

USACE GALVESTON DISTRICT SUMMER 2017 STAKEHOLDER PARTNERING FORUM

BUFFALO BAYOU & TRIBUTARIES, HOUSTON, TEXAS ADDICKS AND BARKER RESERVOIRS DAM SAFETY MEGA PROJECT OVERVIEW



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August 16, 2017



"The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."



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Addicks and Barker Dams



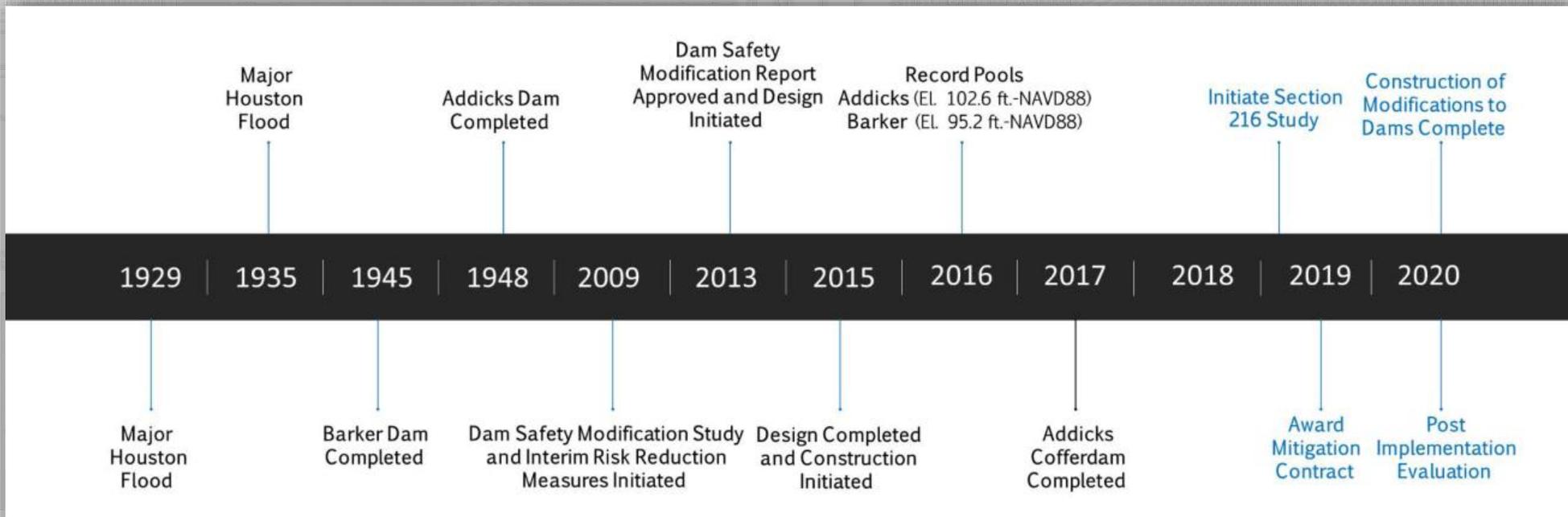
- **Background**
- **Project Status**
- **Critical Issues**



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BACKGROUND



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Overview

Project: Buffalo Bayou, Addicks and Barker Dams

Location: Houston, Texas

Program: Dam Safety

Purpose: Flood Risk Management

Phase: Construction

Total Authorized Project Cost: \$129,883,340

Sponsor: 100% Federal

Dam Safety Action Classification (DSAC): DSAC 1

Dam Safety Issues: High risk associated with seepage and piping beneath, around, and near the outlet works structure conduits and risks associated with auxiliary spillway flows and flows around the ends of the dams

Population at Risk: 1.2 million

Potential Economic Consequences: \$60 billion



Addicks Dam

Dam Type: Earth Embankment
Max. Height: 48.5-ft
Max Pool Elevation: 115-ft NAVD88
Length: 11.6 miles
Outlet Works: 5 – 8-ft x 6-ft gated conduits
Watershed/Drainage Area - 136 sq. mi.

Barker Dam

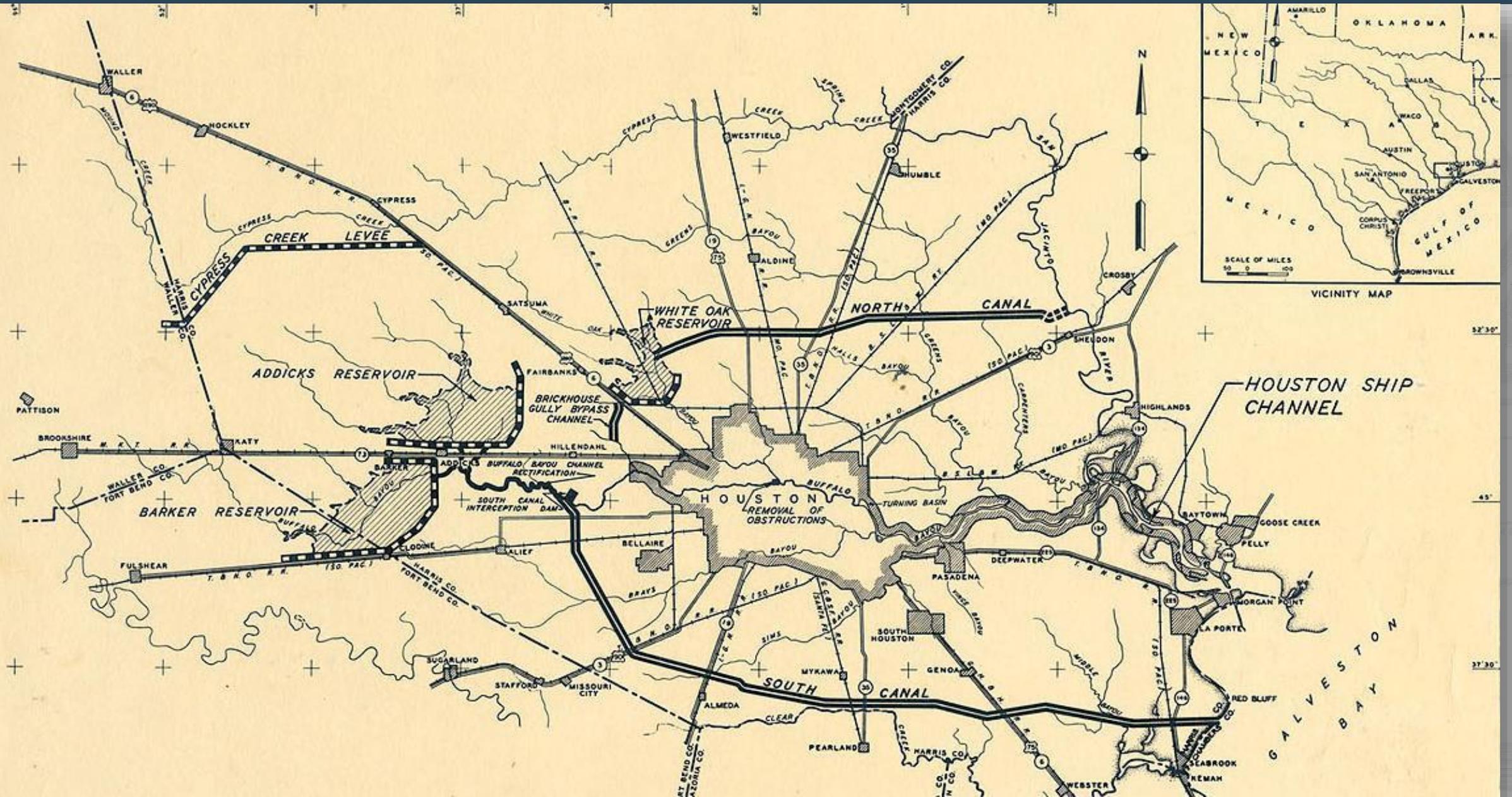
Dam Type: Earth Embankment
Max. Height: 36.5-ft
Max Pool Elevation: 108-ft NAVD88
Length: 13.6 miles
Outlet Works: 5 – 9-ft x 7-ft gated conduits
Watershed/Drainage Area - 130 sq. mi.



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Buffalo Bayou & Tributaries 1940's Original Plan



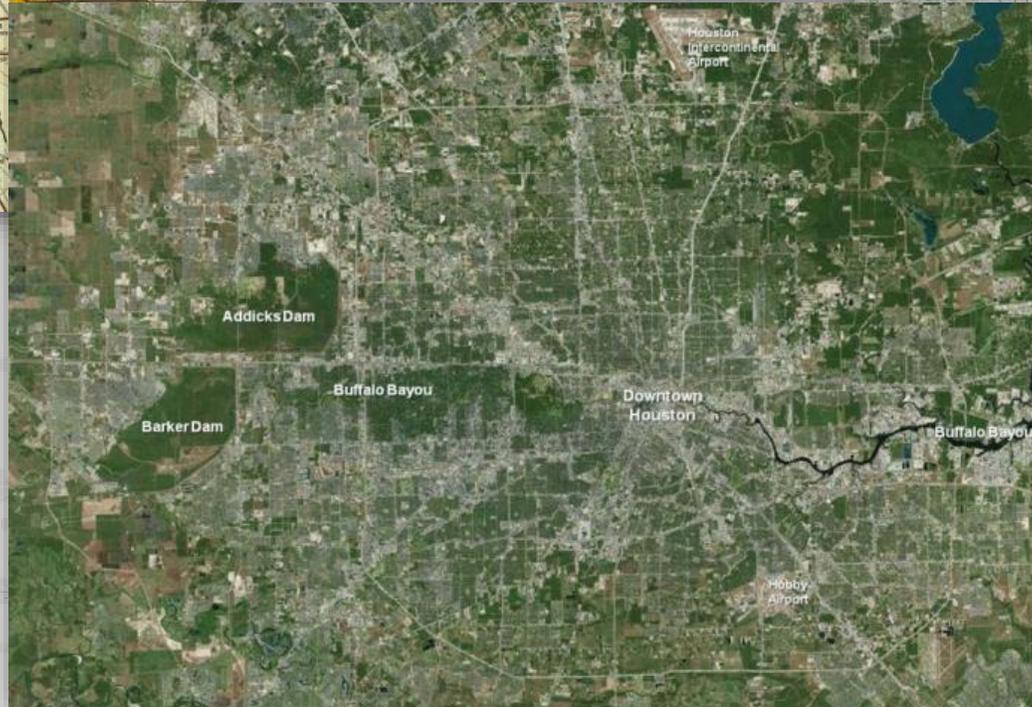
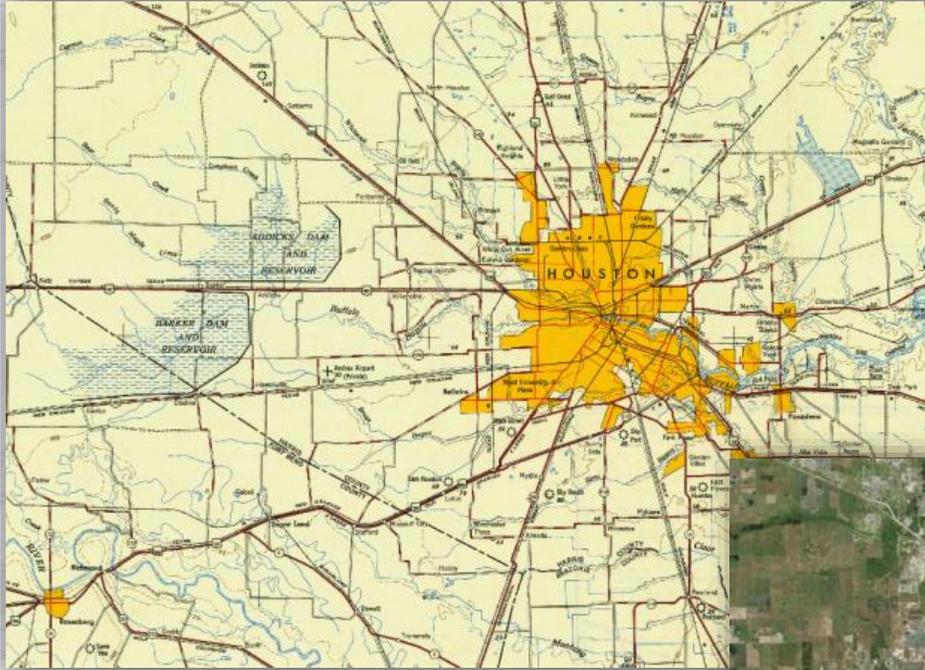
Construction of Addicks and Barker Dams 1942-1948



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Houston 1950, 1992, 2017



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Dam Safety Action Classification (DSAC)

Urgency of Action (DSAC)	Actions for Dams in This Class	Characteristics of This Class
Very High (1)	Take immediate action to avoid failure. <u>Communicate findings to sponsor, local, state, Federal, Tribal officials, and the public. Implement interim risk reduction measures</u> , including operational restrictions. Ensure the emergency action plan is current and functionally tested for initiating event. Conduct heightened monitoring and evaluation. <u>Expedite investigations to support remediation</u> using all resources and funding necessary. Initiate intensive management and situation reports.	CRITICALLY NEAR FAILURE: Progression towards failure is confirmed to be taking place under normal operations. Dam is almost certain to fail under normal operations within a few years without intervention. OR EXTREMELY HIGH INCREMENTAL RISK: <u>Combination of life and economic consequences with likelihood of failure is very high. USACE considers this level of life-risk to be unacceptable</u> except in extraordinary circumstances.

September 2009: Issue Evaluation Study Team recommends classification be changed from DSAC 2 to DSAC 1

October 2009: Dam Senior Oversight Group concurred with recommendation and changed classification to DSAC 1

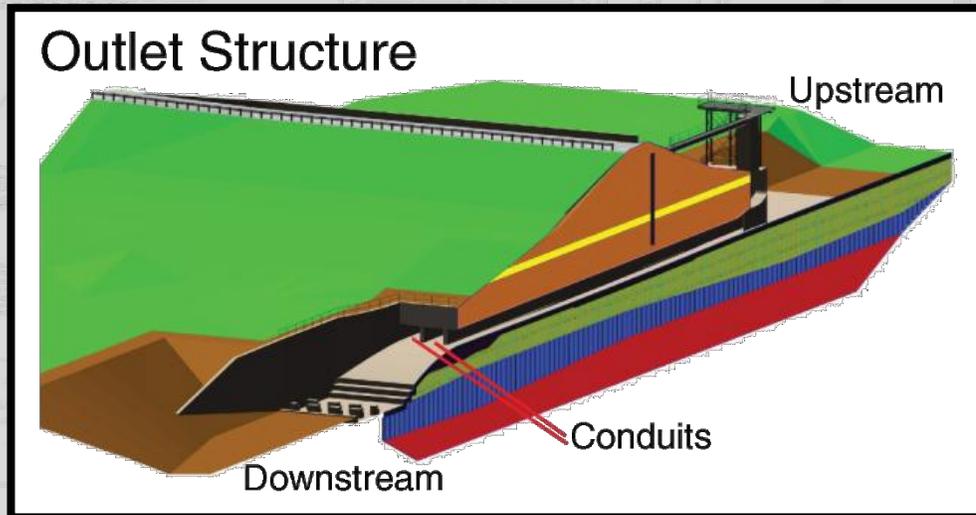


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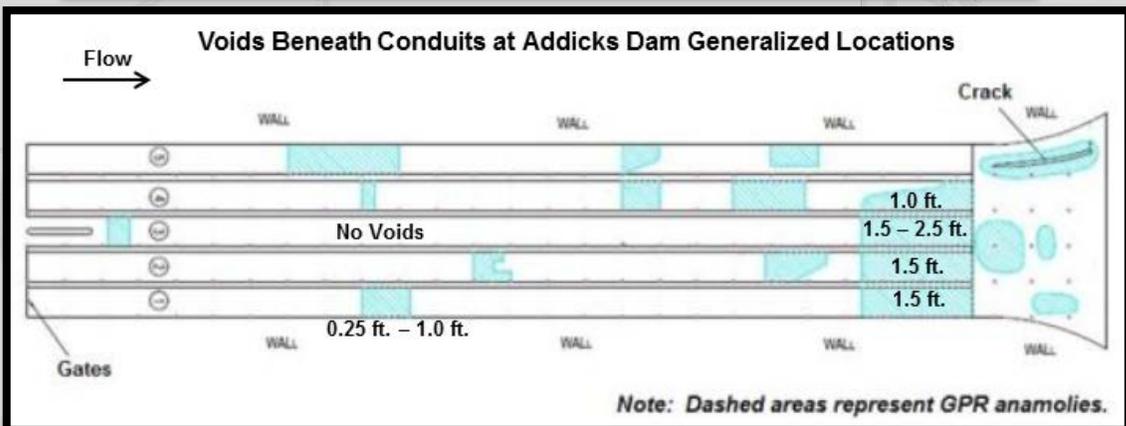
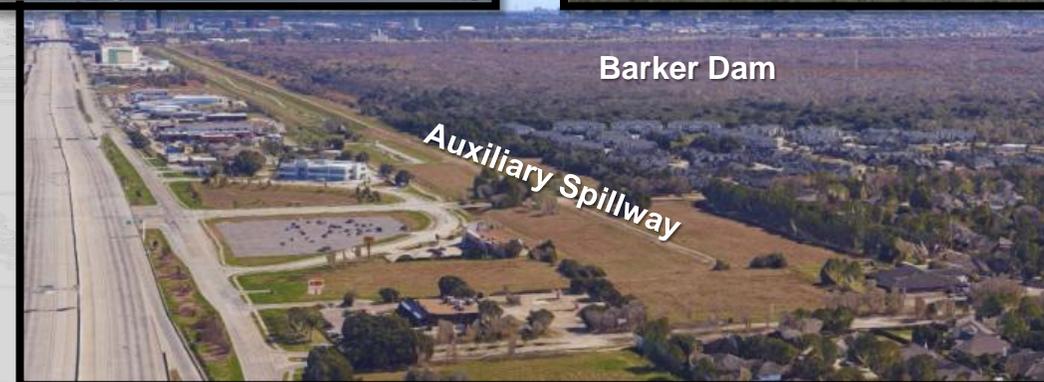


Dam Safety Issues

Seepage and Piping Beneath, Around, and Near the Conduits



Auxiliary Spillway Flows and Flows Around the Ends of the Dams

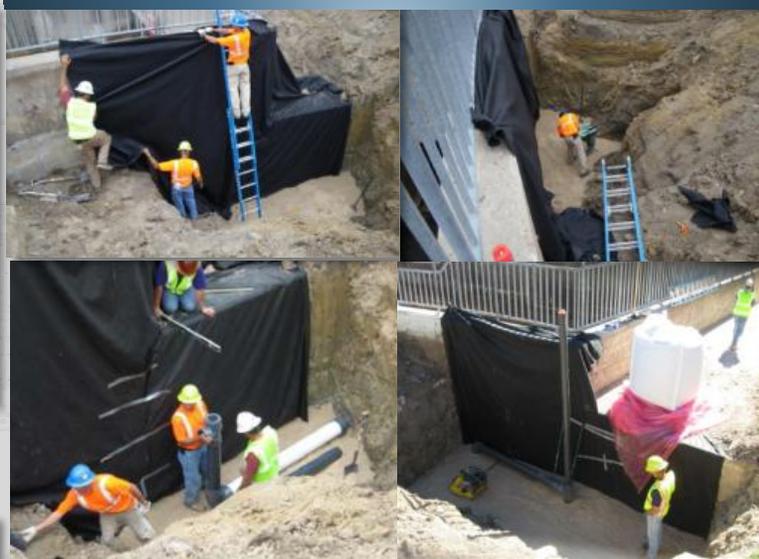


Interim Risk Reduction Measures

Grouting of Conduits and Parabolic Chute



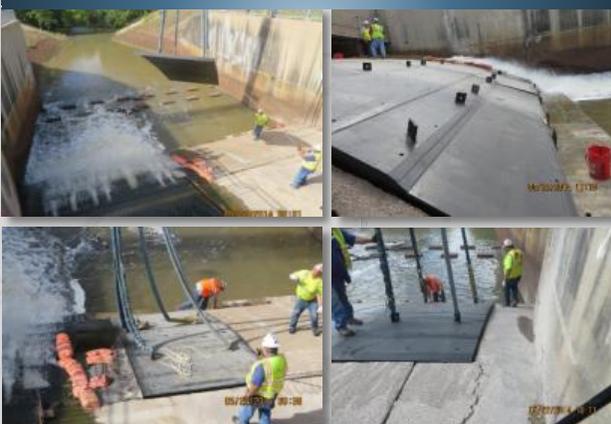
Granular Filter Around Ends of Conduits



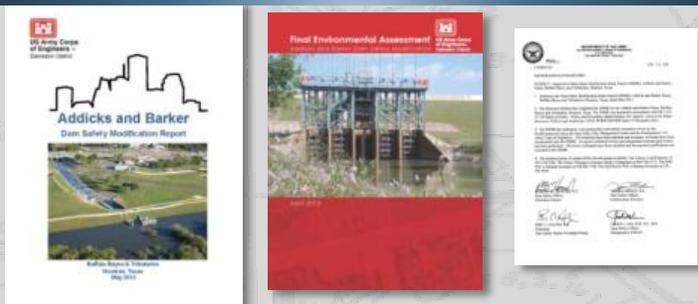
Barker Gate Replacement



Parabolic Chute Slab Steel Plate



Dam Safety Modification Study



Gate Operators & Emergency Generators



September 2010
Polyurethane Grouting of Conduits & Parabolic Chute

April 2011
Cementitious Grouting of Conduits & Parabolic Chute

May 2011
Granular Filter Around Ends of Conduits

August 2012
Barker Gate Replacement
Gate Operators & Actuators
Emergency Generators & Lighting

June 2013
Dam Safety Modification Report

July 2013
EA & FONSI

October 2014
Parabolic Chute Slab Steel Plate



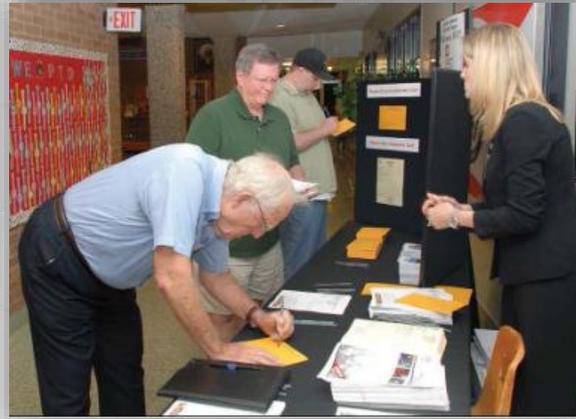
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Public Meetings

Public Meetings

- 12 Feb 2010 Public Release
- 17 Feb 2010 Mtg 1
- 18 Feb 2010 Mtg 2
- 24 Feb 2010 Mtg 3
- 25 Feb 2010 Mtg 4
- 09 Nov 2010 Mtg 5
- 29 Oct 2014 Mtg 6
- 09 Mar 2016 Mtg 7



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Social Media



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Galveston District, U.S. Army Corps of Engineers added 13 new photos to the album: Gary Waxman, tour of Addicks and Barker.

HOUSTON (Sept. 14, 2016) - U.S. Army Corps of Engineers Galveston District and Houston Country Flood Control District staff provide Gary Waxman, Office of Management and Budget, with a tour of the of the ongoing construction at the Addicks and Barker reservoirs. The USACE Galveston District awarded a contract in the amount of \$71,902,340 to Granite Construction Company in 2015 for construction of new outlet structures at the dams in west Houston. Historic rains postponed construction earlier this year, but construction has resumed at the dams. Learn more about our projects at www.swg.usace.army.mil.

Survey teams inspect Addicks and Barker dams [Image 3]

HOUSTON, TX, UNITED STATES
04.27.2016
Photo by Sandra Arnold
U.S. Army Corps of Engineers, Galveston District

HOUSTON (April 27, 2016) - David Byers, U.S. Army Corps of Engineers, Galveston District, and Jonathan Wilhelm, USACE Galveston District surveyor, inspect the Addicks and Barker dams as part of routine maintenance checks to mitigate the risk of flooding both above and below the dams. U.S. Army photo by Edward N. Johnson.

Addicks and Barker Dams

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John Culberson @CongCulberson · 3 Oct 2016
Today, I toured the Addicks and Barker dams with the U.S. Army Corps of Engineers to discuss how... [instagram.com/p/BLHWmjCgS4/](https://www.instagram.com/p/BLHWmjCgS4/)

Tamara Hancock @Tamara_AGC · 25 Aug 2016
UGH! And, more rain is coming: Renovations to Addicks, Barker dams continue months after catastrophic flooding

YouTube Addicks and Barker Dam Safety Program Video

Addicks and Barker Dam Safety Program
US Army Corps of Engineers Galveston District

0:14 / 18:24

Addicks and Barker Dams

More than a half century ago, in response to devastating floods that occurred in Houston in 1929 and 1930, the U.S. Army Corps of Engineers began construction of Addicks and Barker Dams in what was then undeveloped areas in far west Harris and east Fort Bend counties. This undertaking was a milestone in a longstanding partnership between the Corps and the greater Houston community.

Addicks and Barker reservoirs are located near the intersection of I-10 and State Highway 6, in an area considered to be in the upper watershed of Buffalo Bayou. They provide flood damage reduction along Buffalo Bayou downstream of the reservoirs and through the center of the City of Houston. But like much of our national infrastructure, Addicks and Barker have been around a long time. The Corps continuously inspects all of its dams nationwide under its Dam Safety Program, a program that shows our commitment to protecting lives, property and the environment by ensuring that all of its dams are designed, constructed, operated and maintained as safely and effectively as possible. The Corps Dam Safety Program provides a framework to ensure that both short and long term solutions are studied and applied and helps to ensure public safety for our local communities.

March 9, 2016 Public Meeting

HOUSTON - The U.S. Army Corps of Engineers Galveston District held a public meeting March 9, 2016, from 6:30 to 8:30 p.m. at Bear Creek Community Center, 3055 Bear Creek Drive, Houston, TX 77064, to update area residents and business owners about the Addicks and Barker Dam Safety Program, the 2016 Addicks and Barker construction plans and the proposed Section 216 Study. The USACE Galveston District awarded a contract in the amount of \$71,902,340 to Granite Construction Company in 2015 for construction of new outlet structures at the Addicks and Barker Dams in west Houston.

- March 9, 2016 Presentation slides
- Transcript

Dam Safety Program

The U.S. Army Corps of Engineers has a rigorous Dam Safety Program. As part of this program, the Corps continuously inspects all of its dams nationwide. This ongoing inspection and safety program demonstrates our commitment to protecting lives, property and the environment by ensuring that all of our dams are designed, constructed, operated and maintained as safely and effectively as possible.

The way we look at dam safety is changing. In the past, we looked primarily at the structural integrity of our dams as we assessed their risks to the public. Today, though, we are using a formula that combines dam safety risk

News: Construction Contract

Read more here about recent construction updates.

Corps Connections

- 3D Modeling Used
- Addicks & Barker Master Plan
- Addicks Reservoir Water Levels
- Barker Reservoir Water Levels
- Buffalo Bayou Water Levels at Piny Point

USACE Galveston @USACEGALVESTON · 3 Aug 2016
Construction is underway for the Addicks and Barker Dam Safety Program. #AddicksandBarker
swg.usace.army.mil/Missions/Dam-S...



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New Outlet Structures Design and Construction

Design Completion: May 2015

Contract Award: August 2015

Contractor: Granite

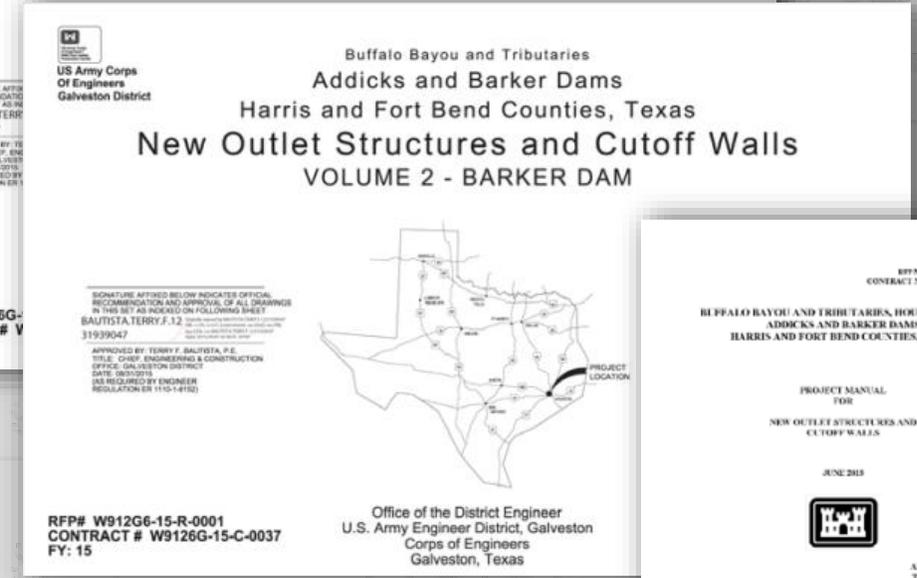
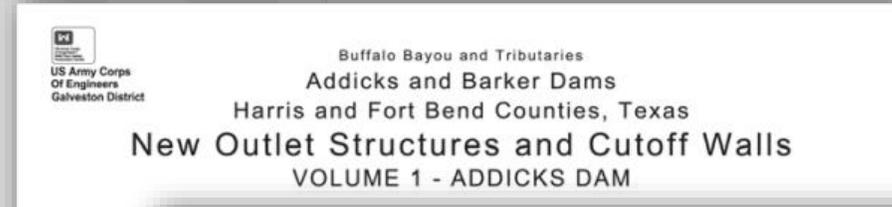
Construction Start: November 2015

Construction Completion: February 2020

Contract Award with Options: \$71,981,540

Contract Modifications: \$1,780,712

Current Contract Amount: \$73,762,252

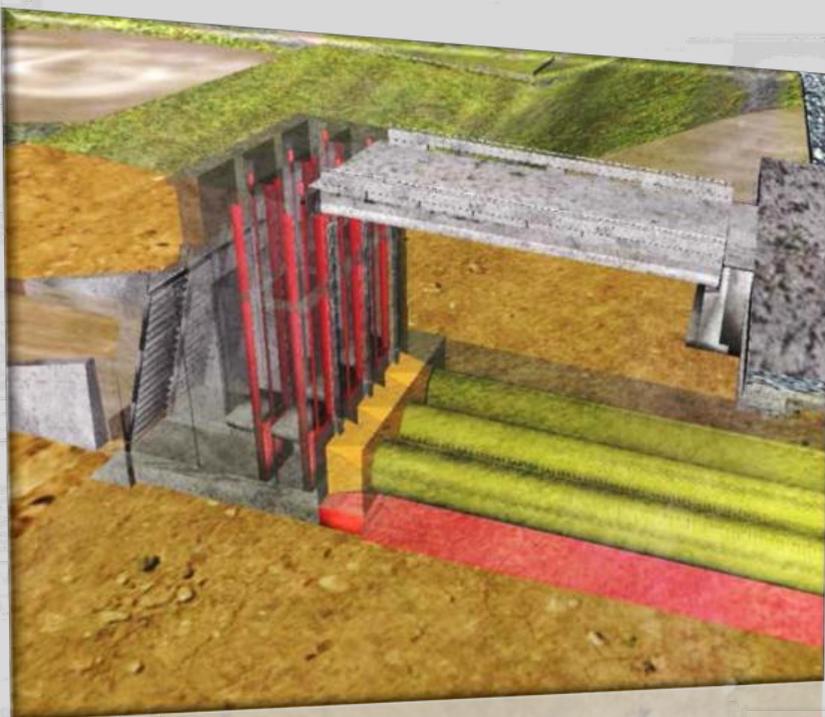


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Addicks and Barker Dams 3-D Model of New Outlet Structures

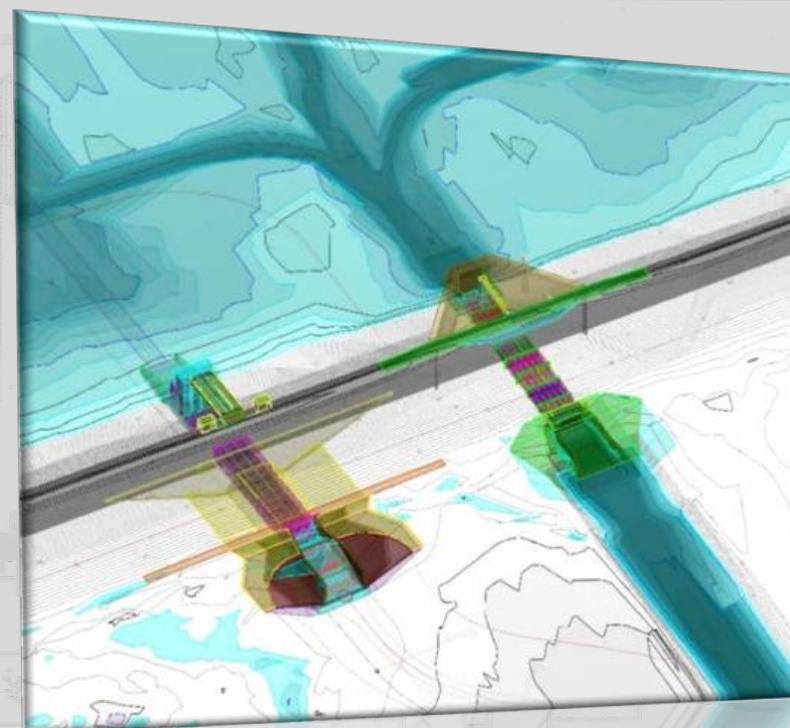


Barker New Outlet Structure

- Located within Existing Dam Embankment
- Approximately 400 Feet North from Existing Outlet Structure
- Three 12-Foot Diameter Steel Lined Conduits
- 12X12-Foot Rectangular Steel Gates at the Intakes

Noble Road Cut-off Wall

- 1,400-Foot long cement bentonite slurry cut-off wall
- Located along upstream embankment at Noble Road
- Will Address Seepage Issues at this Location



Addicks New Outlet Structure

- Located within Existing Dam Embankment
- Approximately 400 Feet West from Existing Outlet Structure
- Three 10-Foot Diameter Steel Lined Conduits
- 10X10-Foot Rectangular Steel Gates at the Intakes



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Addicks Dam Record Pools



SE Corner of Reservoir

Addicks Dam Record High Pool

Elevation: 102.6 feet
Acre Feet: 123,067
Datum: NAVD 1988
Date: April 23, 2016

Addicks Dam Previous Record High Pool

Elevation: 97.4 feet
Acre Feet: 65,264
Datum: NAVD 1988
Date: March 9, 1992



Eldridge Parkway



State Hwy 6



Outlet Structure

Barker Dam Record Pools



NE Corner of Reservoir

Barker Dam Record High Pool

Elevation: 95.2 feet
Acre Feet: 85,816
Datum: NAVD 1988
Date: April 23, 2016

Barker Dam Previous Record High Pool

Elevation: 93.6 feet
Acre Feet: 66,489
Datum: NAVD 1988
Date: March 6, 1992



Outlet Structure



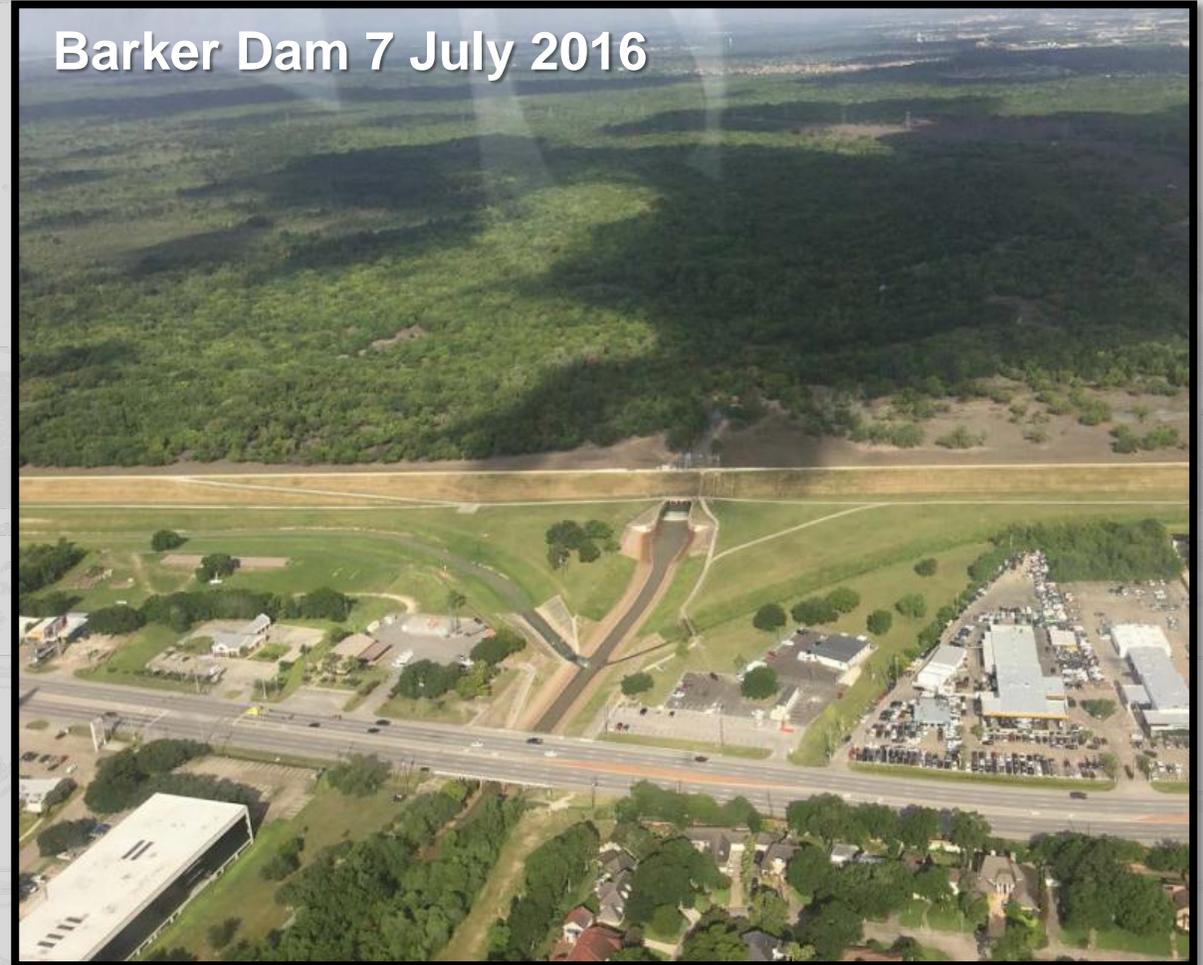
George Bush Park



Westheimer Parkway



Addicks and Barker Dams Tax Day Flood Pools Emptied



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PROJECT STATUS



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Contract Award
31 Aug 2015

NTP
Acknowledged
29 Sep 2015

Partnering
Meeting
3-4 Nov 2015

Start
Construction
9 Nov 2015

Pools in
Reservoirs
18 Dec 2015

Addicks
Borrow Area
23 Jan 2016

Addicks Low
Water Crossing
19 Feb 2016

Addicks and Barker Dams Construction Timeline

Addicks Cofferdam
10 Aug 2016

Addicks Cofferdam
25 Jul 2016

Barker Hwy 6 Casting Yard
Concrete Mix Sample Block
29 Jun 2016

Barker Reservoir Pool
& Hwy 6 Staging Area
13 May 2016

Addicks Reservoir
Record Pool
23 Apr 2016

Addicks Reservoir
4 Mar 2016



Barker Borrow Area
29 Sep 2016

Barker Haul Road
Inlet Channel Xing
19 Oct 2016

Addicks Cofferdam
Avg. Elev 90.0-ft
17 Nov 2016

Barker Hike-Bike Trail
Pedestrian Bridge
1 Dec 2016

Addicks Cofferdam
Avg. Elev 103.0-ft
18 Jan 2017

Addicks Cofferdam
Elev. 120-ft
25 Feb 2017





Addicks Cofferdam Accepted
6 Mar 2017



Barker Cofferdam
20 Apr 2017



Addicks Primary Excavation Mud Slab
19 May 2017



Barker Dam T-wall Demolition
15 Jun 2017



Barker Cofferdam Accepted
31 Jul 2017

Addicks Conduit Installation
3 Aug 2017



Addicks and Barker Dams Construction Timeline

Addicks Dam New Outlet Structure and Cut-off Wall



A3 - Addicks New Outlet Channel Area



Addicks Reservoir A1

A2

A3



A1 - Addicks Borrow Area and Haul Road



A2/A3 - Addicks Cofferdam, Primary Excavation and New Outlet Channel Area

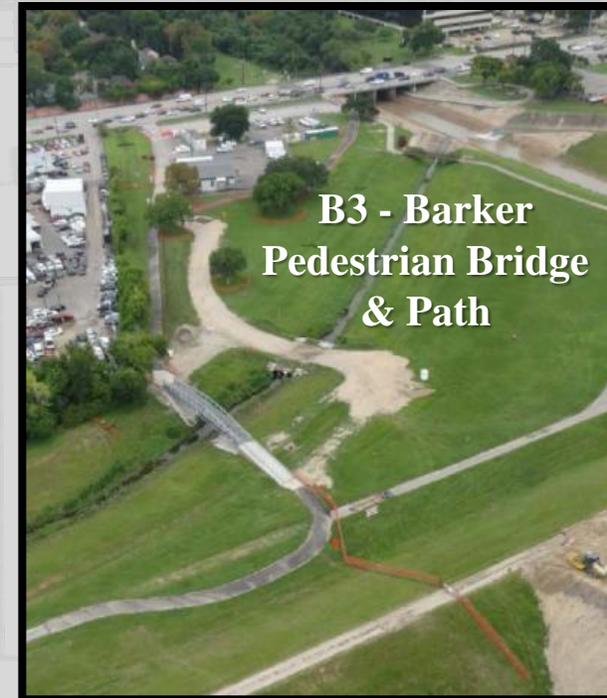
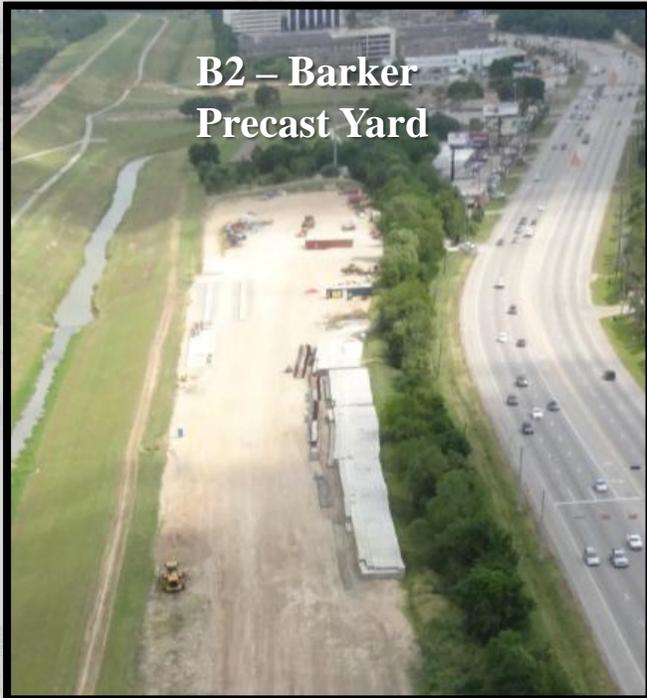
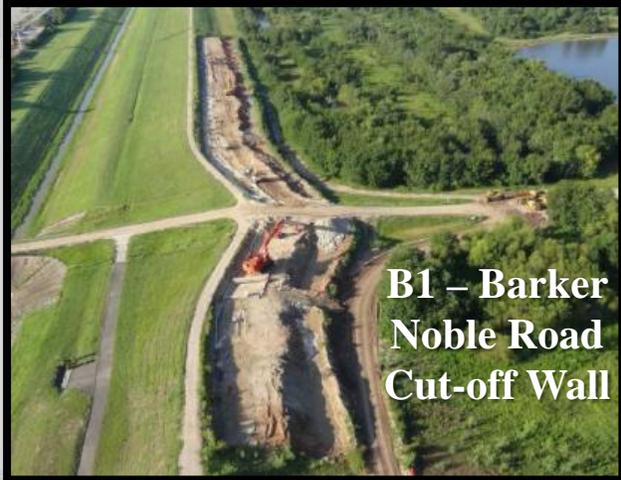


A2 - Addicks Muds Slab for New Outlet Structure



A2 - Addicks Cofferdam and Primary Excavation

Barker Dam New Outlet Structure and Cut-off Walls



CRITICAL ISSUES & RISK REALIZED



**WATER LEVEL IN
RESERVOIRS**



**CUT-OFF WALL
PERMEABILITY AND STRENGTH**



**COFFERDAM UNSUITABLE
MATERIALS**



QA TEST LAB



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Critical Issues and Risk Realized

QA Test Lab (Low Risk)

- Contracting Officer terminated (T4C) QA Test Lab contract due to protest
- Utilized GPC as short term measure
- SWF currently providing field lab support and has established mobile field lab onsite
- ERDC QA Lab inspection conducted 23-24 May 17
- ERDC validation letter forthcoming

Cofferdam Unsuitable Materials (Medium Risk)

- Increase in quantities for directed excavation resulting in contract modifications
 - Addicks Dam: \$540,000 and 27 additional calendars days
 - Barker Dams: \$155,000



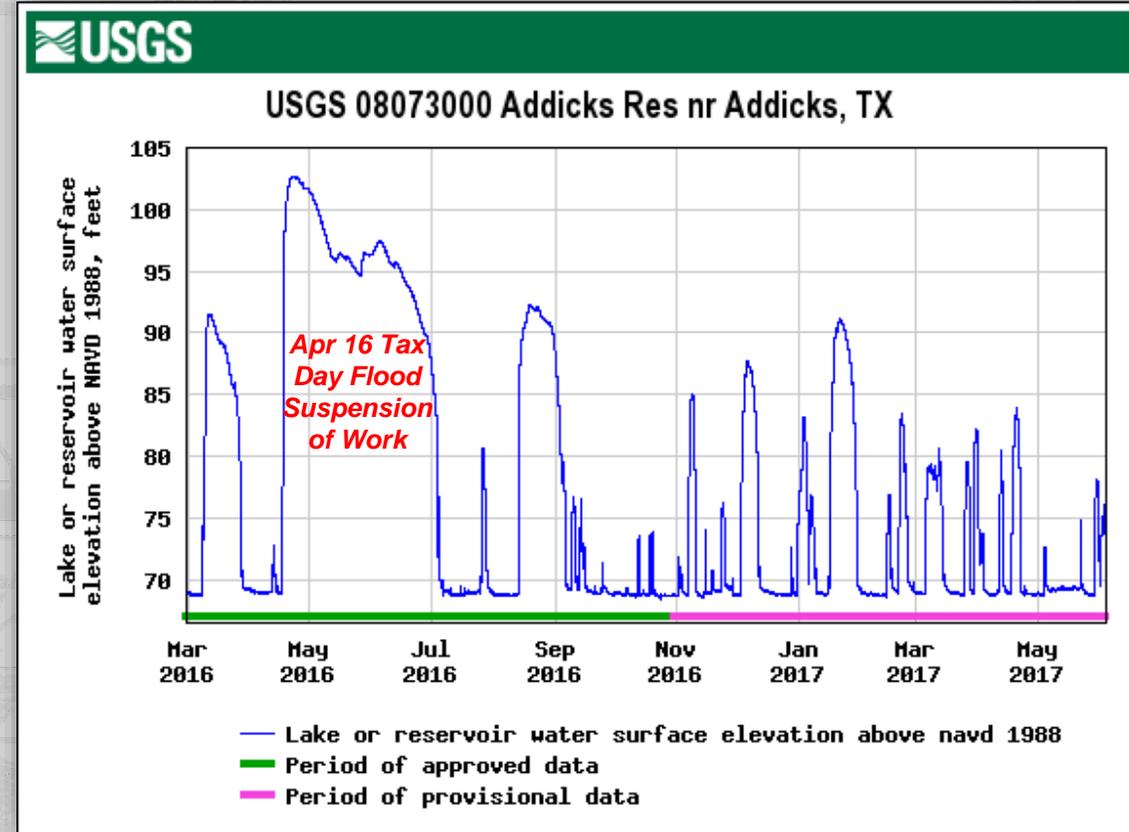
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Critical Issues and Risk Realized

Water Levels in the Reservoirs (High Risk)

- 62% of Calendar Year 2016 Impacted by Weather
 - April 2016 Tax Day Flood Suspension of Work Primary Contributor (22 Apr 16 - 17 Jul 16)
 - » Request for Equitable Adjustment negotiated for \$637,243.65 and 97 calendar days
- Features resequenced outside reservoirs to progress construction
 - Addicks Outlet Channel Clearing and Grubbing
 - Fabrication of Precast Erosion Protection Blocks
 - Alternate access into Barker Borrow Area
- Investigated alternate borrow sources for completion of cofferdams



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Cut-off Wall QA/QC Deficiencies (High Risk)

- Detailed reviews of slurry batching/placement CQC processes did not identify significant deficiencies
- Verification Drilling test results for compression and permeability did not match the results of the produced slurry sampling
- Notice of QA/QC deficiencies issued on 4 May 17 due to the verification drilling results
- Contractor evaluated alternative slurry mixes and performed trial batches
- 75/25% (Slag/Cement Ratio) Mix Approved by Government for use under new structure at Addicks Dam on 27 Jul 2017
- Contractor is of the opinion that SWG's approval of the 75/25 cut-off wall mix for Addicks Dam is a variance from the specifications and considers this as direction by the Government.
- Resident Engineer informed Contractor we do not consider this direction and that they may proceed with installation of the Addicks cut-off wall.
- Installation of the Addicks cut-off wall to start the week of Aug 14th



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Questions

Addicks and Barker Dam Safety Program

Thank You



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