediment probing conducted in the embayment area indicate sediment deposits averaging 2 feet thick and average water depths of approximately 12 feet (Figure 11). The majority of sediment cores collected in this area (73%) were visually characterized as fine-grained (Figure 12) and 91% of grain size samples evaluated from this area passed a #40 sieve (i.e., either fine sands, silts, and/or clay materials).

Sediment PCB concentrations in this portion of the creek generally do not exceed 1 mg/kg (Figure 10) and average 0.29 mg/kg. As part of the Off-Site RFI, radioisotope cores were collected from the embayment area. The Cs-137 profile for MLM-GEO-7 was suitable for dating and had a peak activity in the 26- to 28-inch interval of the core (corresponding to the 1963 horizon). As a result of the impoundment being created when the Logan Martin Dam was constructed in 1964, the initial occurrence of Cs-137 in the sediment profile is approximately coincident with the peak Cs-137 value since the rate of soil accretion in the floodplain prior to the construction of the dam was likely relatively low as compared with the sediment deposition rates after the area was impounded. The PCB profile for this core plotted by depth and year deposited is presented in Figure 21. As shown on this figure, the peak PCB concentration for this core (1.1 mg/kg) is associated with the mid-1970s (approximately 1974).

Of the lines of evidence considered during the preparation of this evaluation (Table 1), the majority (10) indicate that these sediment are stable and that no additional data or evaluation are necessary to complete the RI or FS.

5. Summary of Findings

As noted in Sections 3 and 4, sediment deposits for the majority of Choccolocco Creek are not considered stable. This includes the reach of creek from the Friendship Road Bridge downstream to approximately 2 miles upstream of Jackson Shoals. While sediments in this reach of creek do not appear to be stable, they do not represent a significant risk from a sediment transport perspective given that average PCB concentrations are both below 1 mg/kg and that the coarse-grained sediments that characterize this reach of the creek cannot be readily transported downstream. More than 90% of the sediment cores taken within this 25-mile long reach of creek were characterized as either having coarse-grained sediment, gravel or no recovery (Figure 12). These sediment deposits are relatively thin (average of 9 inches) and in combination with the low PCB concentrations, comprise a small percentage of the overall PCB mass in Choccolocco Creek. The high percentage of fine-grained sediment just upstream of Jackson Shoals Dam and for the embayment area downstream of Jackson Shoals are evidence of the lack of transport of these coarse sediments. Given these findings, no additional data are proposed for this reach of Choccolocco Creek.

Sediments in the low-energy Backwater area are stable. This finding is confirmed by the evaluation conducted as part of this Technical Memorandum. The thick deposits of fine-grained sediment in this low energy portion of Choccolocco Creek are not expected to move. These sediments were in place during multiple previous high flow conditions and have not been mobilized. This is further supported by the radioisotope and PCB profile data that confirm the long-term presence of sediments in this area. No additional data or information is needed to evaluate sediment stability or transport in the Backwater area for the RI or FS. While a portion of the creek channel in the Backwater area has changed over time, these changes appear to be the result of human activity and not geomorphologic processes.

No additional data or information are planned for the 2-mile-long reach of creek just upstream of Jackson Shoals Dam. Sediments in this portion of the creek are stable under current conditions, and if the former dam structure is removed in the future, the relatively thin sediment deposits characterized by low PCB concentrations do not represent a significant risk from the perspectives of sediment stability and transport.

Sediment deposits in the embayment area are characterized as fined grained with low PCB concentrations (average of 0.29 mg/kg). Their presence is supported by the deep water, low energy environment created by the construction of the Lake Logan Martin impoundment. No additional data or information needs are proposed for the embayment sediments as they represent low stability and transport risks.

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Tables

Table 1
Summary of Sediment Stability Indicators

OU-4 Sediment Stability Technical Memorandum
Anniston PCB Site, Anniston, AL

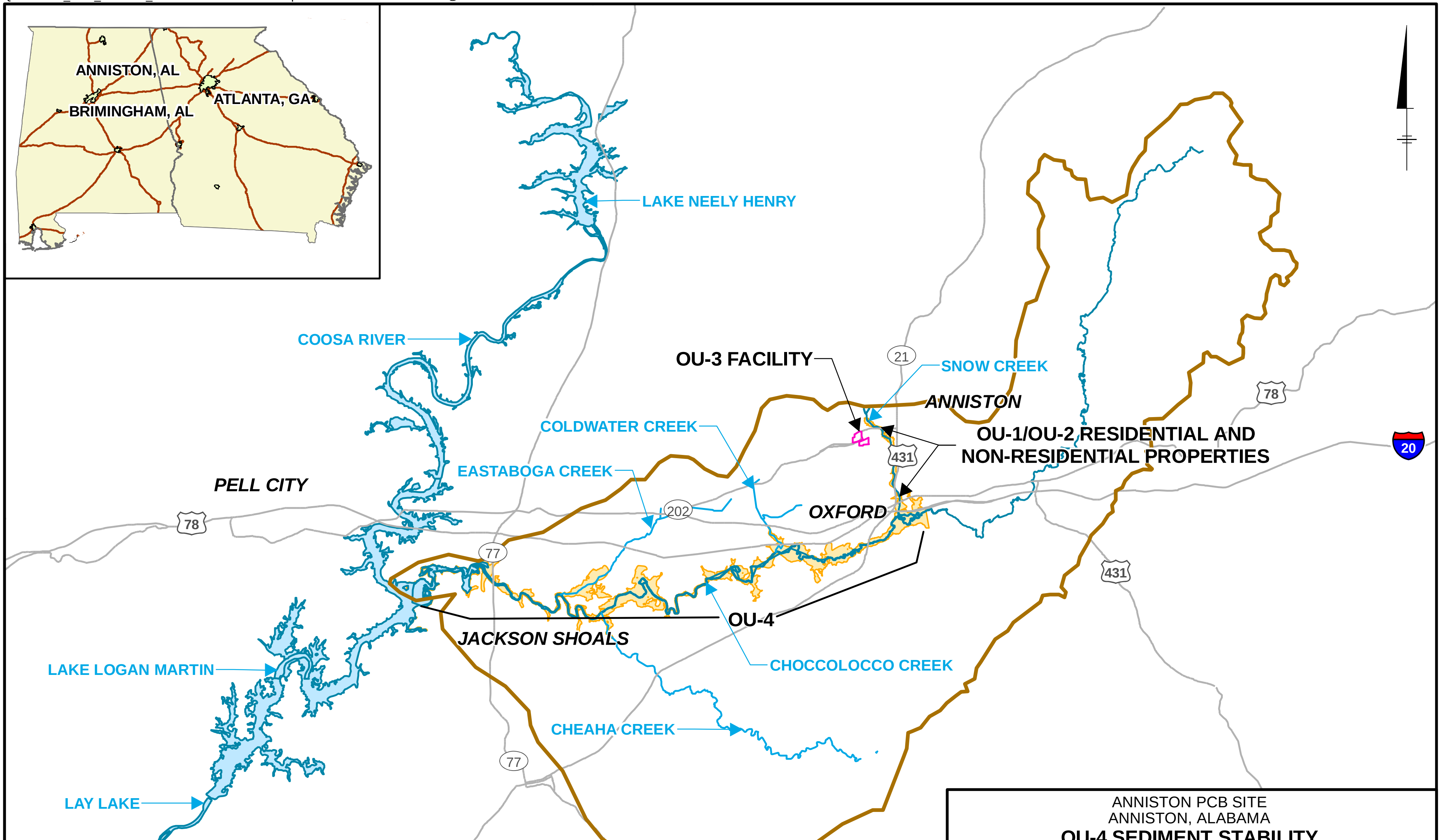
Line of Evidence	Figure	Backwater Area	Area Upstream of Jackson Shoals Dam	Embayment	Rest of Creek
Bathymetry - Bottom Elevation Gradient	2	0.25 feet/mile (ft/mi) - very low gradient	1.0 ft/mi - low gradient	0 ft/mi - no gradient	4.6 ft/mi - steepest gradient
Bathymetry - Water Surface Elevation Gradient	3	1.9 ft/ mi - mild gradient	0.35 ft/mi - very low gradient	0 ft/mi - no gradient	4.3 ft/mi - steepest gradient
Bathymetry - Water Depth	4, 11	2.9 feet (ft) average water depth (lowest of any area)	9.6 ft average water depth (2nd highest of any area)	12 ft average water depth (highest of any area)	3.7 ft average water depth (2nd lowest of any area)
Water Velocity - Measured (base flow)	5	0.30 feet per second (fps)	0.17 fps	0.05 fps	1.0 fps
Water Velocity - Modeled (2-year Event)	5	2.3 fps	4.6 fps	2.5 fps	4.4 fps
Flow Events	6	USGS flow data have been collected at or near Jackson Shoals since 1938. During this period of record, peak flows exceeding a 10-year flood flow event have occurred 8 times. These large flow events indicate that events capable of scouring sediment from susceptible areas of the creek bed occur on a regular basis.			
Sediment Thickness	7, 11	2.9 ft average sediment depth (highest of any area)	1.0 ft average sediment depth (2nd lowest of any area)	2.0 ft average sediment depth (2nd highest of any area)	0.72 ft average sediment depth (lowest of any area)
Sediment Texture	12	53% of cores characterized as fine-grained 38% of cores characterized as coarse-grained	41% of cores characterized as fine-grained 29% of cores characterized as coarse-grained	73% of cores characterized as fine-grained 11% of cores characterized as coarse-grained	7% of cores characterized as fine-grained 52% of cores characterized as coarse-grained
Sediment Grain Size Distribution	12	Average 62% passing #40 Sieve 57/133 samples had more than 70% passing #40 sieve	Average 71% passing #40 Sieve 6/11 samples had more than 70% passing #40 sieve	Average 91% passing #40 Sieve 17/19 samples had more than 70% passing #40 sieve	Average 46% passing #40 Sieve 22/90 samples had more than 70% passing #40 sieve
PCB Profiles	14, 15, 18, 21	Peak PCB levels found below surface with highest detected concentration deeper than 3 ft below sediment surface	Highest PCB at surface decreases with depth - Average PCB concentrations ~ 1 mg/kg	Average PCB concentration well below 1 mg/kg (average = 0.34 mg/kg)	Profiles not evaluated
Radioisotope Dating	15, 21	Peak PCB concentrations correspond to late 1940s, PCB concentrations decrease since then	No isotope data collected	Peak PCB concentration corresponds to early 1970s, secondary peak around 1990	No isotope data collected
Changes in Channel Alignment Historic Photos, Manmade Changes	13, 17, 20	Some channel shifting due to human activity	No change in channel alignment over 70 years	Section impounded in 1964 - increase in cross sectional area enhances deposition	NRCS Channel Cutoffs - photo comparison not evaluated

Positive indicator of sediment stability (green)
Negative indicator of sediment stability (orange)
Neither a positive or negative indicator of sediment stability

ARCADIS

Figures

CITY: ROCH SYR DIV/GROUP: 40 DB: EAL KES LD: PIC: PM: TM: TR:
Anniston (B0010291.2010.00003)
Q:\Anniston_PCB_site\OU4_SedStabTechMemo\mxd\OperableUnits.mxd - 6/28/2010 @ 10:40:47 AM



LEGEND:
MAJOR ROADWAY
WATERSHED BOUNDARY
100-YEAR FLOODPLAIN

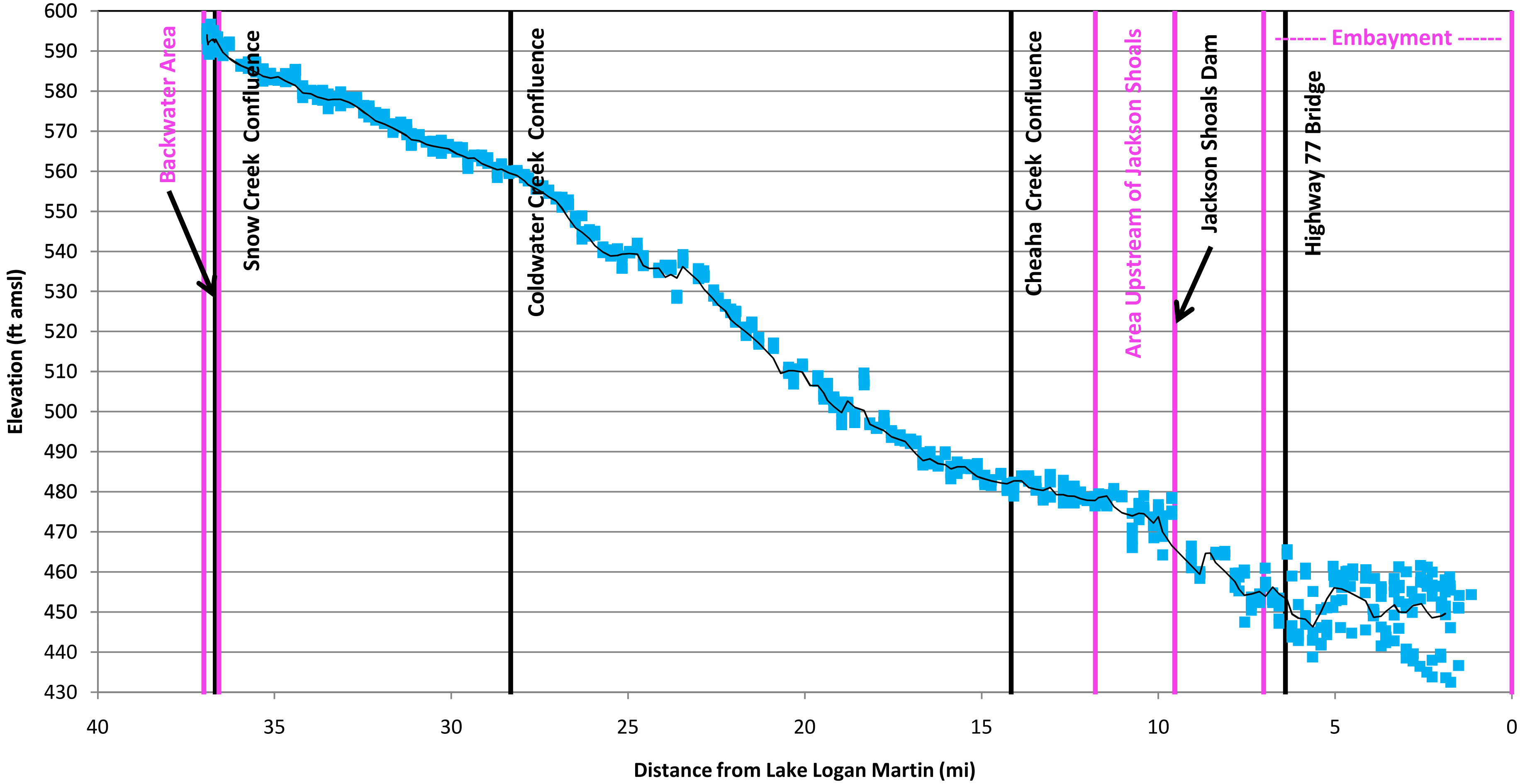
0 6 12 Miles
GRAPHIC SCALE

ANNISTON PCB SITE
ANNISTON, ALABAMA
OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

OPERABLE UNITS

ARCADIS

FIGURE
1



Notes:

1. Based on probing data from 769 locations

ANNISTON PCB SITE
ANNISTON, ALABAMA

OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

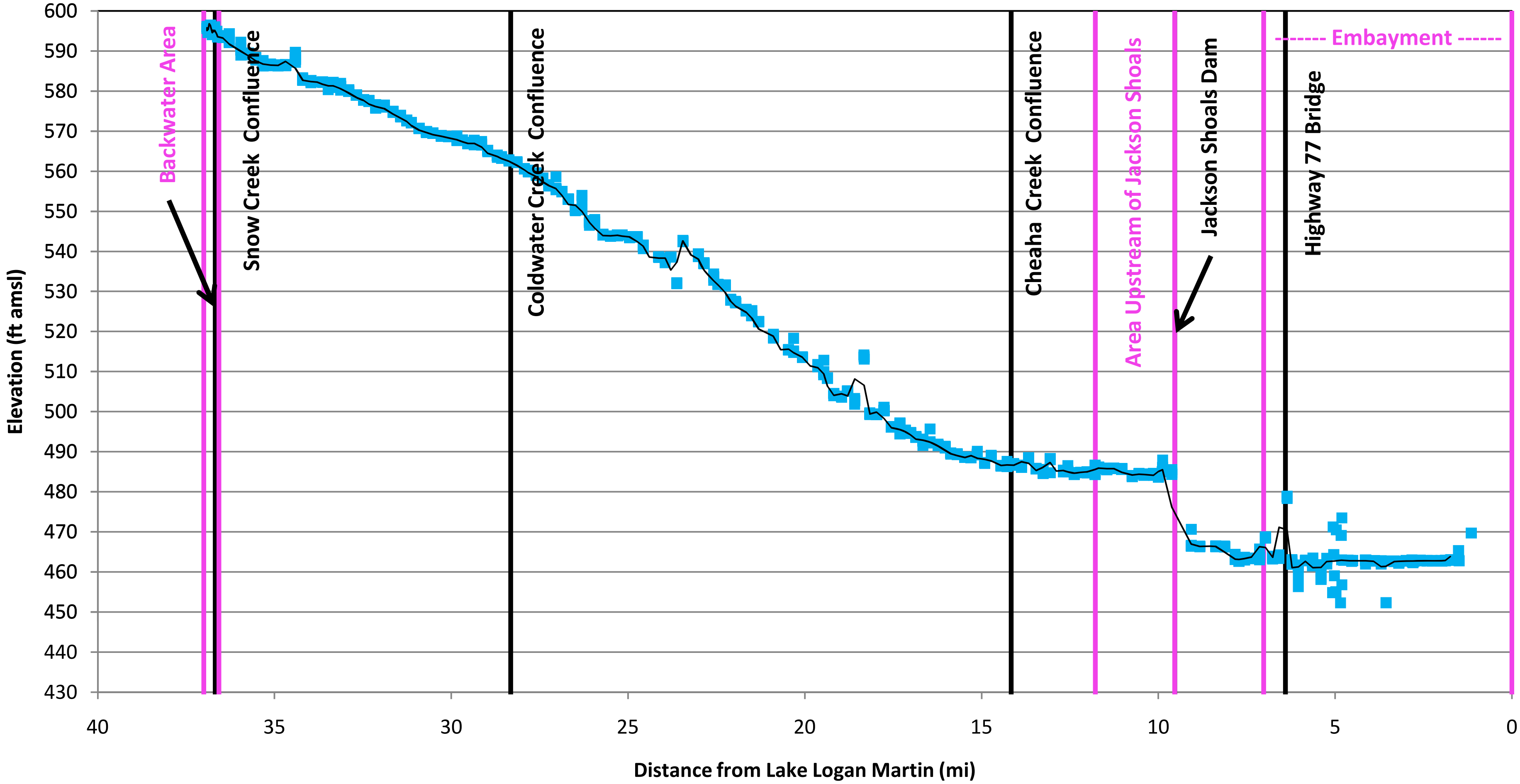
BOTTOM ELEVATION IN CHOCCOLOCCO CREEK SEDIMENT WITH DISTANCE FROM LAKE LOGAN MARTIN

ARCADIS

FIGURE

2

6/29/2010
G:\PROJECTS\Anniston\Sed_Stability_Memo_2010\Stability_Figures_Draft.xlsxF 3 WS Elevation



Notes:

1. Based on probing data from 769 locations

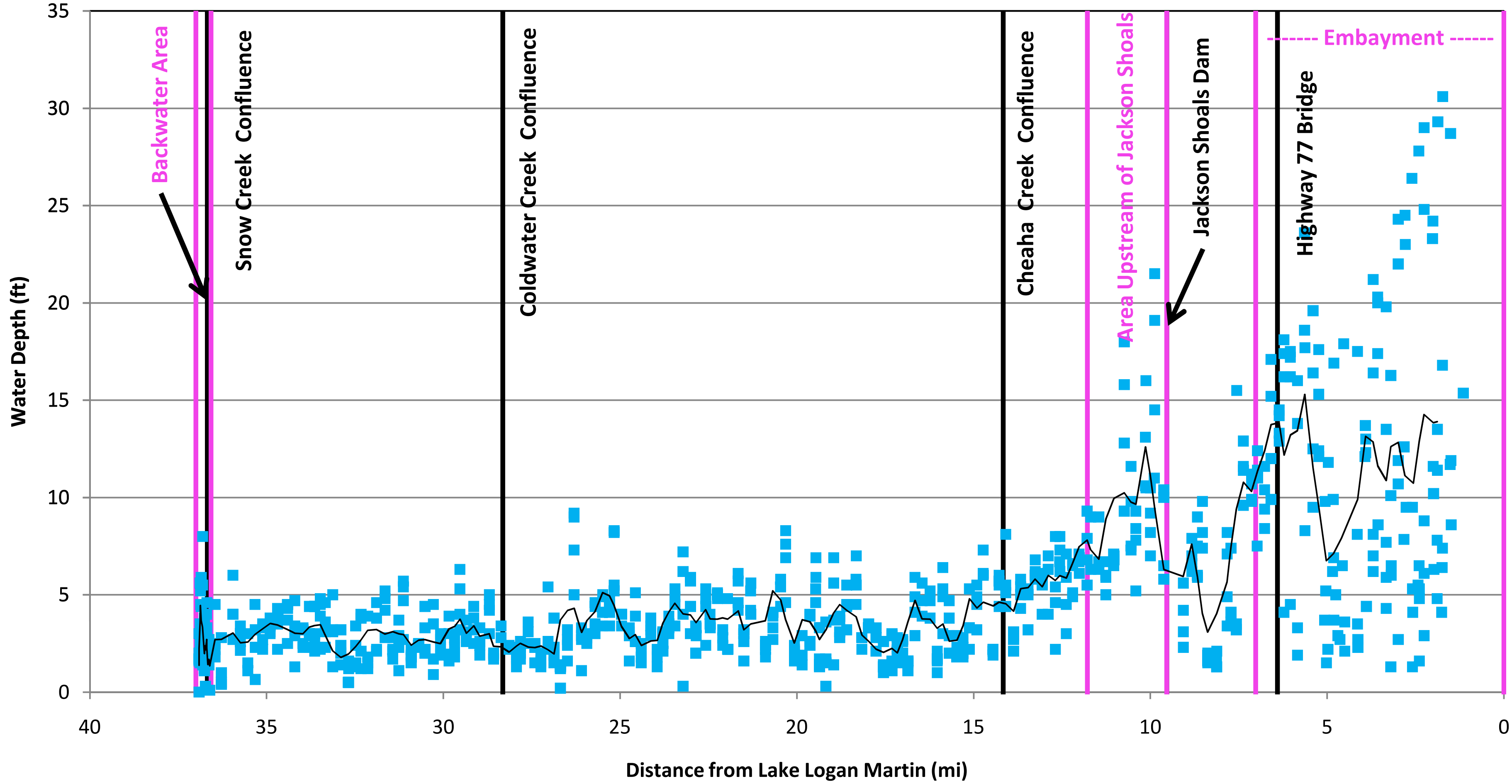
ANNISTON PCB SITE
ANNISTON, ALABAMA

OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

WATER SURFACE ELEVATION IN CHOCCOLOCCO CREEK WITH DISTANCE FROM LAKE LOGAN MARTIN

ARCADIS

FIGURE
3



Notes:

1. Based on probing data from 769 locations

ANNISTON PCB SITE
ANNISTON, ALABAMA

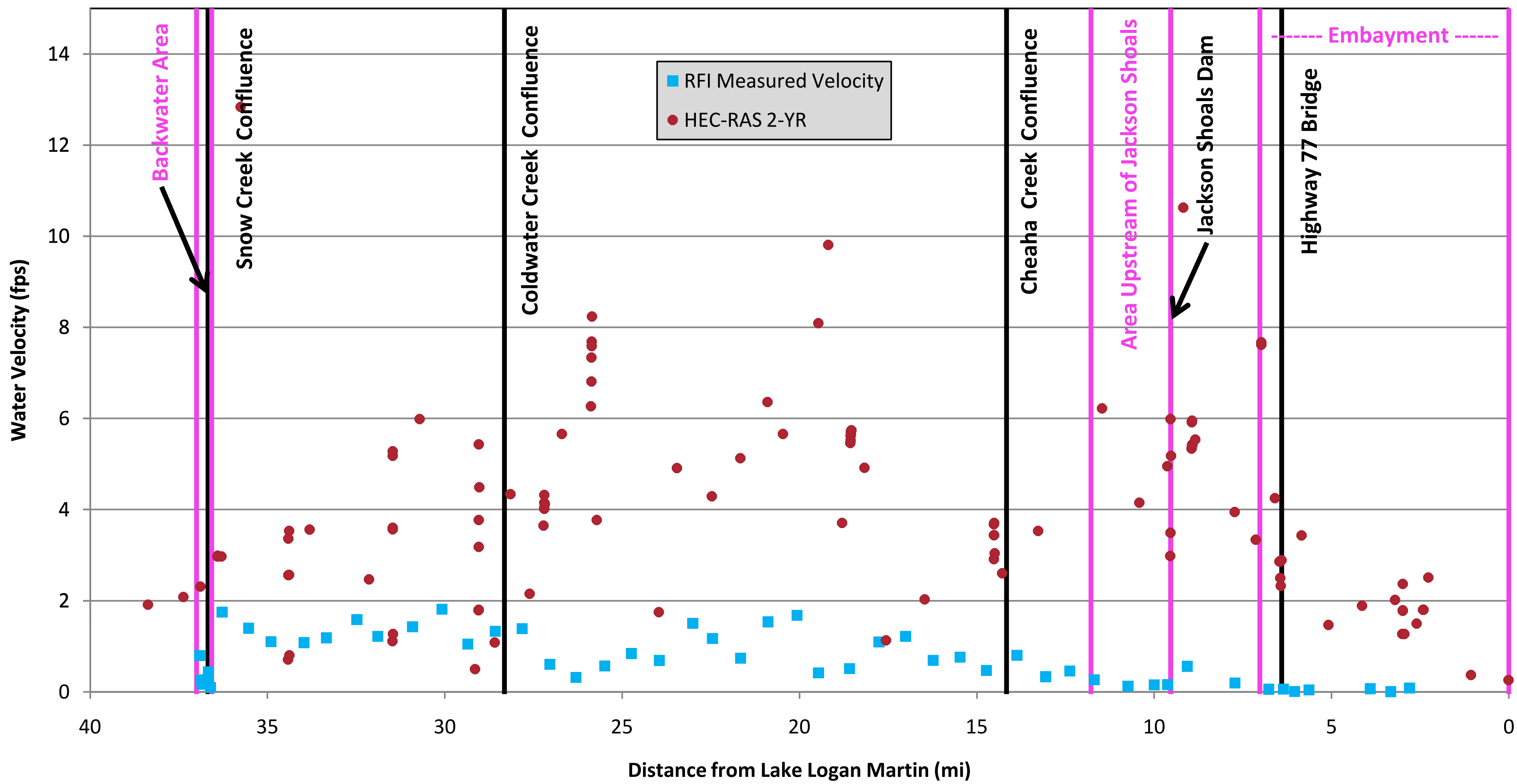
OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

WATER DEPTH IN CHOCCOLOCCO CREEK WITH DISTANCE FROM LAKE LOGAN MARTIN

ARCADIS

FIGURE

4



Notes:
1. Measured data collected during off-site RFI base flow condtions
2. Model data based on the Off-Site RFI HEC-RAS model for a 2-yr flow event

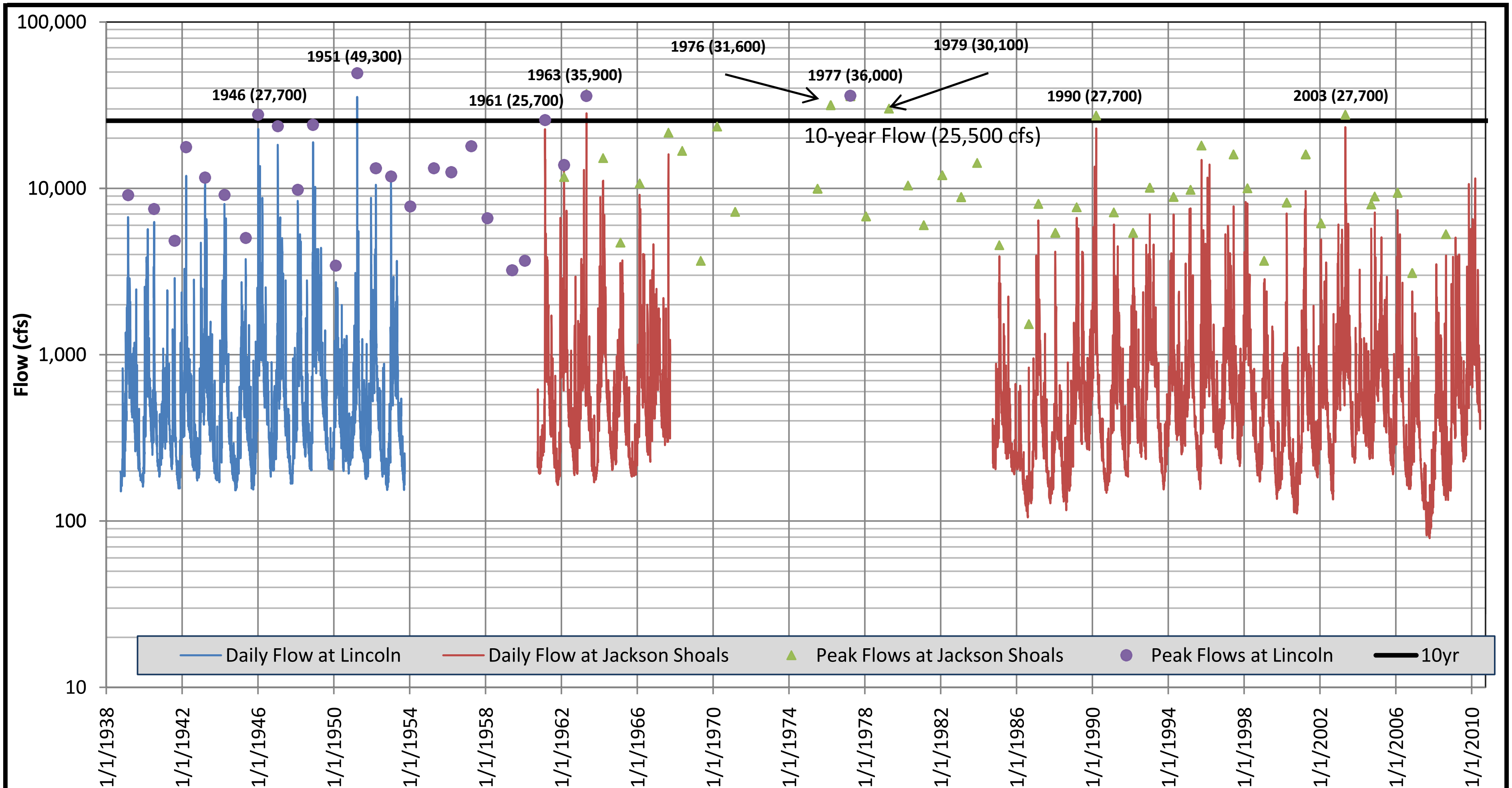
ANNISTON PCB SITE
ANNISTON, ALABAMA

OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

WATER VELOCITY IN CHOCCOLOCCO CREEK WITH DISTANCE FROM LAKE LOGAN MARTIN

ARCADIS

FIGURE
5



Event	Flow (cfs)
2-year	10,500
10-year	25,500
25-year	40,000
50-year	52,000
100-year	55,000

ANNISTON PCB SITE
ANNISTON, ALABAMA

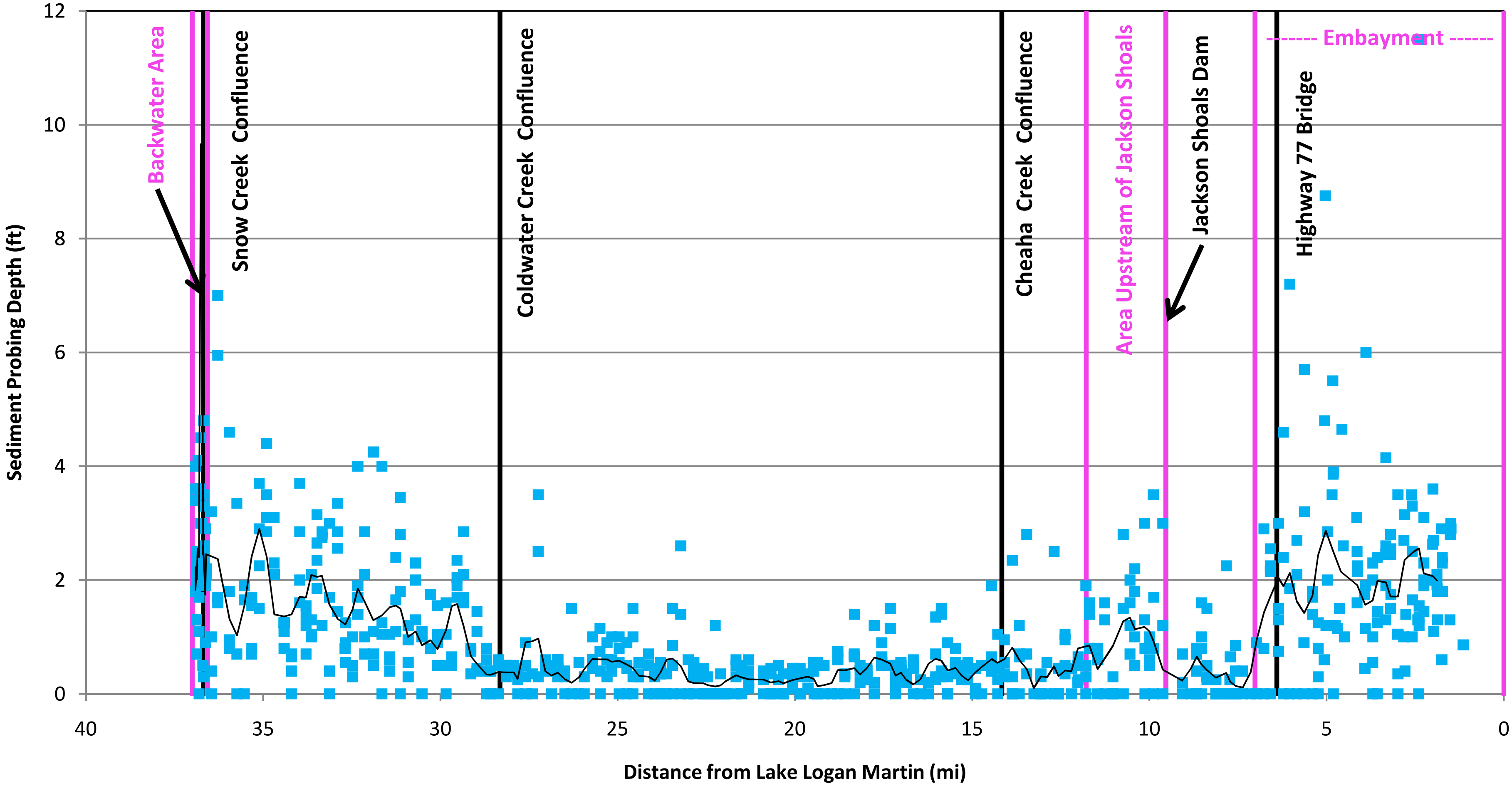
OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

SUMMARY OF FLOW IN CHOCCOLOCCO CREEK AT OR NEAR JACKSON SHOALS

ARCADIS

FIGURE
6

6/29/2010
G:\PROJECTS\Anniston\Sed_Stability_Memo_2010\Stability_Figures_Draft.xlsxF 7 Probe



Notes:
1. Based on probing data from 769 locations

ANNISTON PCB SITE
ANNISTON, ALABAMA

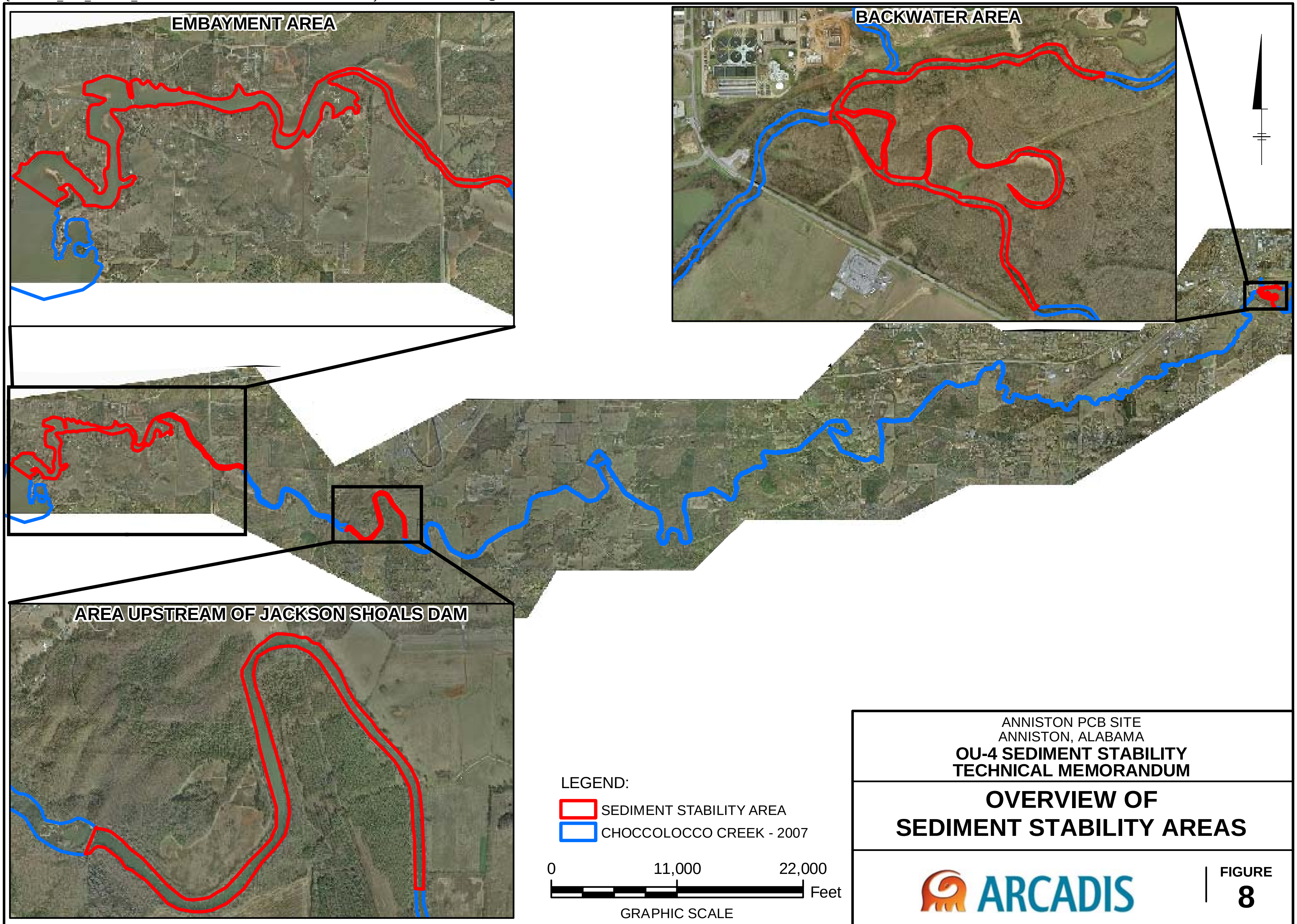
OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

PROBING DEPTH IN CHOCCOLOCCO CREEK SEDIMENT WITH DISTANCE FROM LAKE LOGAN MARTIN

ARCADIS

FIGURE
7

CITY: ROCH SYR DIV/GROUP: 40 DB: EAL KES LD: PIC: PM: TM: TR:
Anniston (B0010291.2010.00003)
Q:\Anniston_PCB_site\OU4_SedStabTechMemo\mxd\OverviewSedimentStabilityAreas.mxd - 6/29/2010 @ 11:21:11 AM



ANNISTON PCB SITE
ANNISTON, ALABAMA

OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

OVERVIEW OF SEDIMENT STABILITY AREAS

ARCADIS

FIGURE
8

CITY: ROCH SYR DIV/GROUP: 40 DB: EAL KES LD: PIC: PM: TM: TR:
Anniston (B0010291.2010.00003)
Q:\Anniston_PCB_site\OU4_SedStabTechMemo\mxd\BackwaterArea.mxd - 6/29/2010 @ 11:21:50 AM

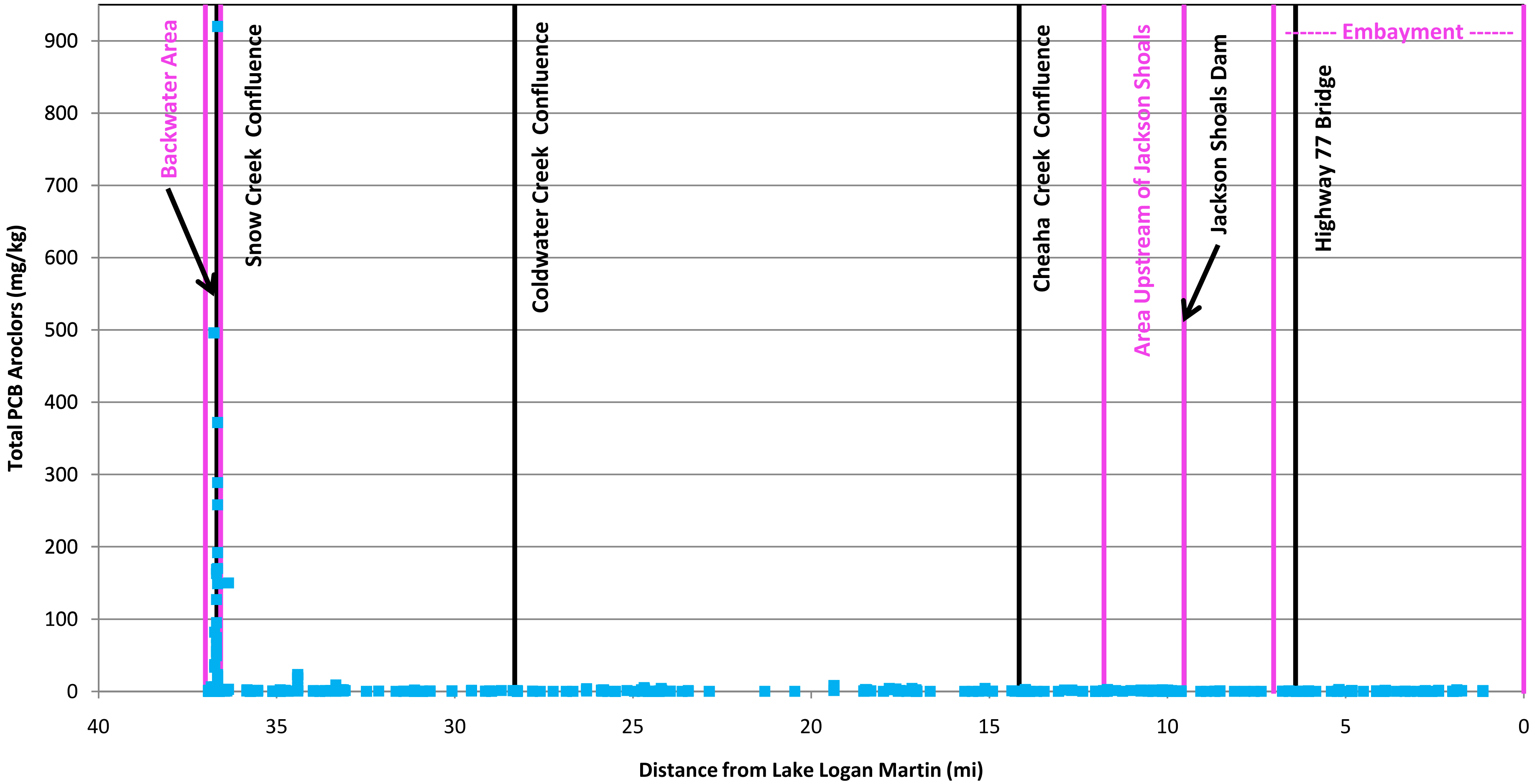
ANNISTON PCB SITE
ANNISTON, ALABAMA

OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

BACKWATER AREA

ARCADIS

FIGURE
9



ANNISTON PCB SITE
ANNISTON, ALABAMA

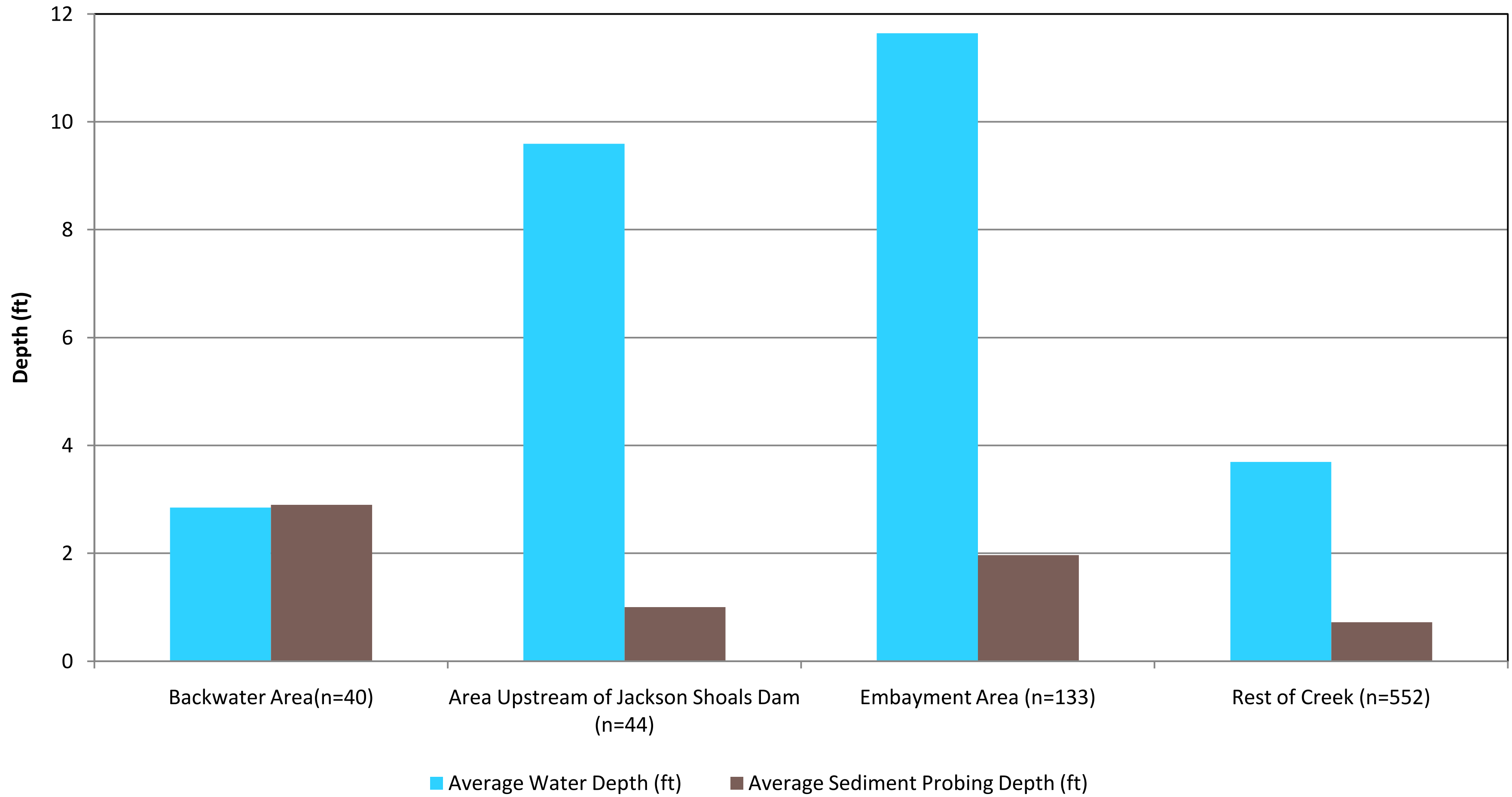
OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

TOTAL PCB AROCLOR CONCENTRATIONS IN CHOCCOLOCCO CREEK SEDIMENT WITH DISTANCE FROM LAKE LOGAN MARTIN

ARCADIS

FIGURE

10



ANNISTON PCB SITE
ANNISTON, ALABAMA

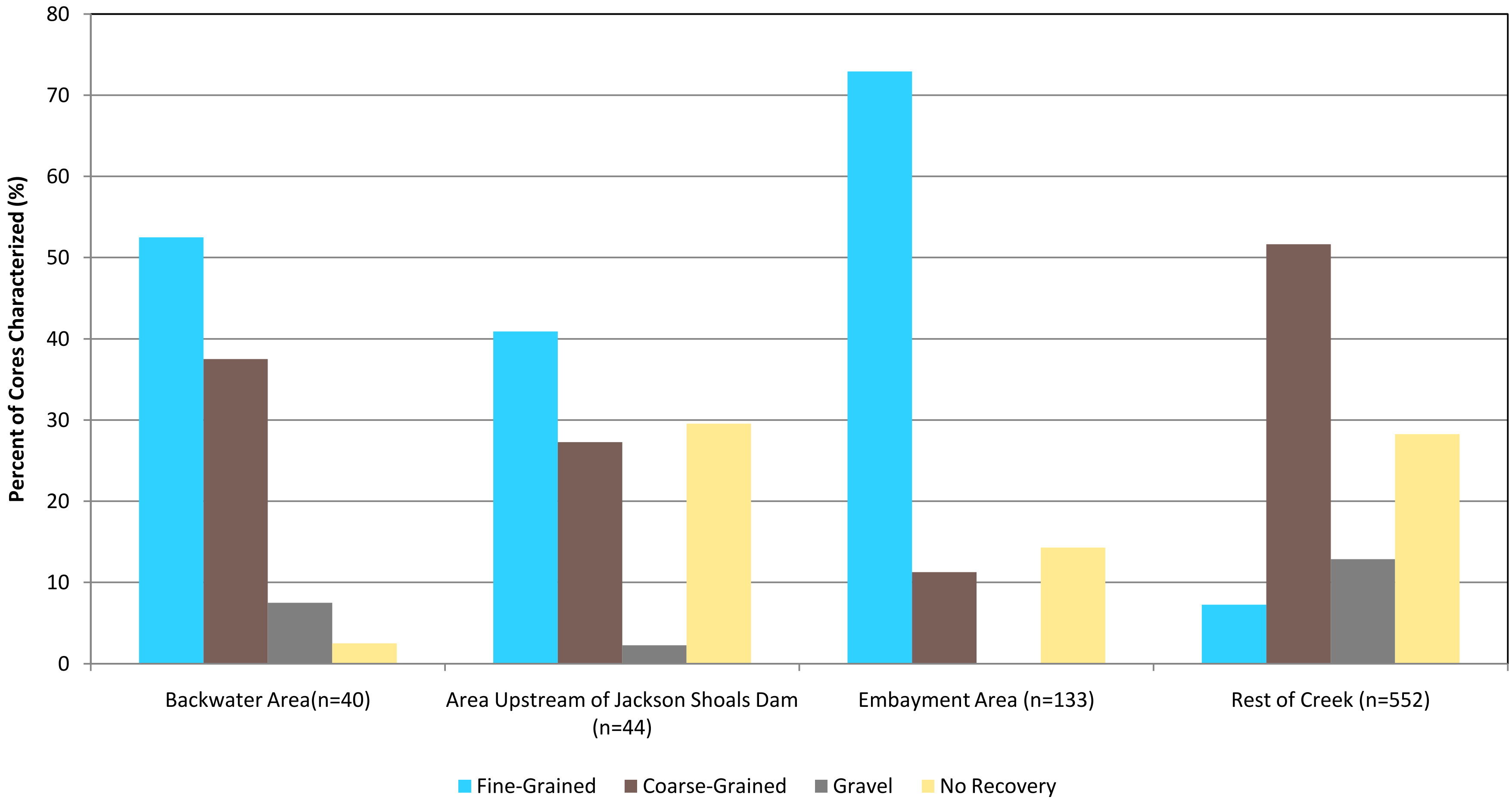
OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

SUMMARY OF AVERAGE WATER AND SEDIMENT PROBING DEPTH BY AREA

ARCADIS

FIGURE

11



ANNISTON PCB SITE
ANNISTON, ALABAMA

OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

SUMMARY OF SEDIMENT TEXTURE BY AREA

ARCADIS

FIGURE

12

LEGEND:
CHOCCOLOCCO CREEK - 2007

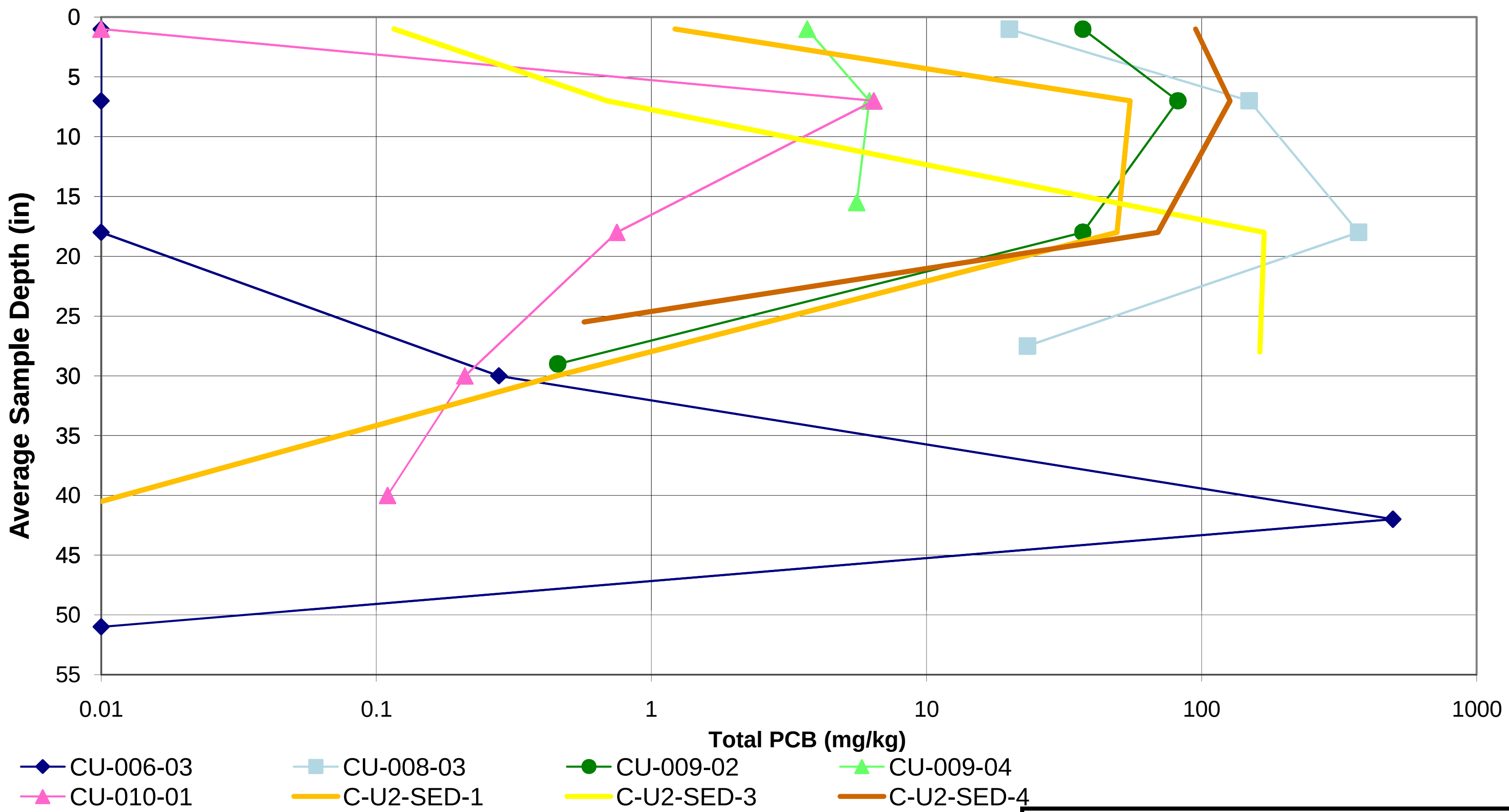
0 350 700 Feet
GRAPHIC SCALE

ANNISTON PCB SITE
ANNISTON, ALABAMA
OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

BACKWATER AREA WITH 1940 AERIAL IMAGERY

ARCADIS

FIGURE
13



Notes:

1. Based on core locations with maximum PCB concentrations greater than 5 milligrams per kilogram.
2. RFI locations include: C-U2-SED-1, C-U2-SED-3, and C-U2-SED-4.

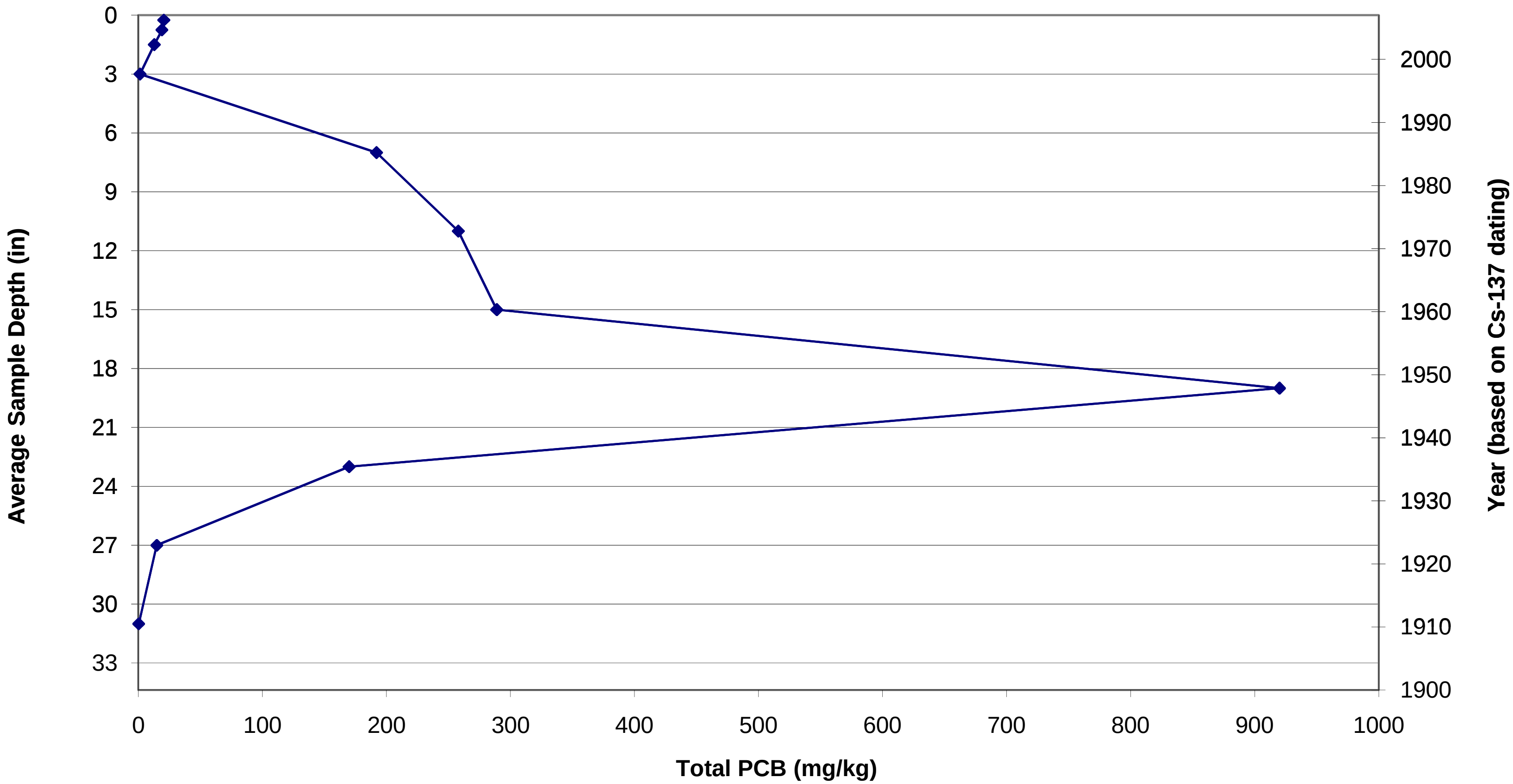
ANNISTON PCB SITE
ANNISTON, ALABAMA

OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

BACKWATER AREA SEDIMENT PCB PROFILES

ARCADIS

FIGURE
14



Notes:

1. Dates based on Cesium-137 (Cs-137) radiodating with first detectable Cs-137 reported between 15 and 19 inches which corresponds to the 1954 horizon.

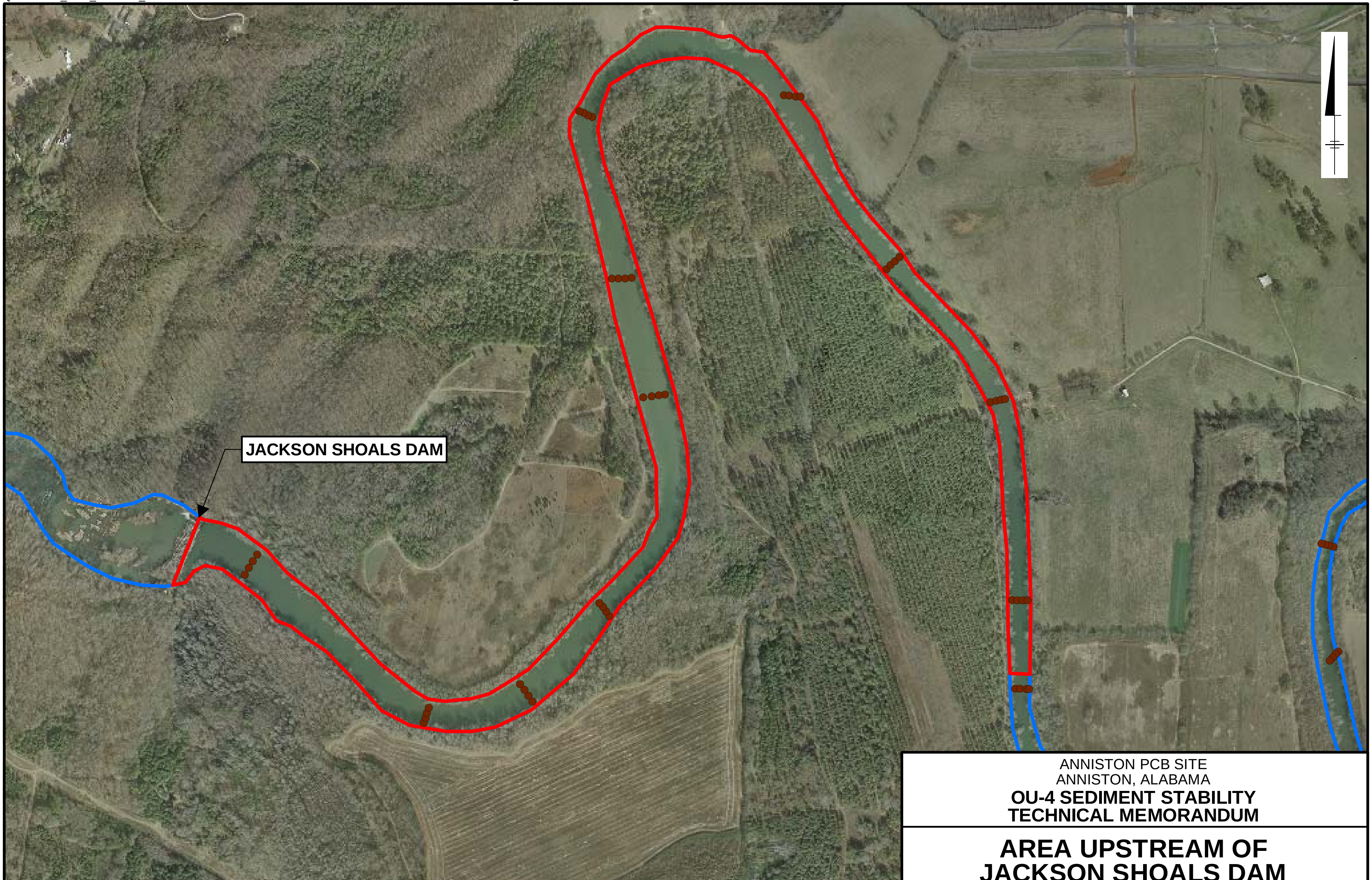
ANNISTON PCB SITE
ANNISTON, ALABAMA

OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

BACKWATER AREA SEDIMENT PCB/GEOCHRONOLOGICAL PROFILE CU-GEO-02

ARCADIS

FIGURE 15



LEGEND:

- CORE COLLECTION LOCATION
- SEDIMENT STABILITY AREA
- CHOCCOLOCCO CREEK - 2007

0 800 1,600 Feet

GRAPHIC SCALE

ANNISTON PCB SITE
ANNISTON, ALABAMA

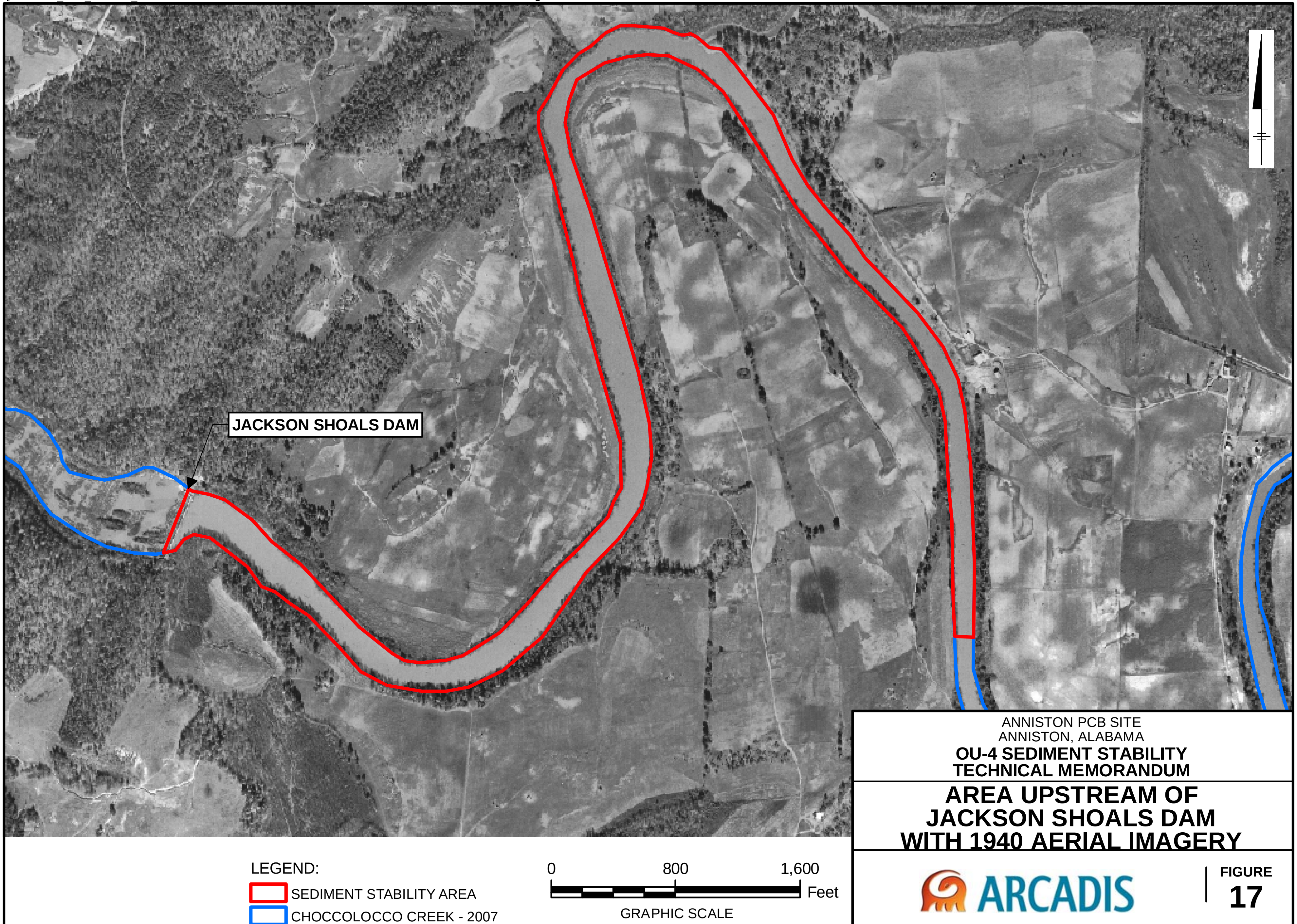
OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

AREA UPSTREAM OF JACKSON SHOALS DAM

ARCADIS

FIGURE **16**

CITY: ROCH SYR DIV/GROUP: 40 DB: EAL KES LD: PIC: PM: TM: TR:
Anniston (B0010291.2010.00003)
Q:\Anniston_PCB_site\OU4_SedStabTechMemo\mxd\AreaBehindJacksonShoalsDam1940Aerial.mxd - 6/28/2010 @ 10:36:31 AM



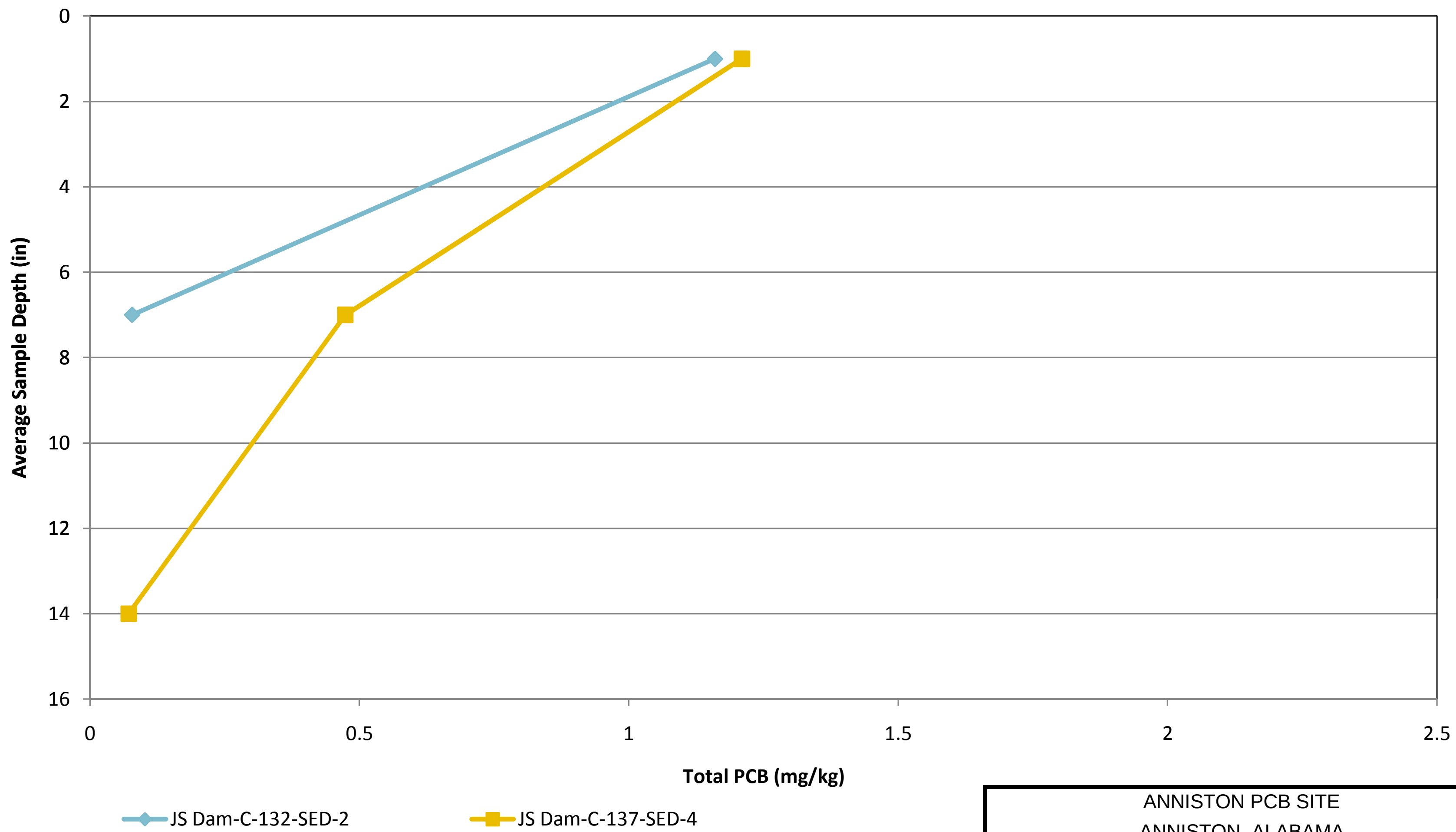
ANNISTON PCB SITE
ANNISTON, ALABAMA

OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

AREA UPSTREAM OF JACKSON SHOALS DAM WITH 1940 AERIAL IMAGERY

ARCADIS

FIGURE
17



Notes:

1. Based on core locations with maximum PCB concentrations greater than 1 milligrams per kilogram.
2. Includes only locations with a bottom sampling depth greater than or equal to 12 inches

ANNISTON PCB SITE
ANNISTON, ALABAMA

OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

AREA UPSTREAM OF JACKSON SHOALS DAM SEDIMENT PCB PROFILES

ARCADIS

FIGURE **18**

6/25/2010
G:\PROJECTS\Anniston\Sed_Stability_Memo_2010\Sed Stability PCB profiles.xlsxFigure18

CITY: ROCH SYR DIV/GROUP: 40 DB: EAL KES LD: PIC: PM: TM: TR:
Anniston (B0010291.2010.00003)
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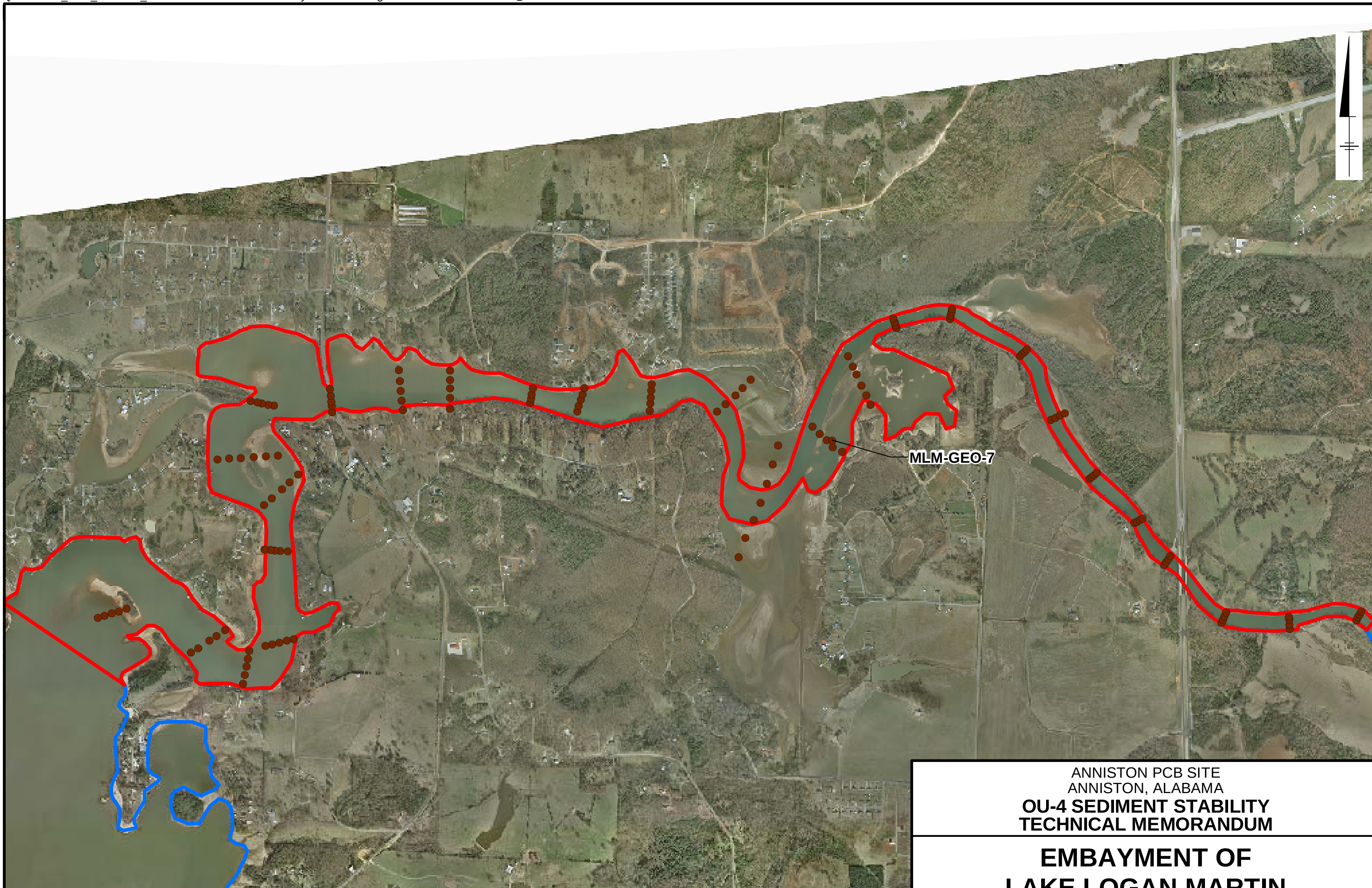

LEGEND:

- CORE COLLECTION LOCATION
- SEDIMENT STABILITY AREA
- CHOCCOLOCCO CREEK - 2007

0 2,000 4,000 Feet

GRAPHIC SCALE

ANNISTON PCB SITE
ANNISTON, ALABAMA

OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

EMBAYMENT OF LAKE LOGAN MARTIN

ARCADIS

FIGURE **19**

CITY: ROCH SYR DIV/GROUP: 40 DB: EAL KES LD: PIC: PM: TM: TR:
Anniston (B0010291.2010.00003)
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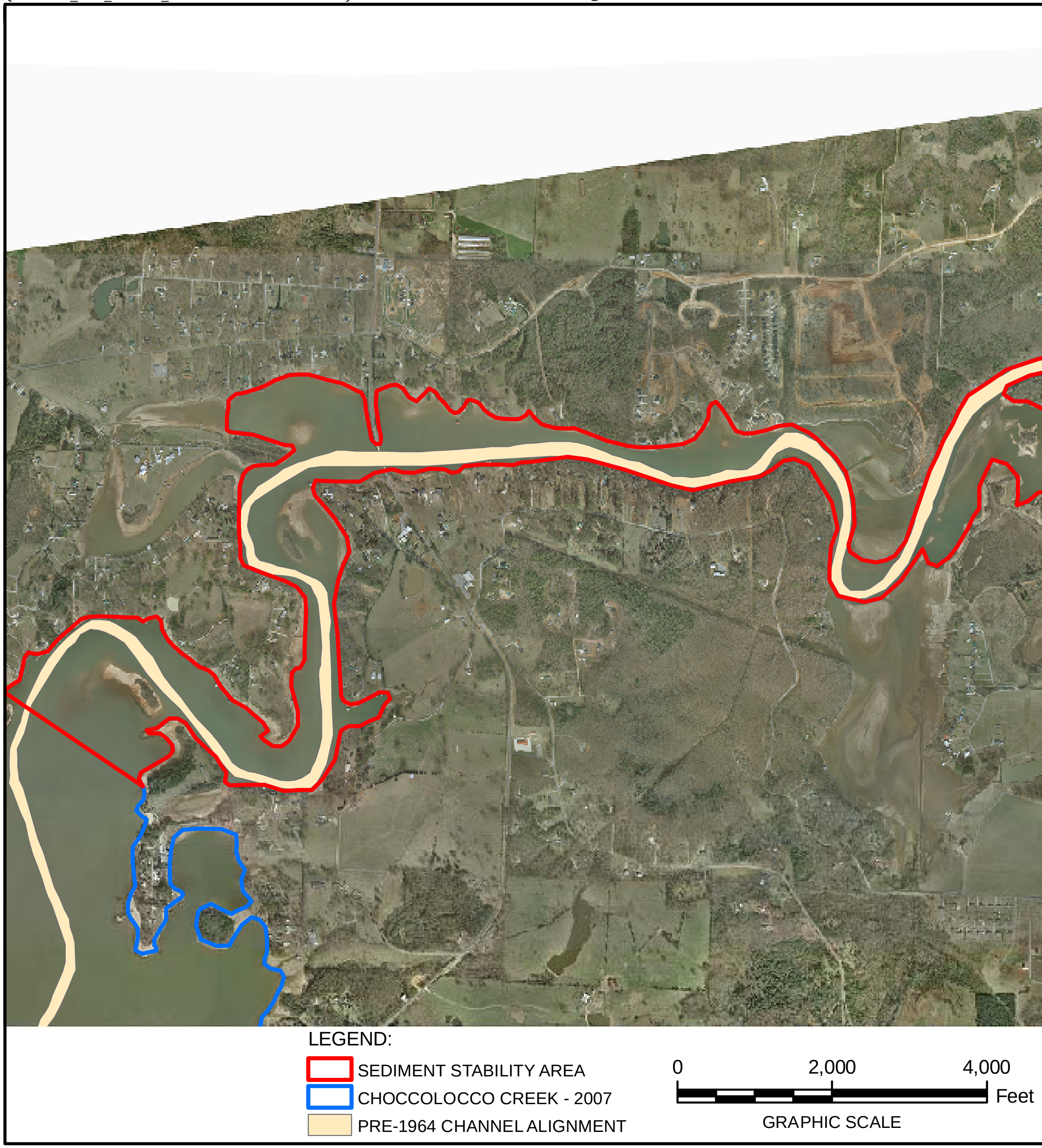


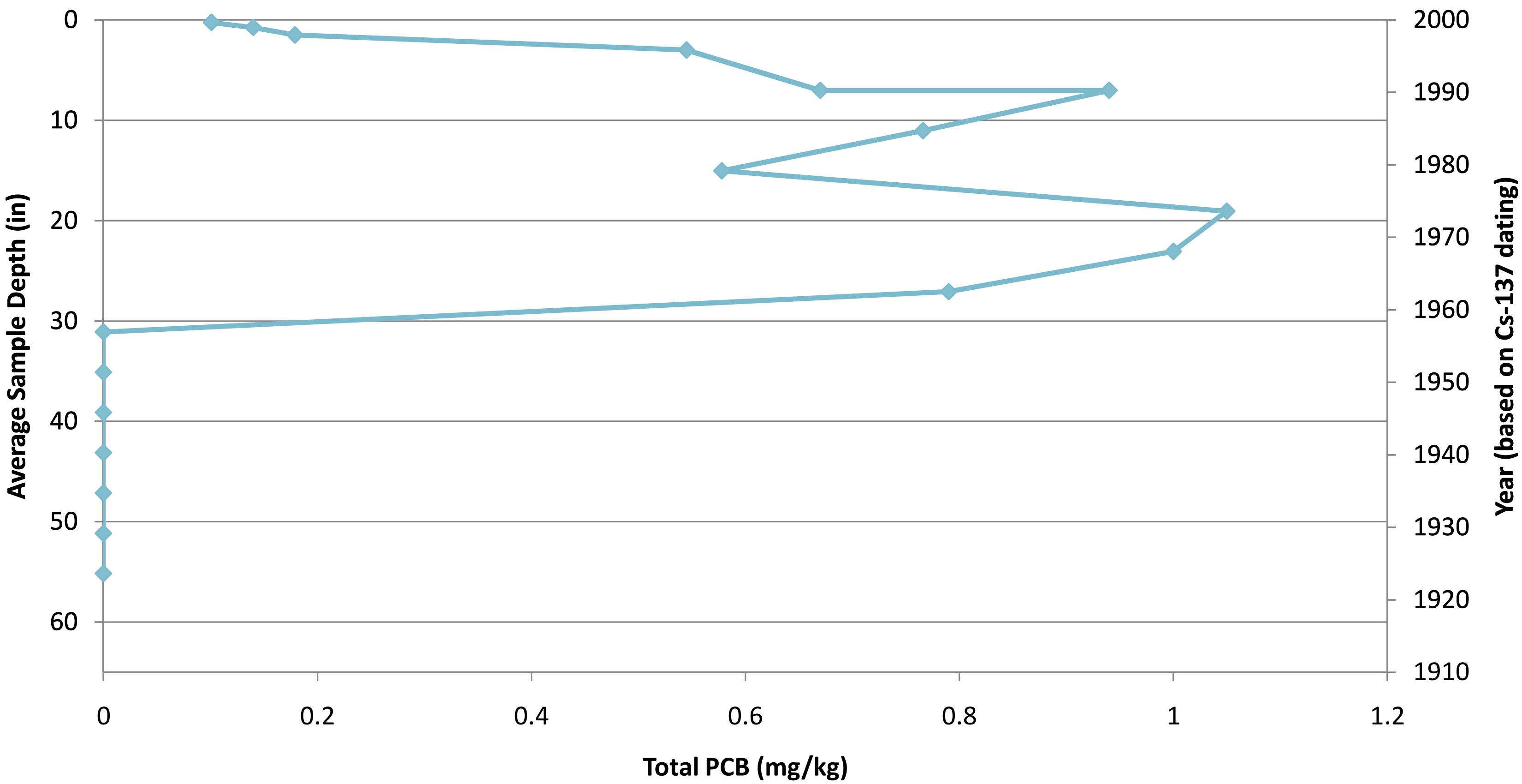
ANNISTON PCB SITE
ANNISTON, ALABAMA

OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

EMBAYMENT AREA DEPICTING PRE-1964 CHANNEL

ARCADIS

FIGURE 20



Notes:
1. Dates based on Cesium-137 (Cs-137) radiodating with peak Cs-137 reported between 26 and 28 inches which corresponds to the 1963 horizon.

ANNISTON PCB SITE
ANNISTON, ALABAMA

OU-4 SEDIMENT STABILITY TECHNICAL MEMORANDUM

EMBAYMENT AREA SEDIMENT PCB/GEOCHRONOLOGICAL PROFILE MLM-GEO-7

ARCADIS

FIGURE
21