



COMITÉ PANAMEÑO DE PRESAS

FORO: SEGURIDAD DE PRESAS

17 DE NOVIEMBRE DE 2012

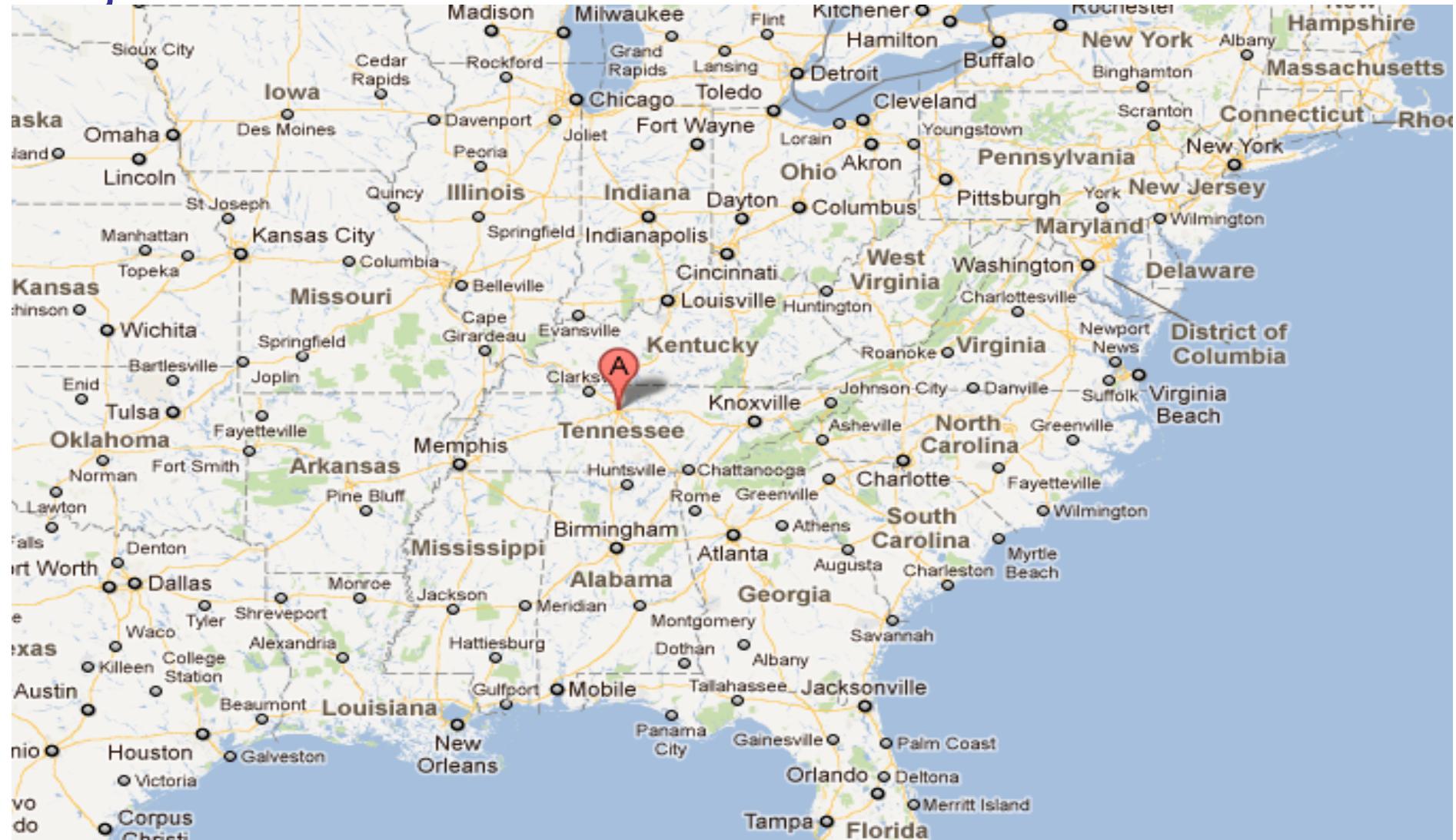
Hans Schwarzweller

Center Hill Dam Foundation Remediation

BAUER Spezialtiefbau – Bauer Foundation Corp.



Center Hill Dam Foundation Remediation Project Location



Wolf Creek Dam Foundation Remediation Project Location



Center Hill Dam Foundation Remediation

Project Overview



- Concrete Dam approx. 420m long
- Main Dam is 69m high above stream bed
- Embankment Dam is approx. 300 m long
- Diff. U/S to D/S Water Level approx. 50m

Center Hill Dam Foundation Remediation

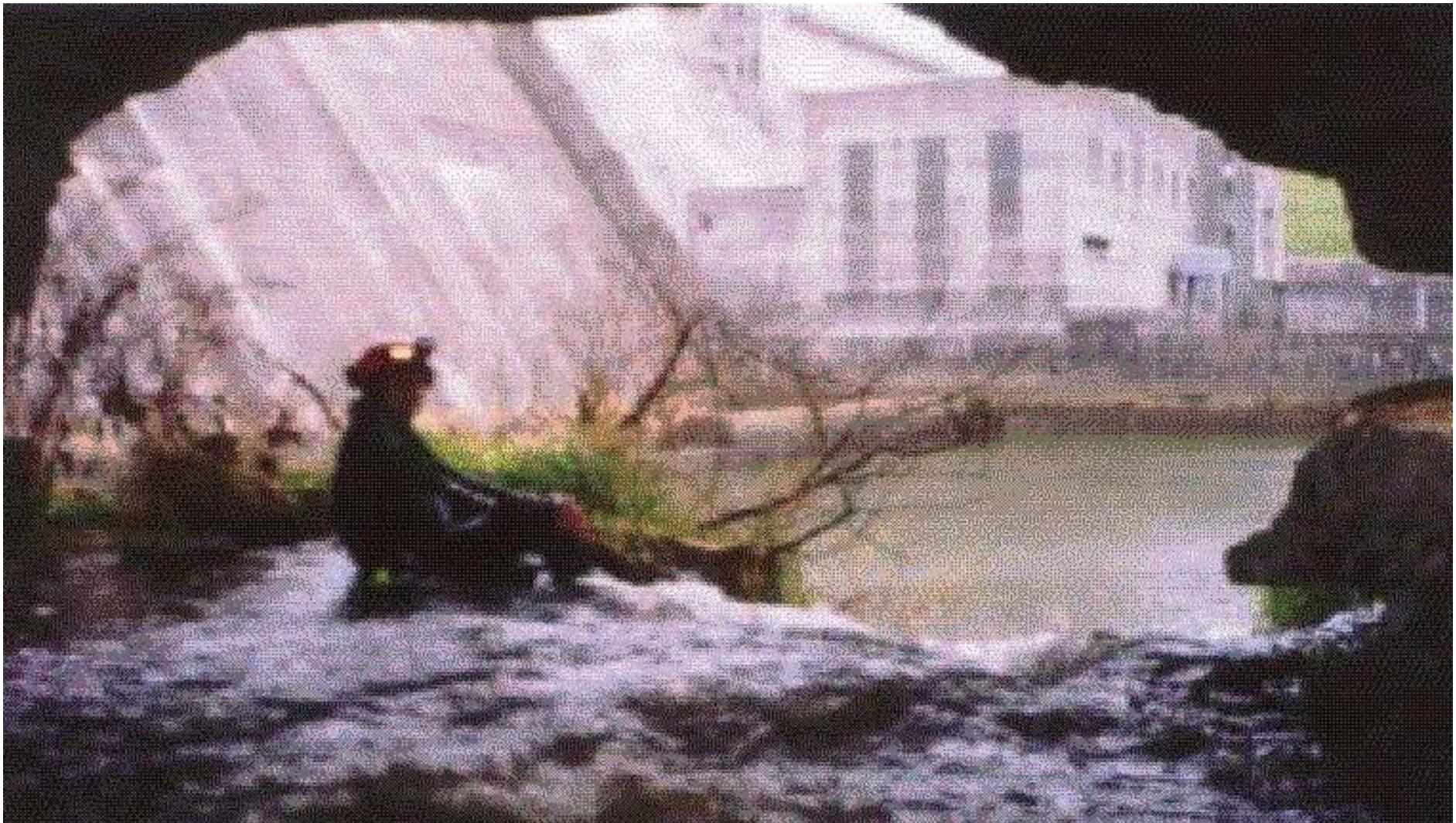
The basic problem



6. 6. 2003

Center Hill Dam Foundation Remediation

The basic problem



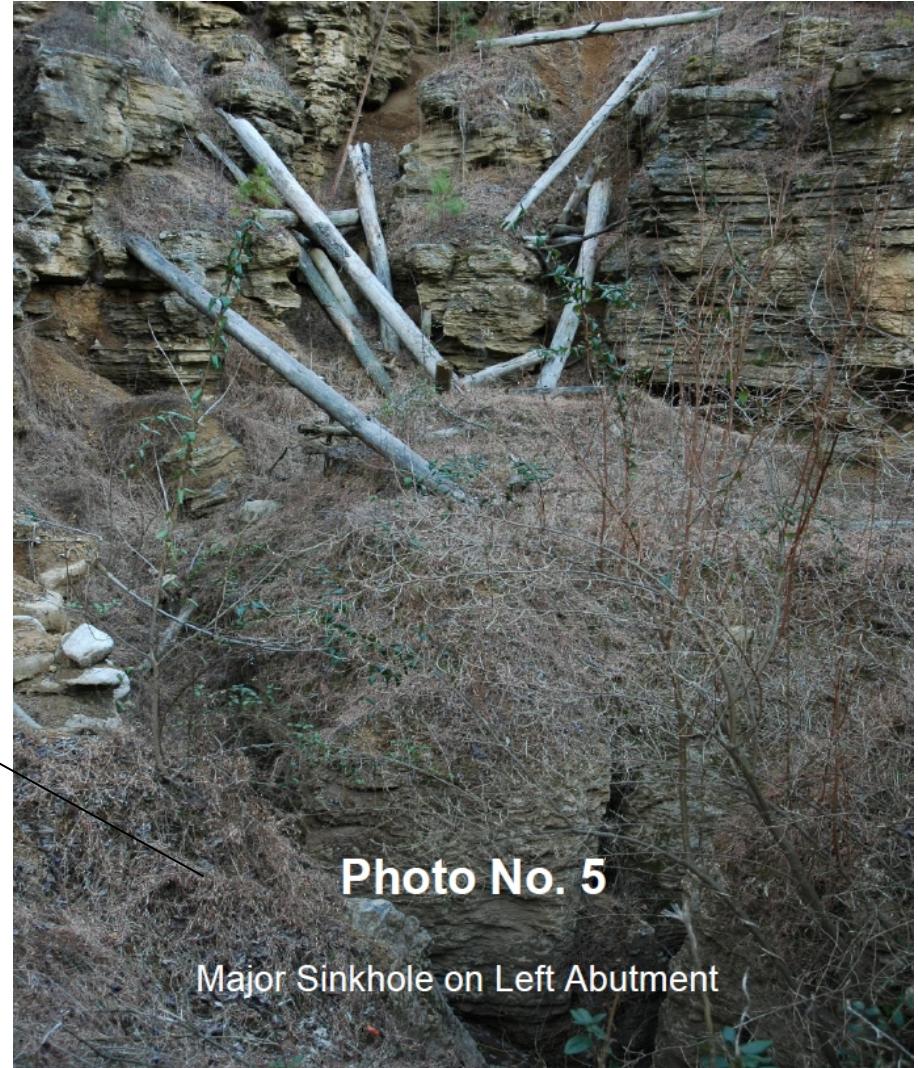
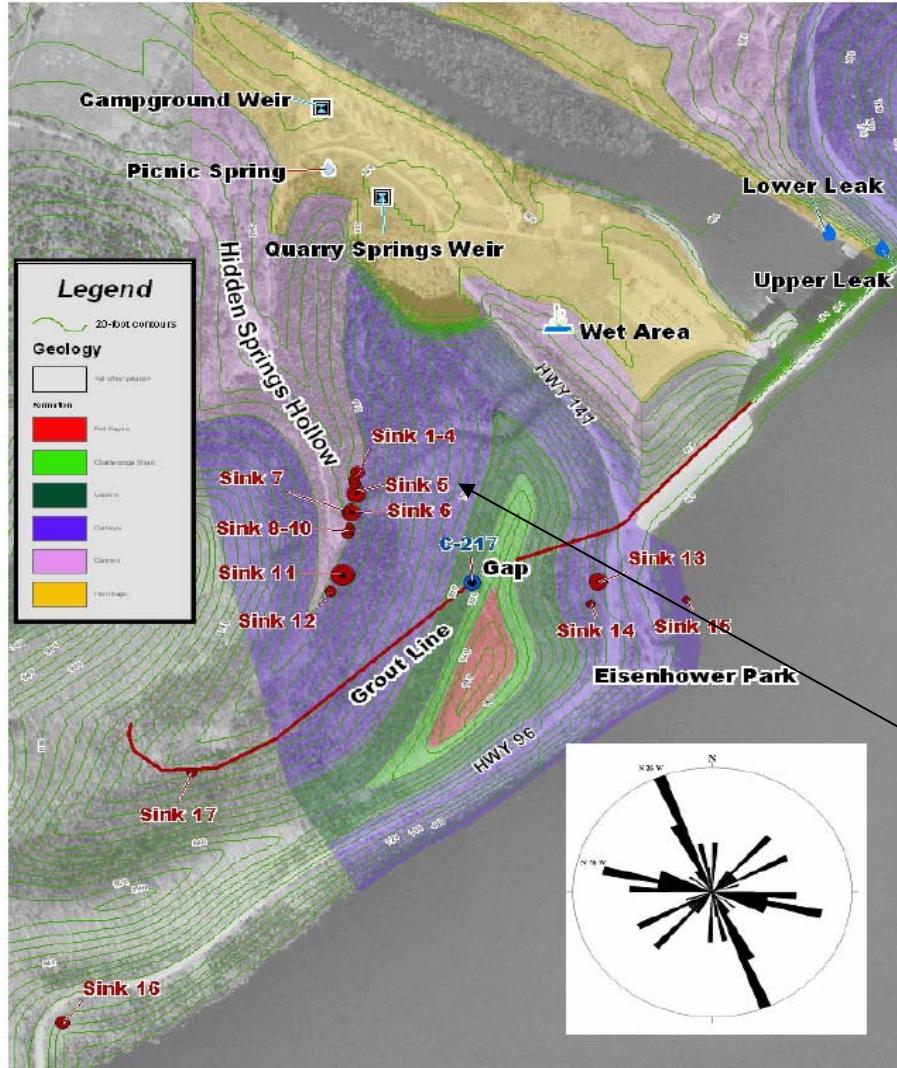
Center Hill Dam Foundation Remediation

The basic problem



Center Hill Dam Foundation Remediation

Sink holes



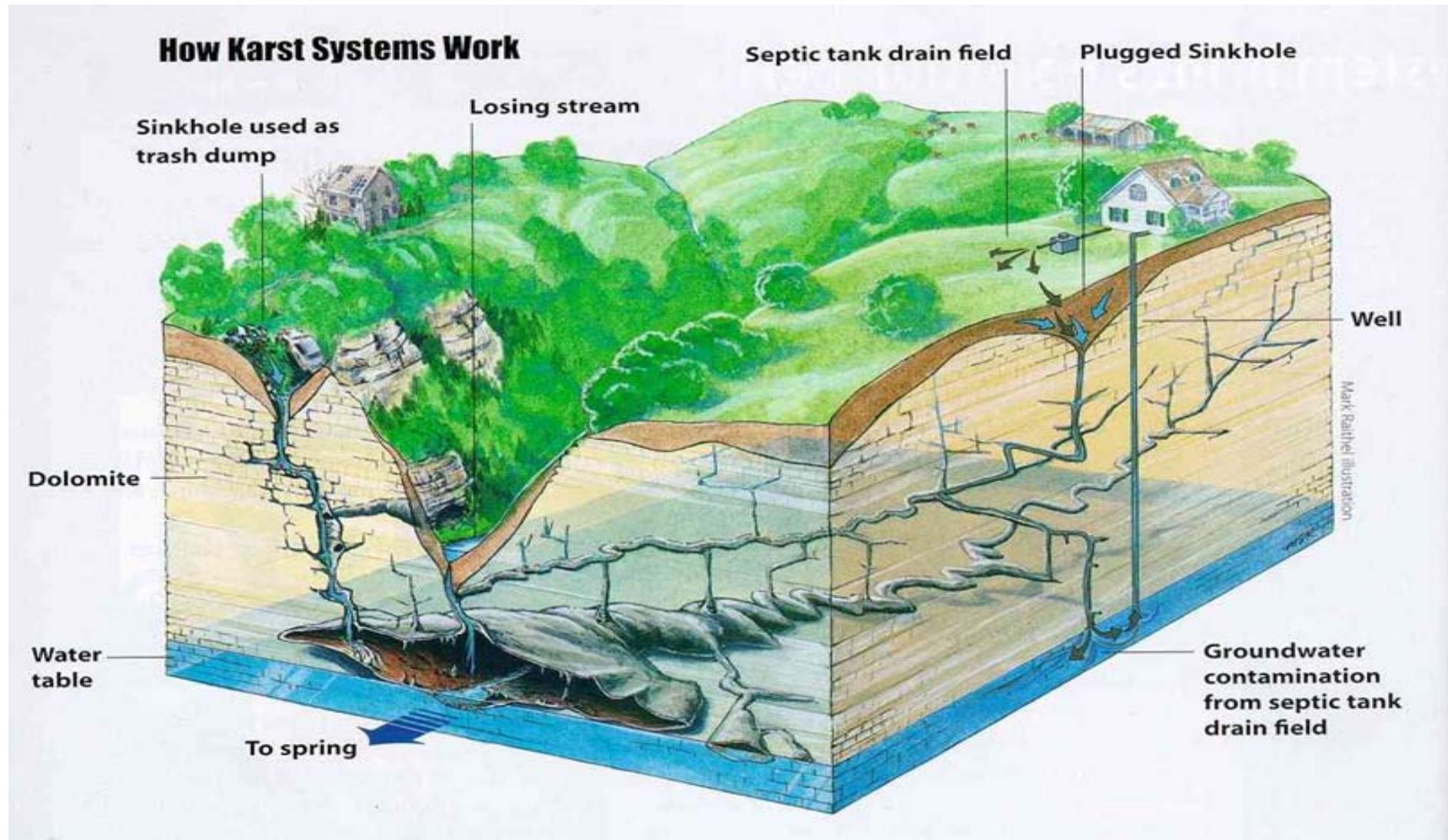
Center Hill Dam Foundation Remediation

Sink holes



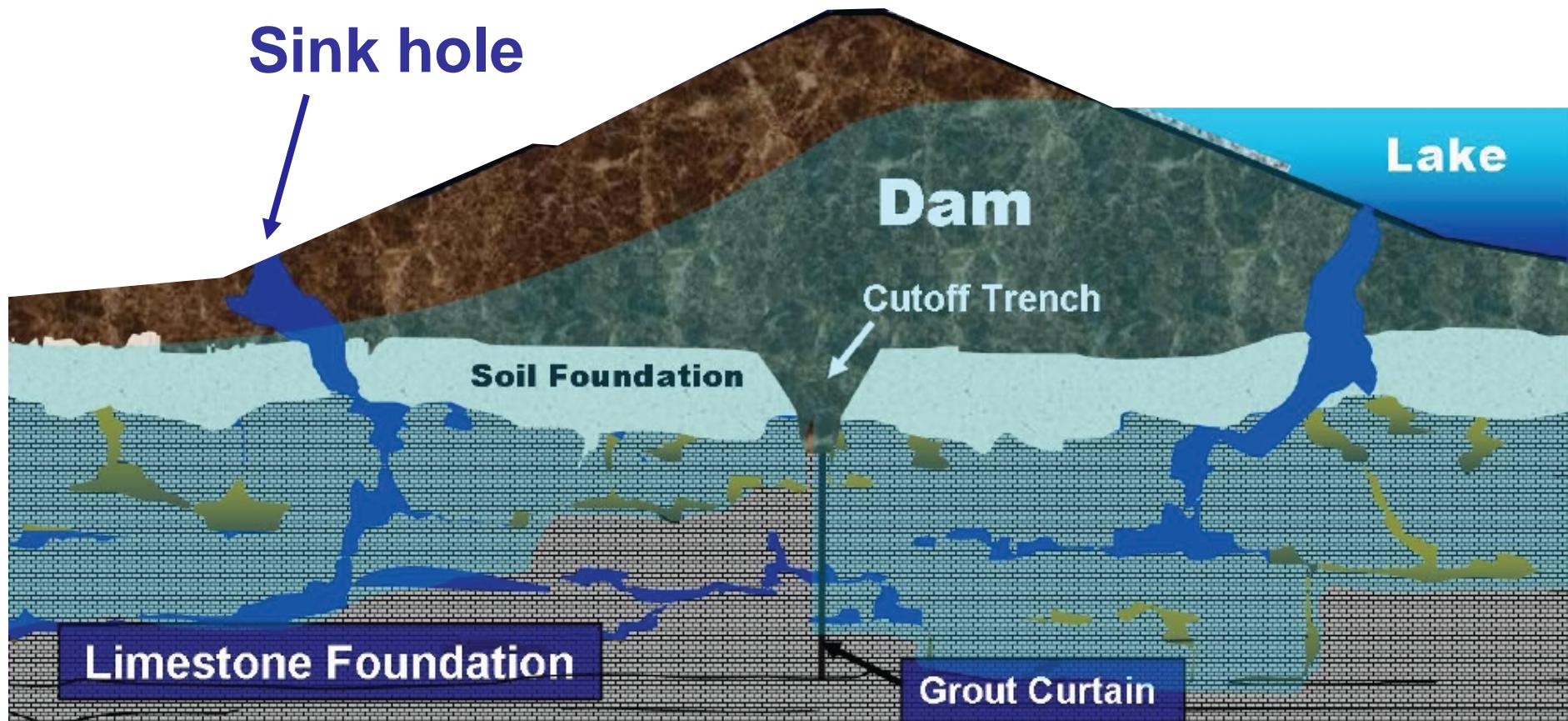
Center Hill Dam Foundation Remediation

Sink holes



Center Hill Dam Foundation Remediation

Sink holes / Existing Condition

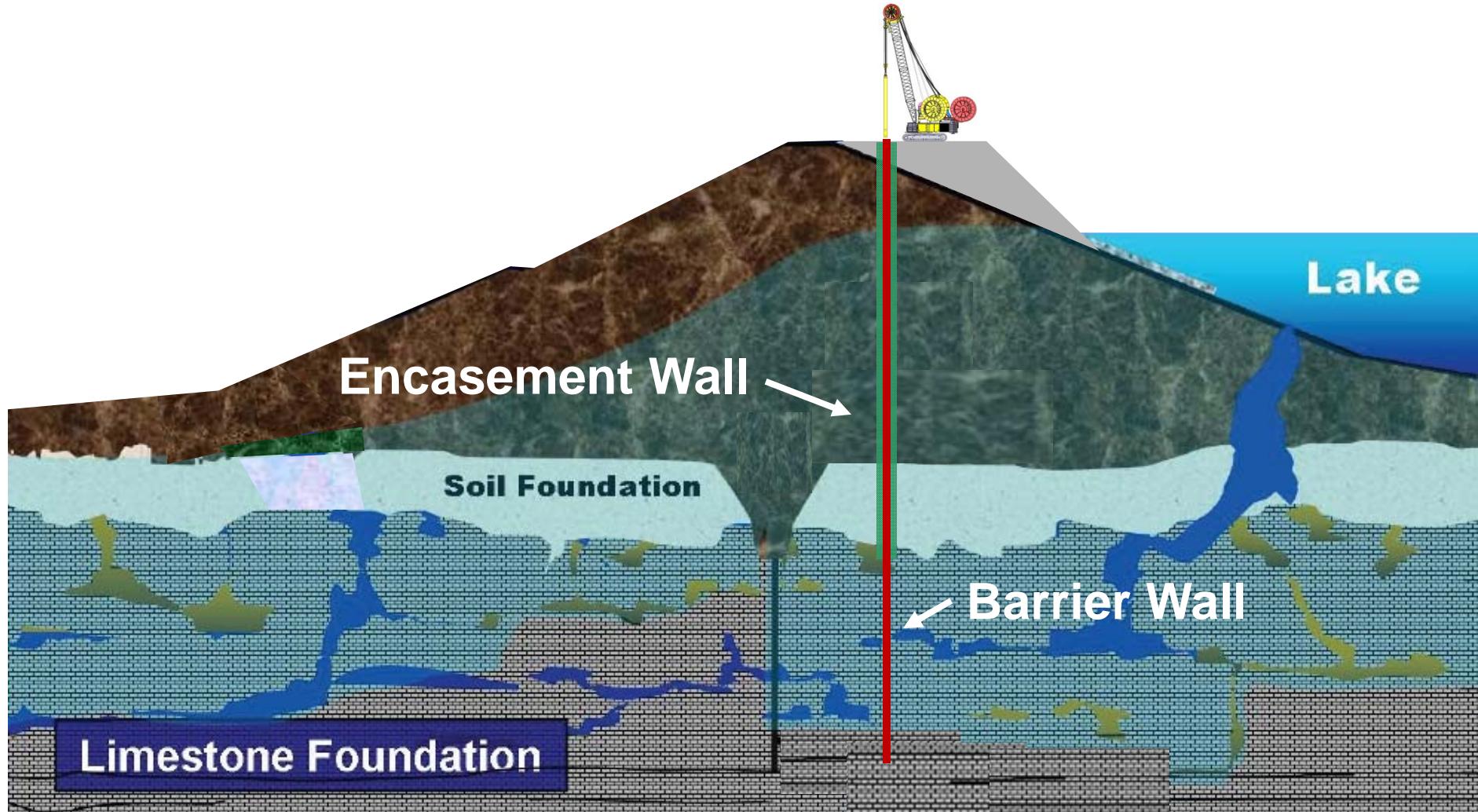


Center Hill Dam Foundation Remediation

Cut off trench works



Center Hill Dam Foundation Remediation Solution



Center Hill Dam Foundation Remediation

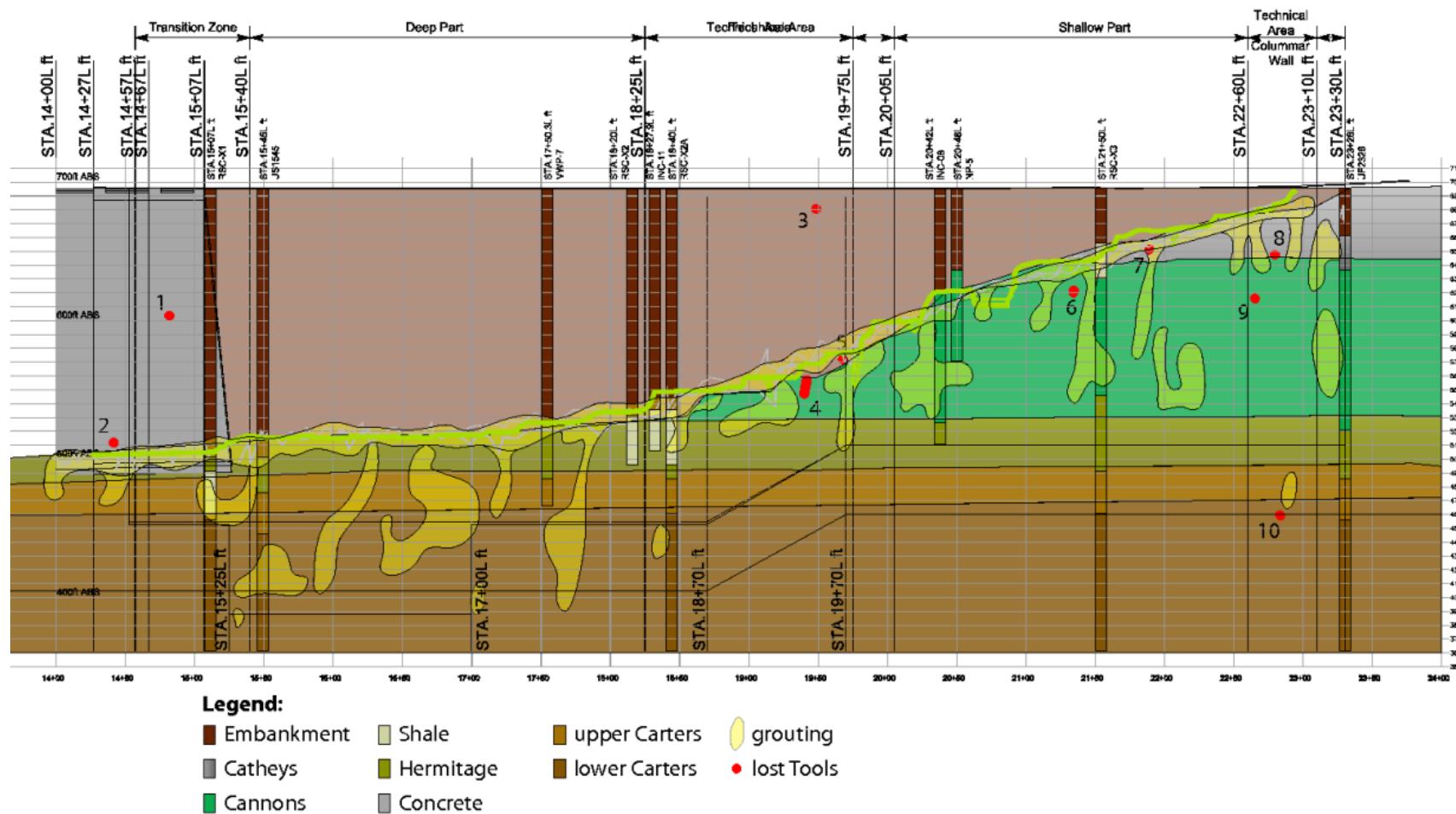
Geology



Foundation Left Side of Dam	Max. UCS Values	UCS Average as base of performance
Catheys Limestone	15,678 Psi	15,678 Psi
Quarry Marker (in Cannon)	26,126 - 30,715 Psi	27,500 Psi
Cannon Limestone	5,314 - 32,230 Psi	16,700 Psi
Hermitage 'a' Shale is 2-foot thick and too weak to provide a sample.		1000Psi ~ 7Mpa
Hermitage 'b' Limestone	9,068 - 21,094 Psi	11,600 Psi
Hermitage 'c' Shale	5,096 - 15,505 Psi	7,250 Psi
Hermitage 'd' Limestone	6,973 - 29,357 Psi	21,750 Psi
Carters 'a' Limestone	8,029 - 28,138 Psi	12,500 Psi
Carters 'b' T3 Bentonite is 2-foot sandy volcanic weak shale.		
Carters 'c' Limestone	17,367 - 26,122 Psi	21,750 Psi

USA - Center Hill Dam Foundation Remediation

Geology



USA - Center Hill Dam Foundation Remediation

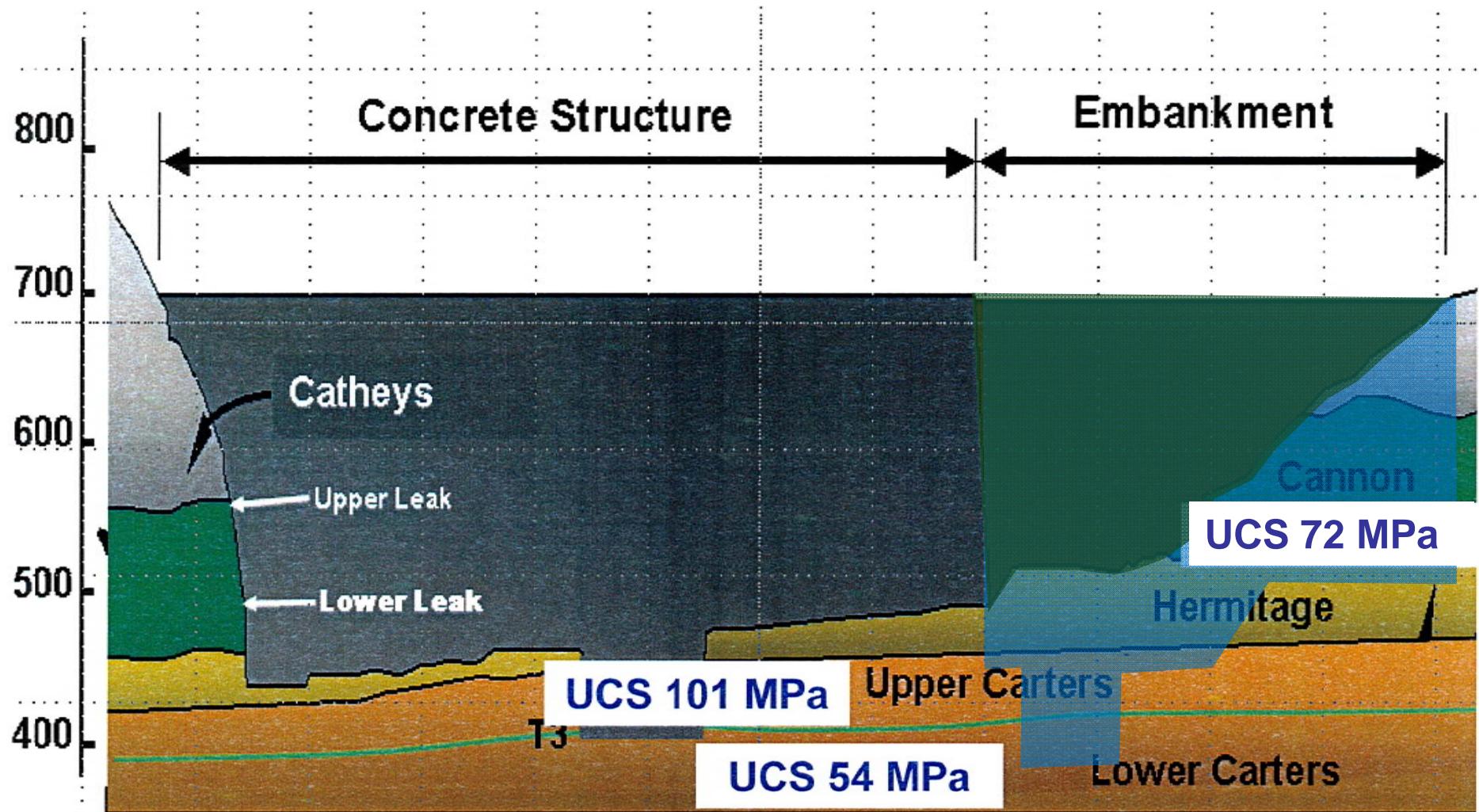
Geology



Formation	Rock Type	Approximate Thickness	Character	Unconfined Compressive Strength
Catheys	Limestone	56 - 116 ft	finely crystalline shaley Limestone bands medium to thin bedded hard to moderately hard	108 MPa
Cannon	Limestone	110 - 120 ft	finely crystalline shaley Limestone bands massive bedded hard to moderately hard	36 – 220 MPa
Hermitage	4 beds of Shale and Limestone	50 - 55 ft	dense to finely crystalline thin bedded soft to moderately hard	35 – 200 MPa
Upper Carters	Limestone	25 - 27 ft	dense to finely crystalline shale stringers/bands medium to thin bedded hard to very hard	55 – 195 MPa
T3 Bentonite sandy volcanic weak shale	Shale	1-1/4 to 2 ft	dense to fine grained sandy at top, shale at bottom thin bedded soft	
Lower Carters	Limestone	55 - 85 ft	fine to medium crystalline shaley LS bands/stringers massive to thick bedded hard to very hard	120 – 180 MPa

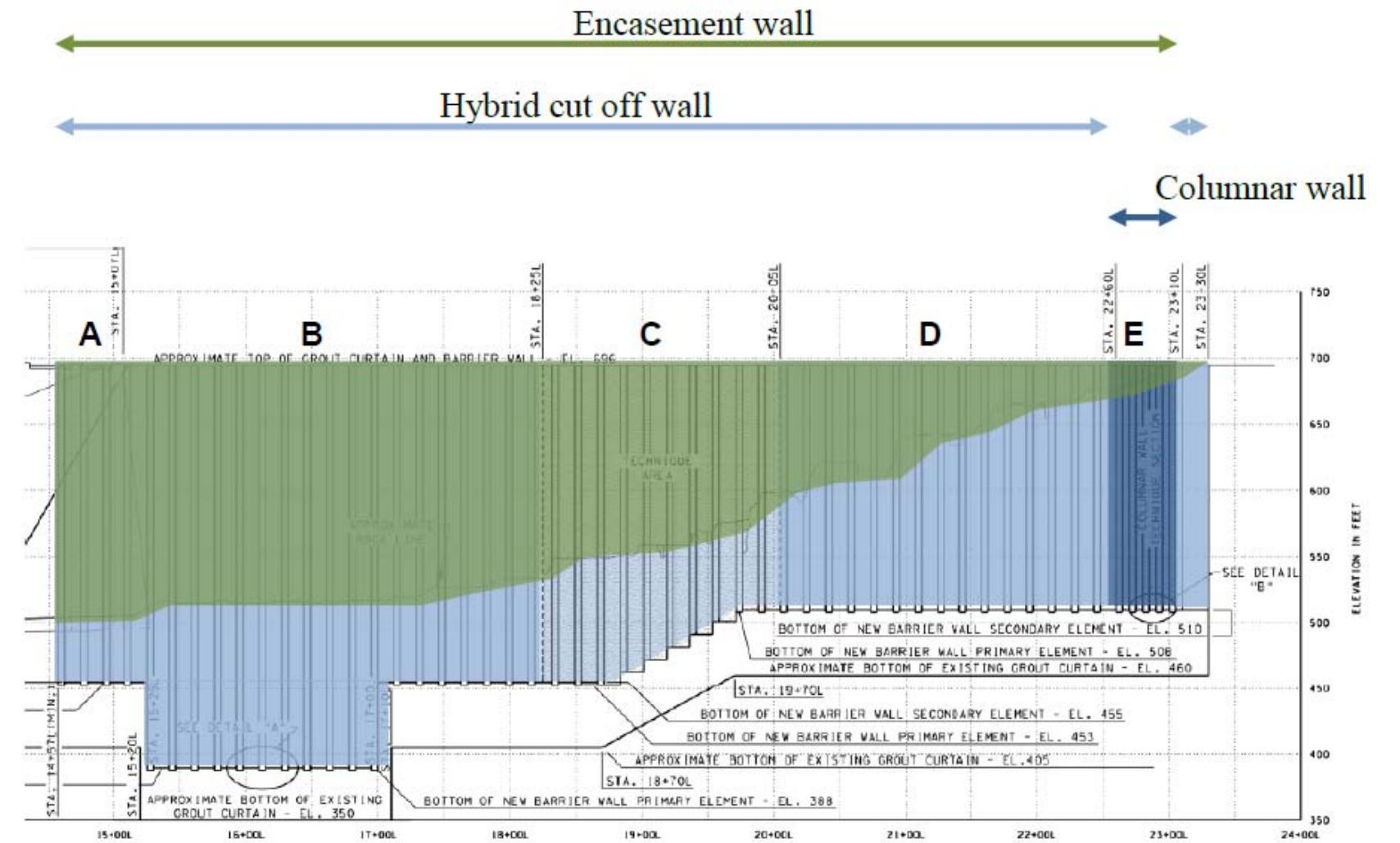
Center Hill Dam Foundation Remediation

Geology



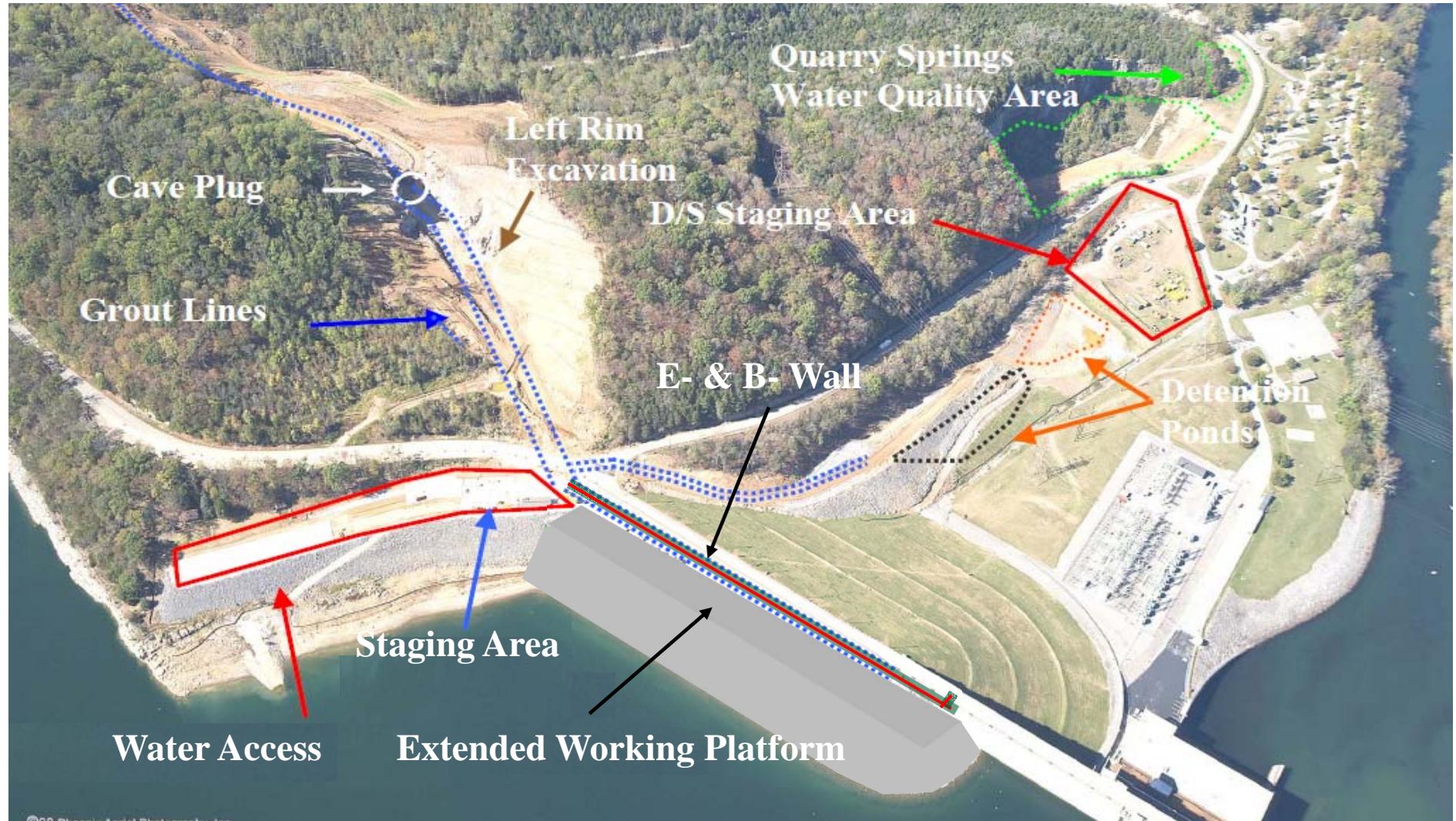
Center Hill Dam Foundation Remediation

Encasement & Barrier wall layout



Center Hill Dam Foundation Remediation

Site Works Overview



©2019 Phoenix Aerial Photography, Inc.

Center Hill Dam Foundation Remediation

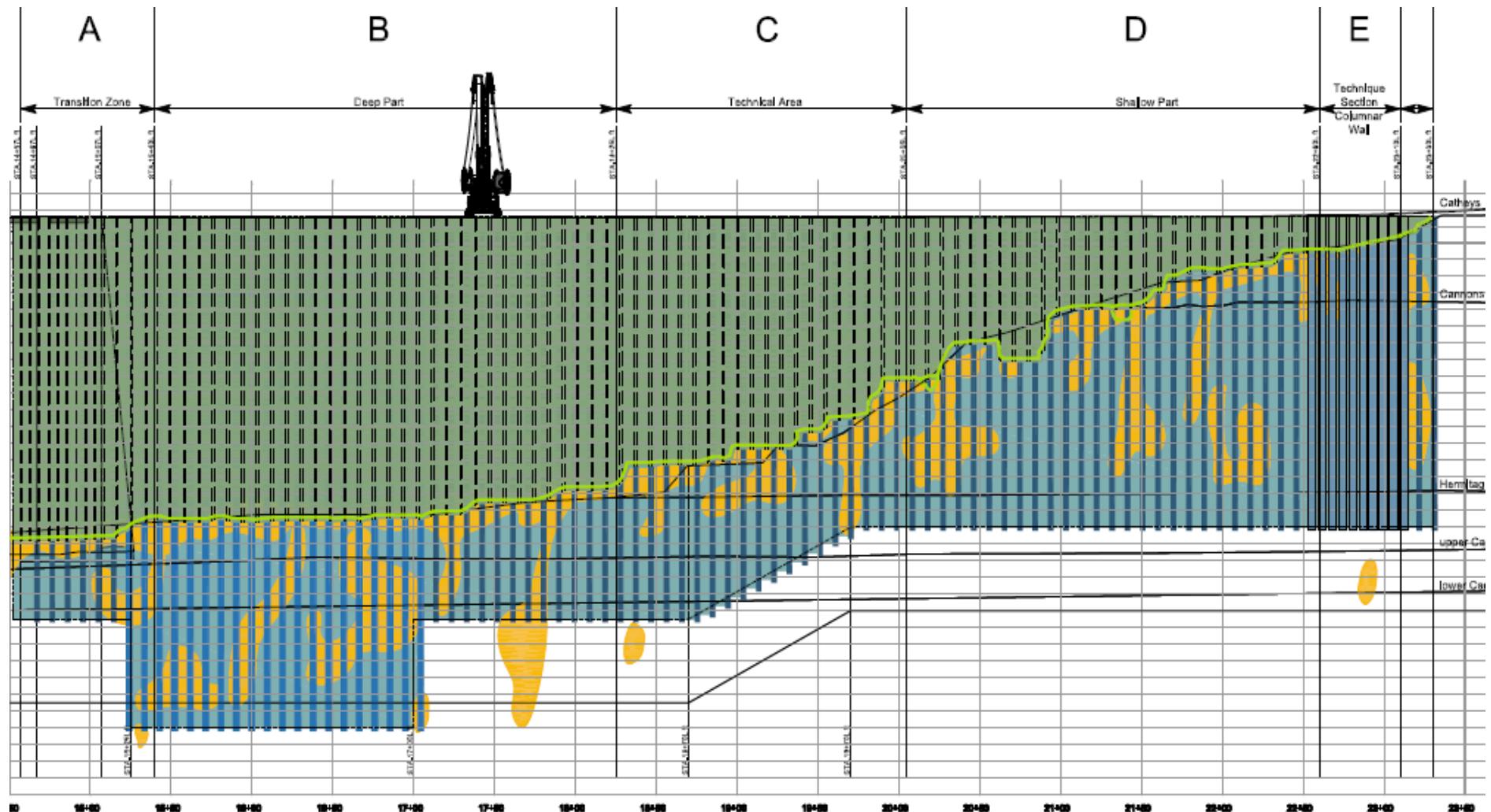
Previous Works



Phoenix Aerial Photography, Inc.

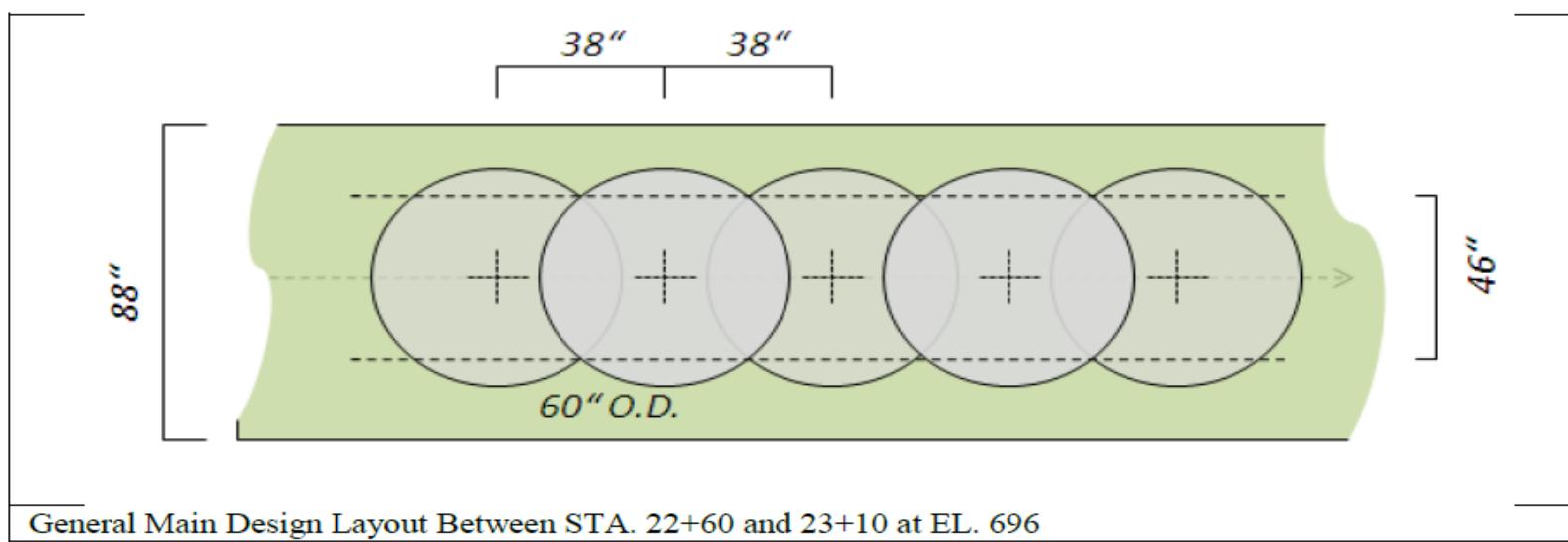
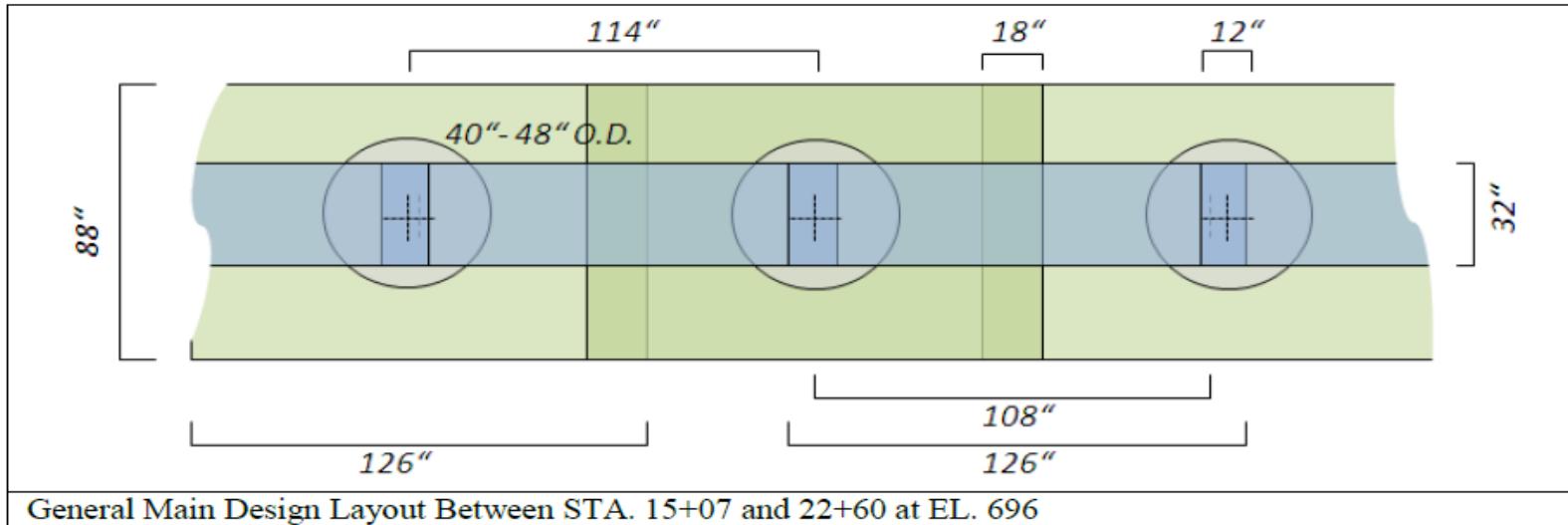
Center Hill Dam Foundation Remediation

Todays Scope of Work



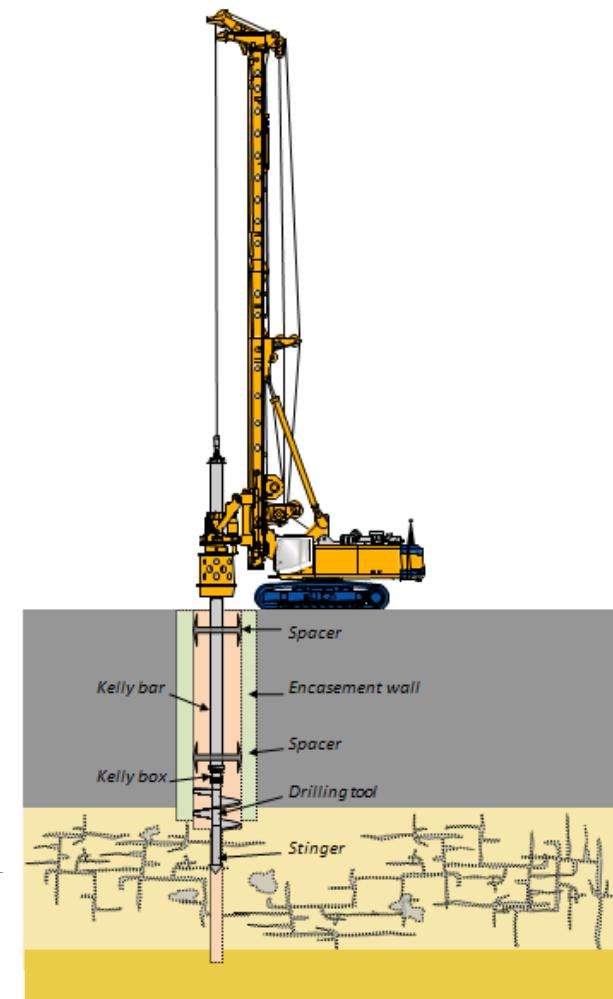
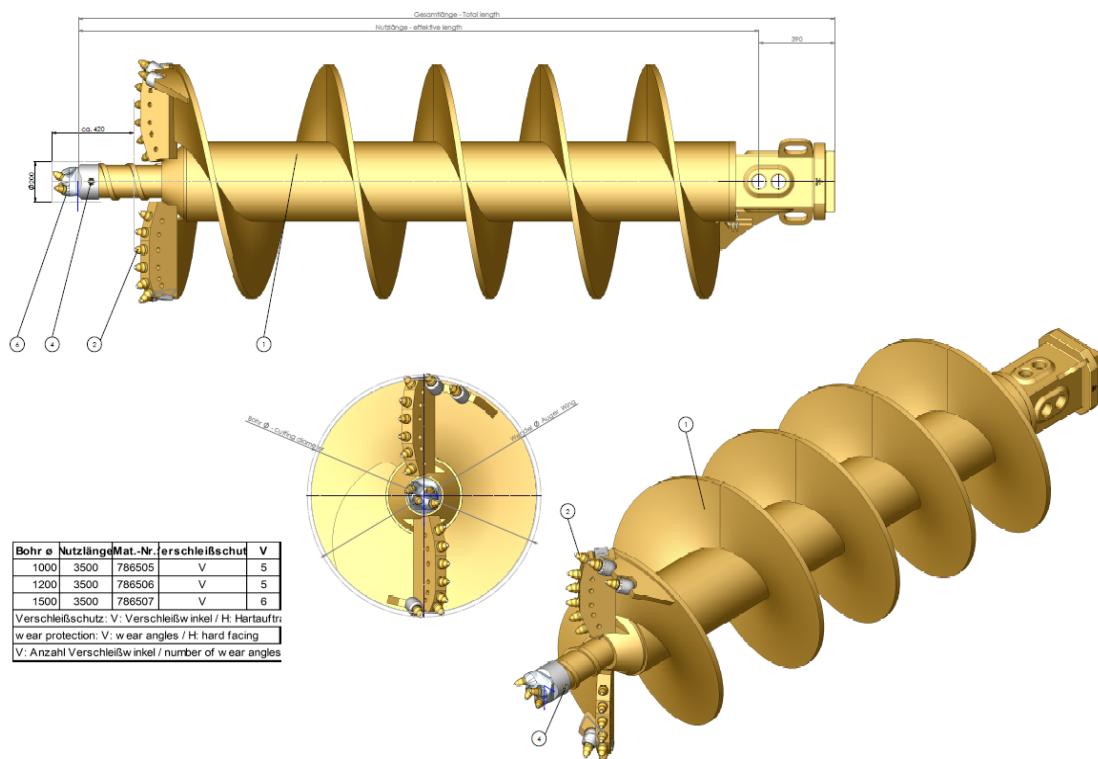
Center Hill Dam Foundation Remediation

Todays Scope of Work



Center Hill Dam Foundation Remediation

Todays Scope of Work

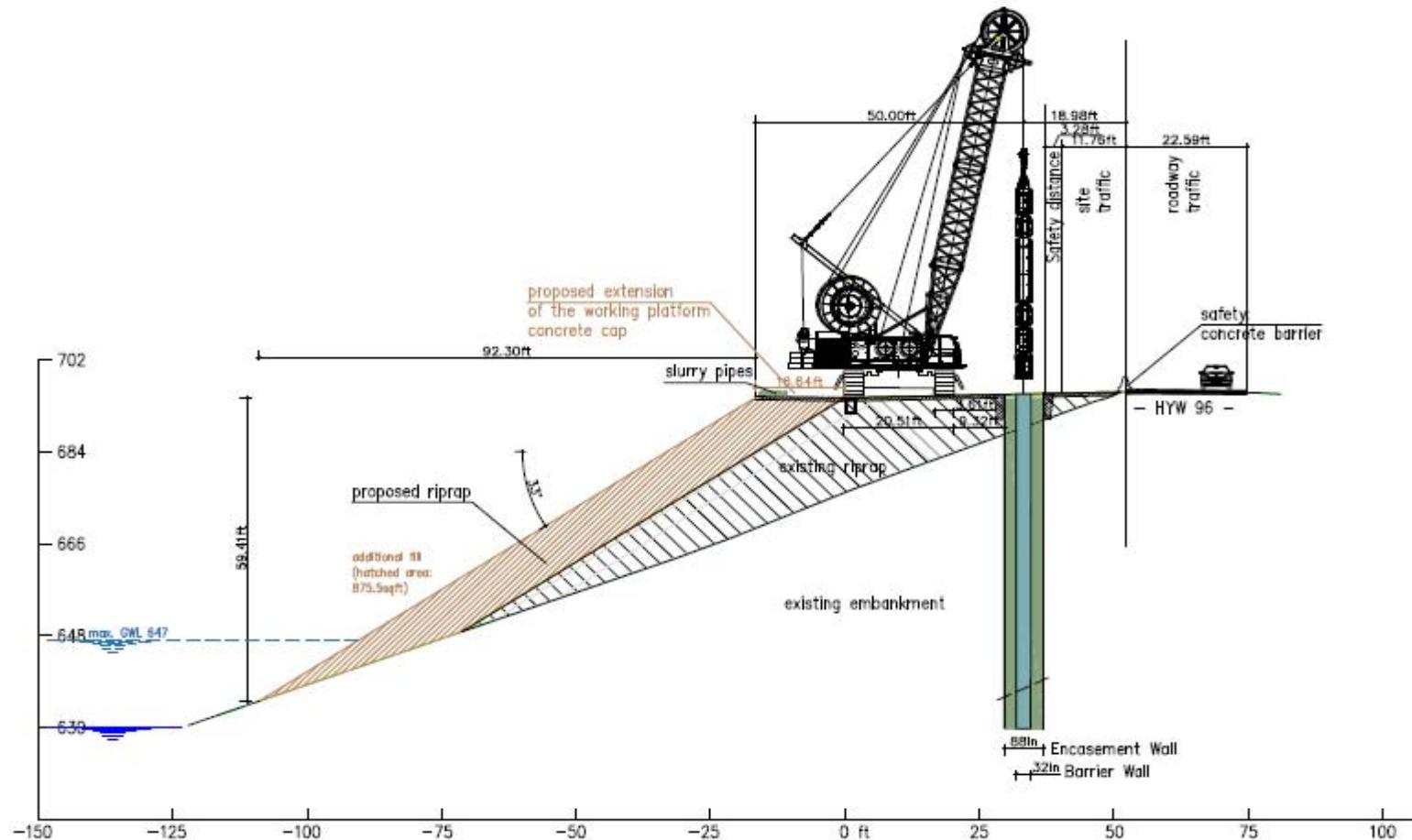


Center Hill Dam Foundation Remediation

Todays Scope of Work



Section St. 16+00.00



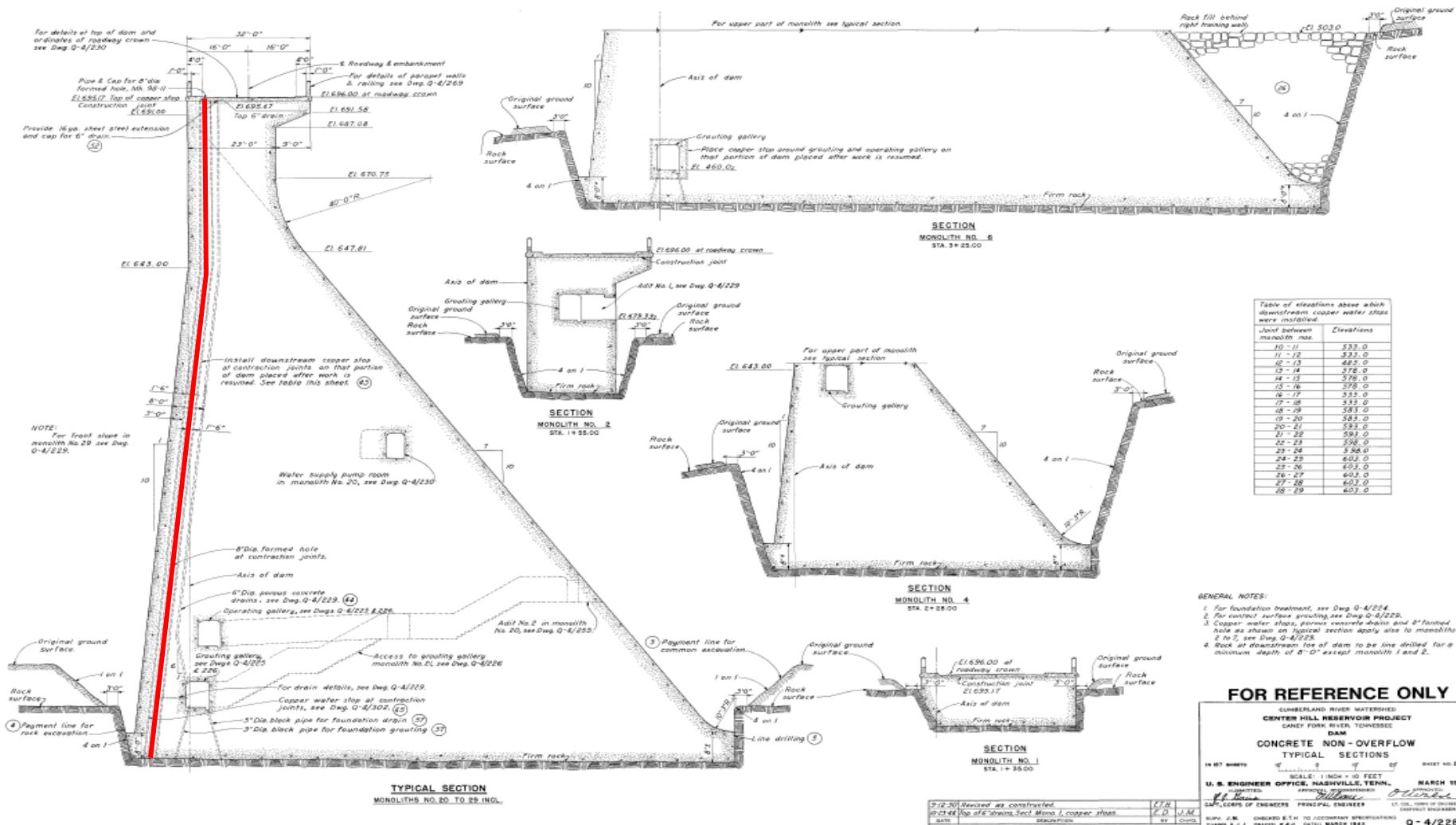
Center Hill Dam Foundation Remediation

Todays Scope of Work



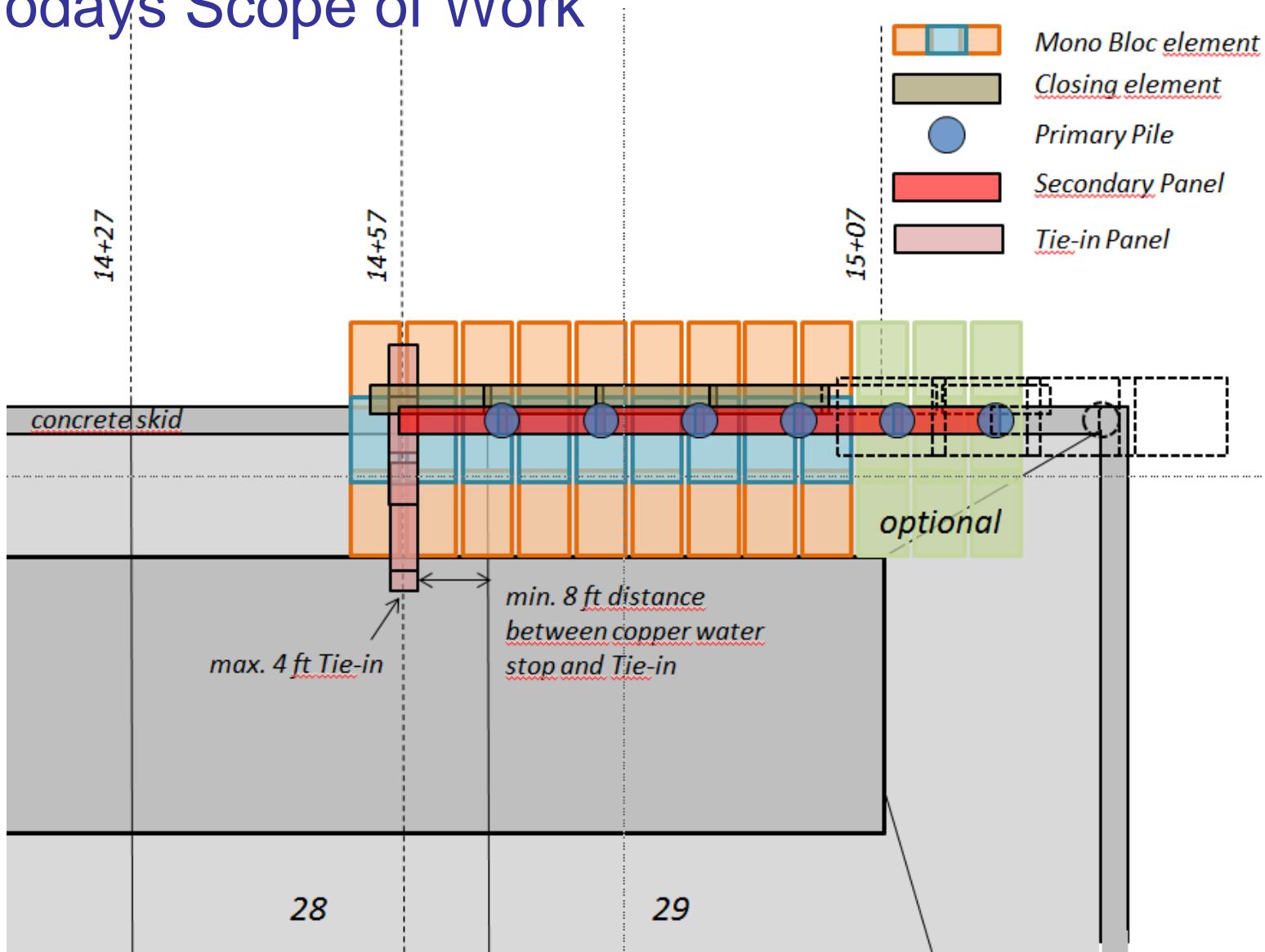
Center Hill Dam Foundation Remediation

Todays Scope of Work



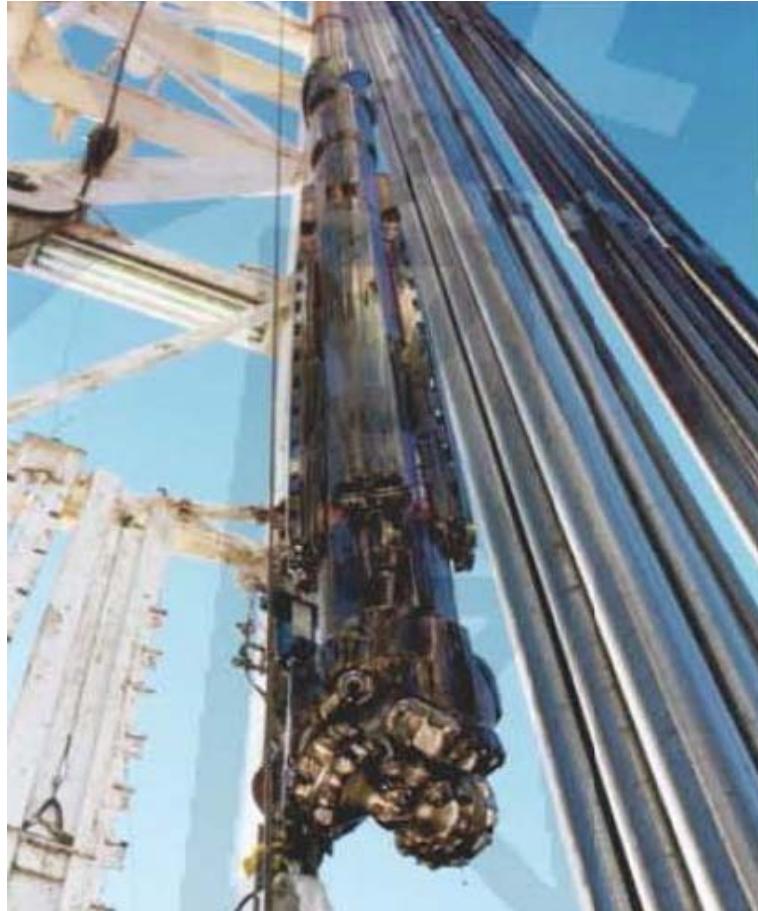
Center Hill Dam Foundation Remediation

Todays Scope of Work

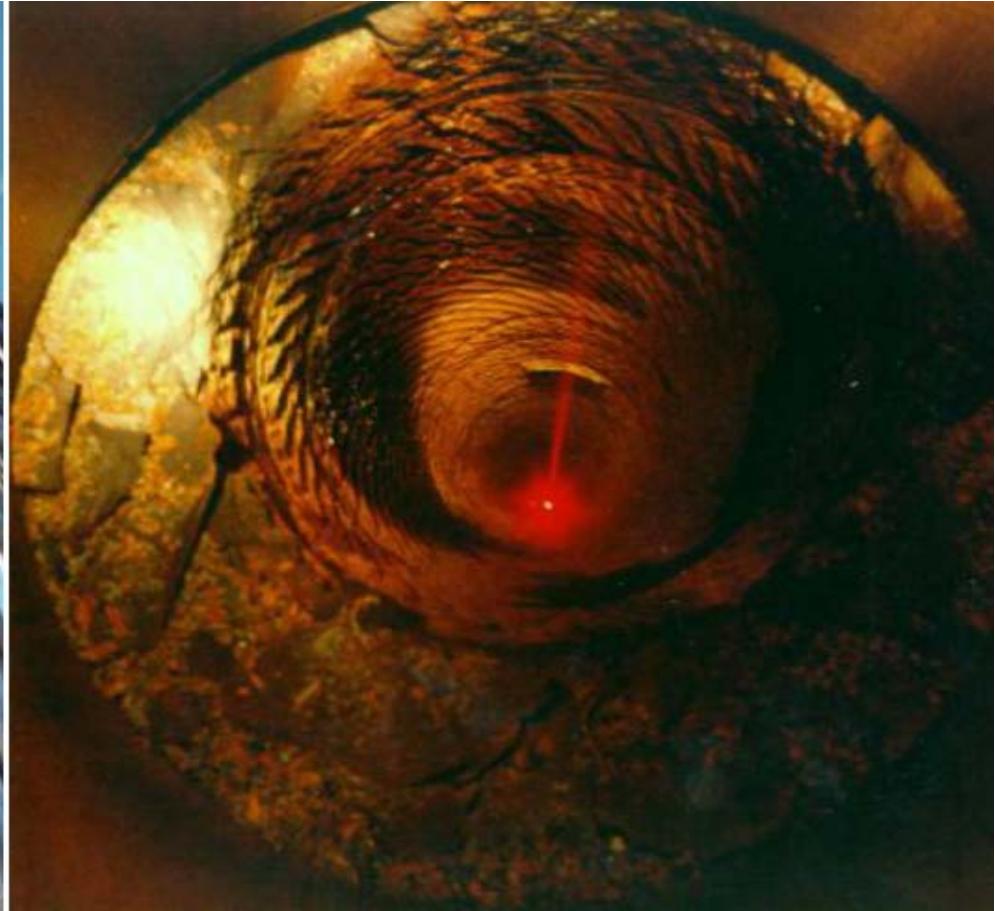


Center Hill Dam Foundation Remediation

Scheduled Small Drilling Equipment



Precision tool for Pilot Hole Drilling



Verticality Control by Laser at a Coal Mine in Belgium
Drilling depth: 626 ft – Laser beam confirms a total deviation of 1 inch = 0.01%

Center Hill Dam Foundation Remediation

Scheduled Large Drilling Equipment



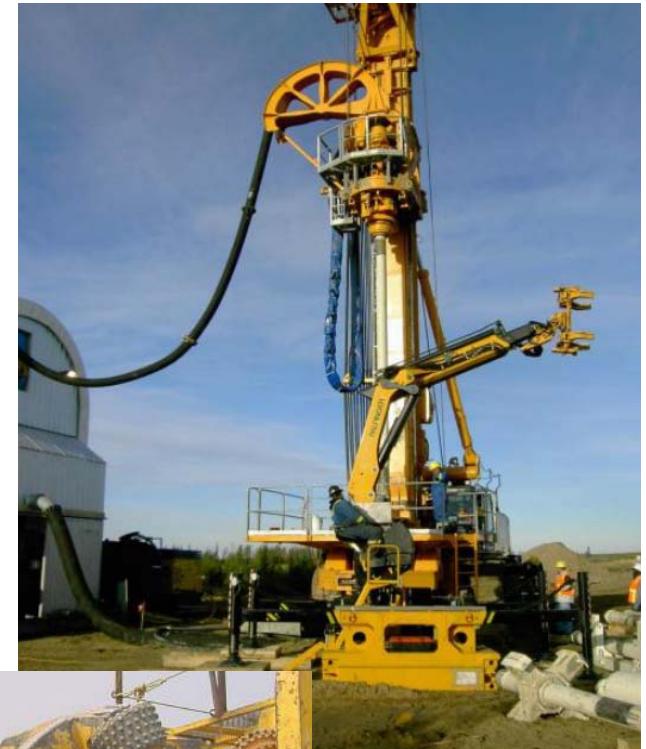
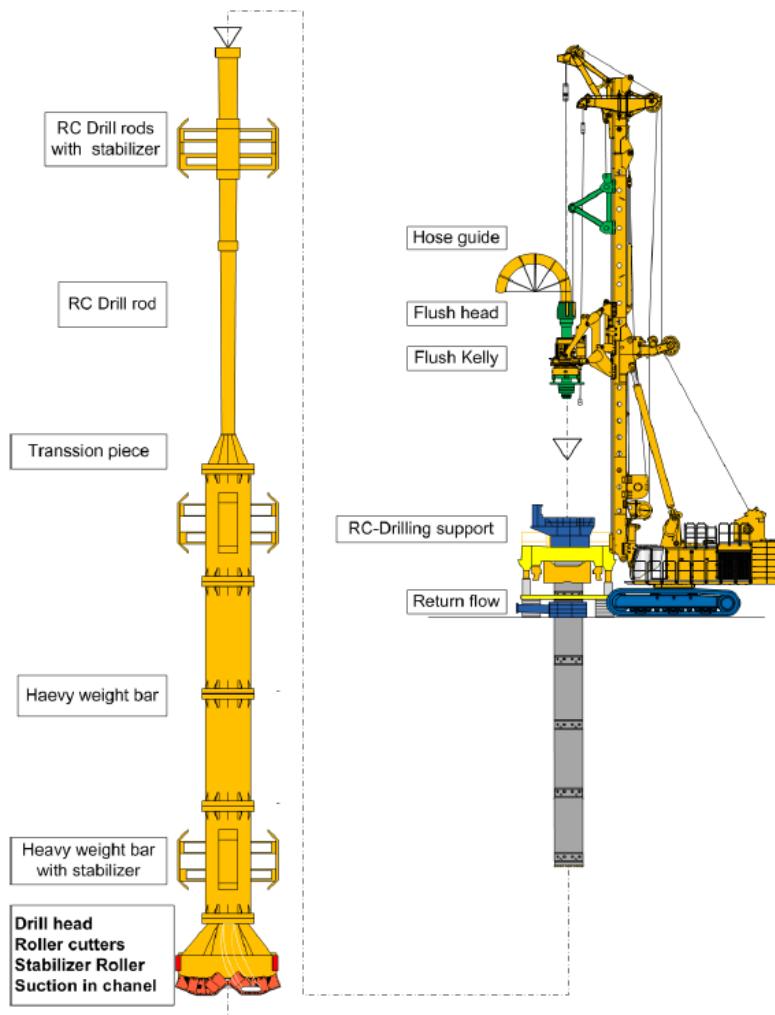
Center Hill Dam Foundation Remediation

Scheduled Large Drilling Equipment



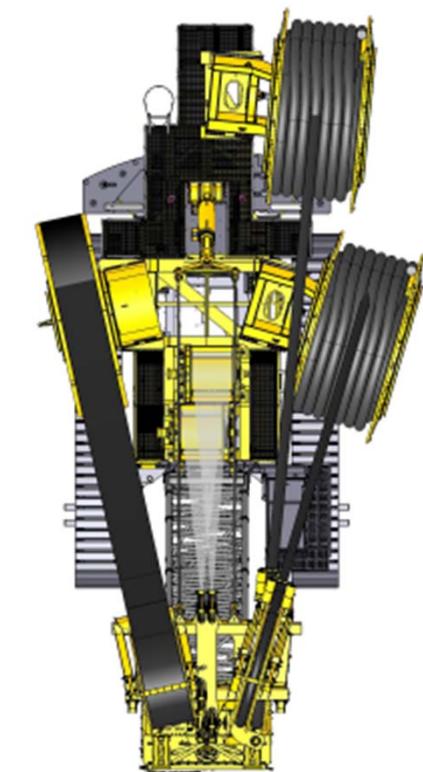
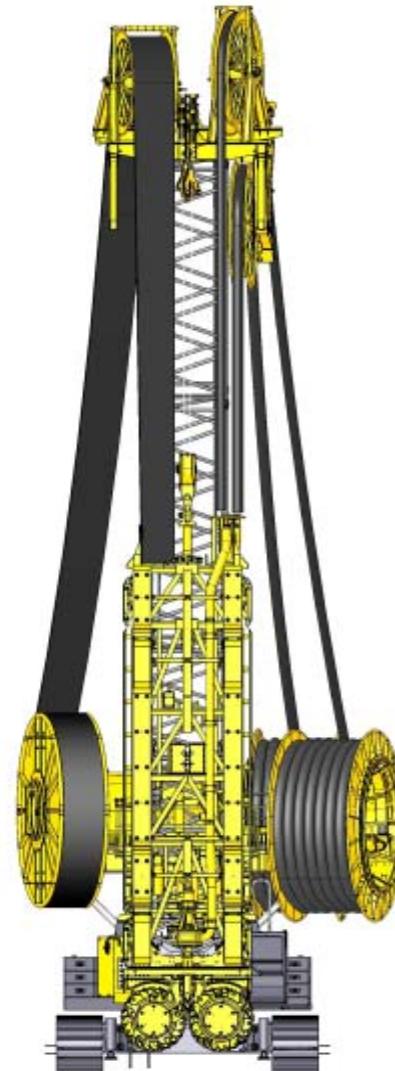
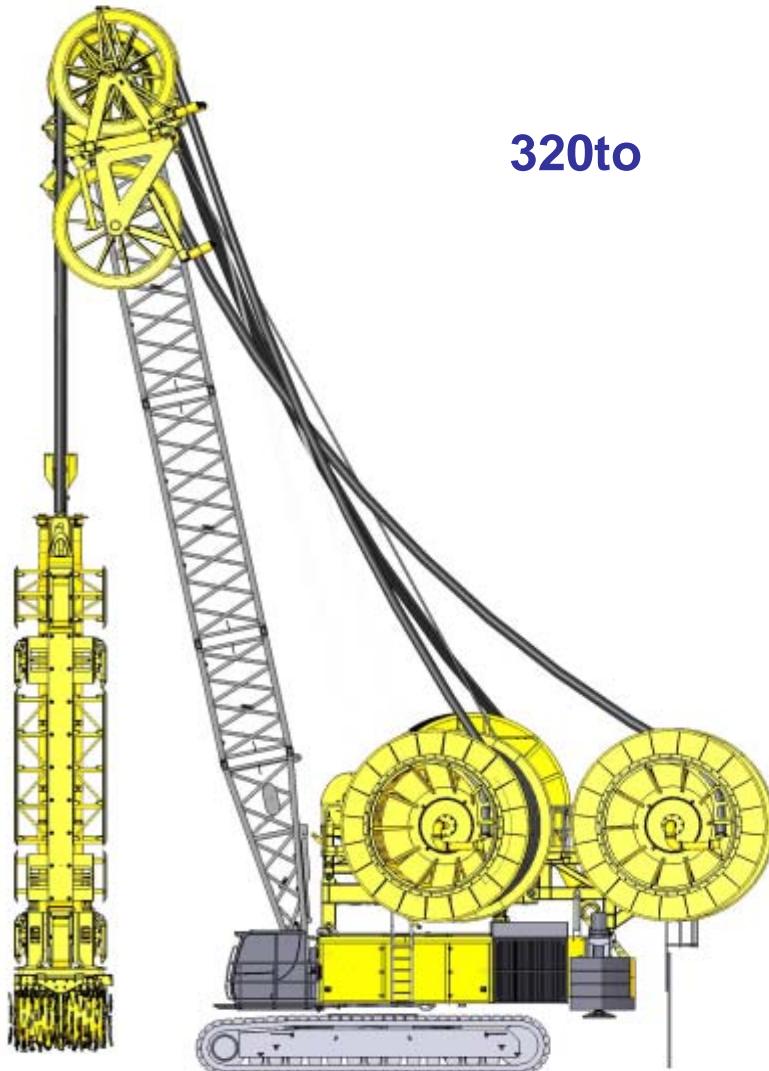
Center Hill Dam Foundation Remediation

Scheduled Large Drilling Equipment



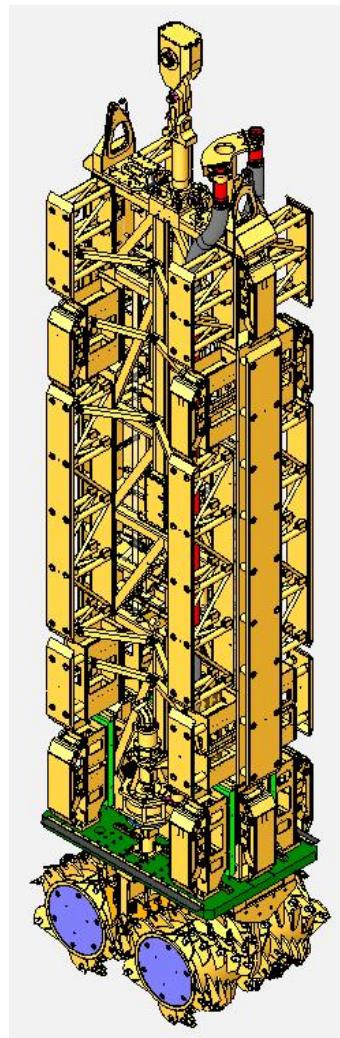
Center Hill Dam Foundation Remediation

Scheduled Cutter Equipment

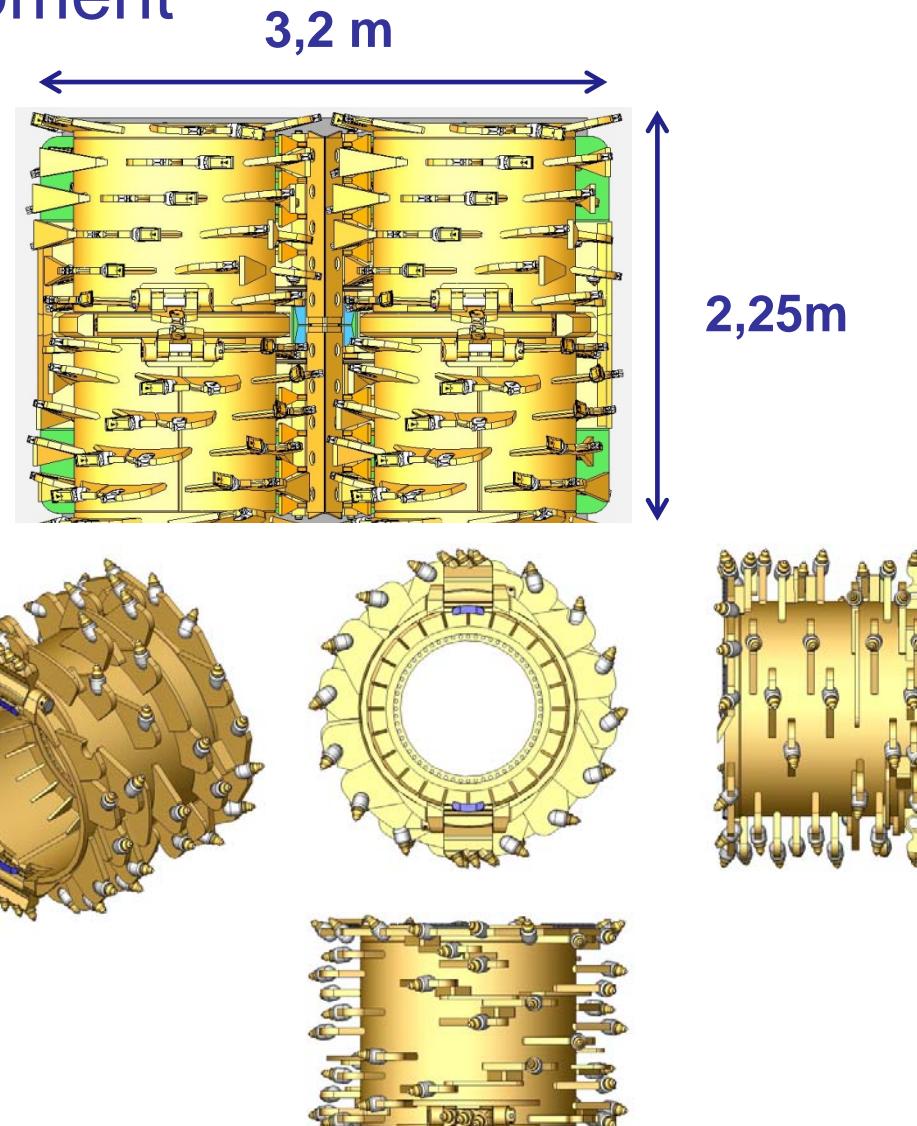


Center Hill Dam Foundation Remediation

Scheduled Cutter Equipment

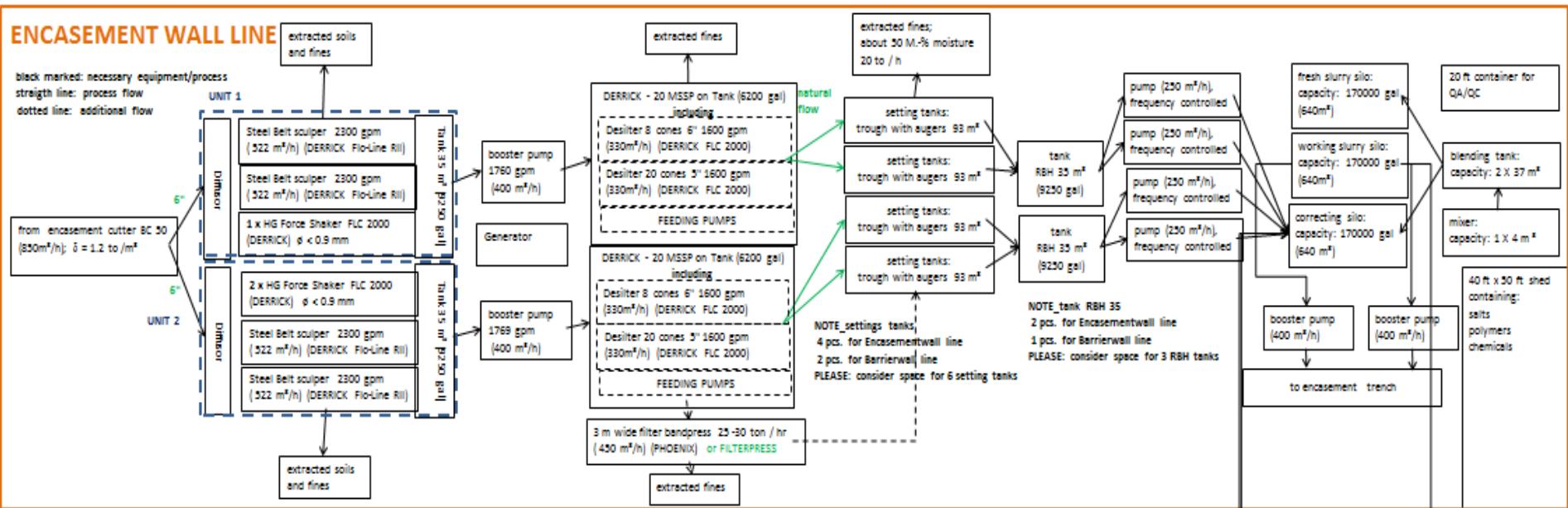


70to

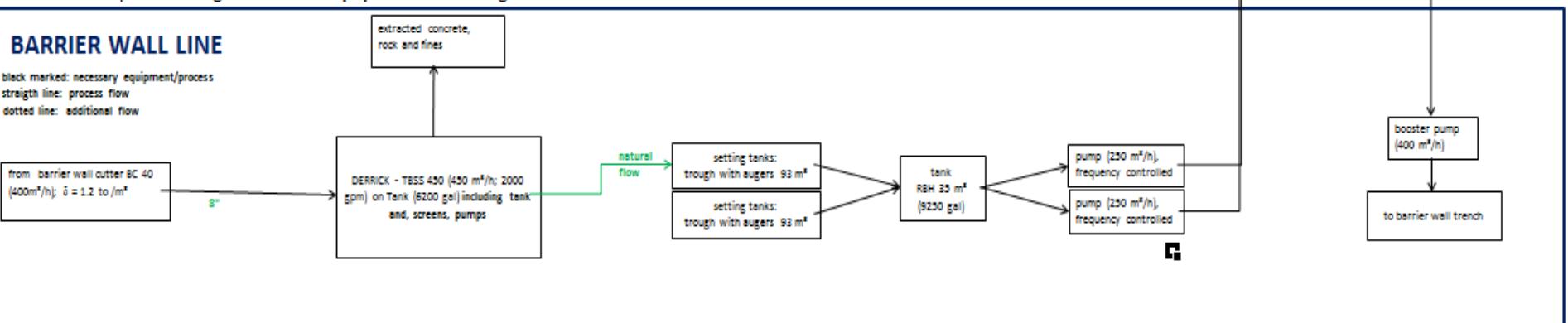


Center Hill Dam Foundation Remediation

Scheduled Slurry Equipment



This is a concept containing a additional equipment for working at the barrier wall



Center Hill Dam Foundation Remediation

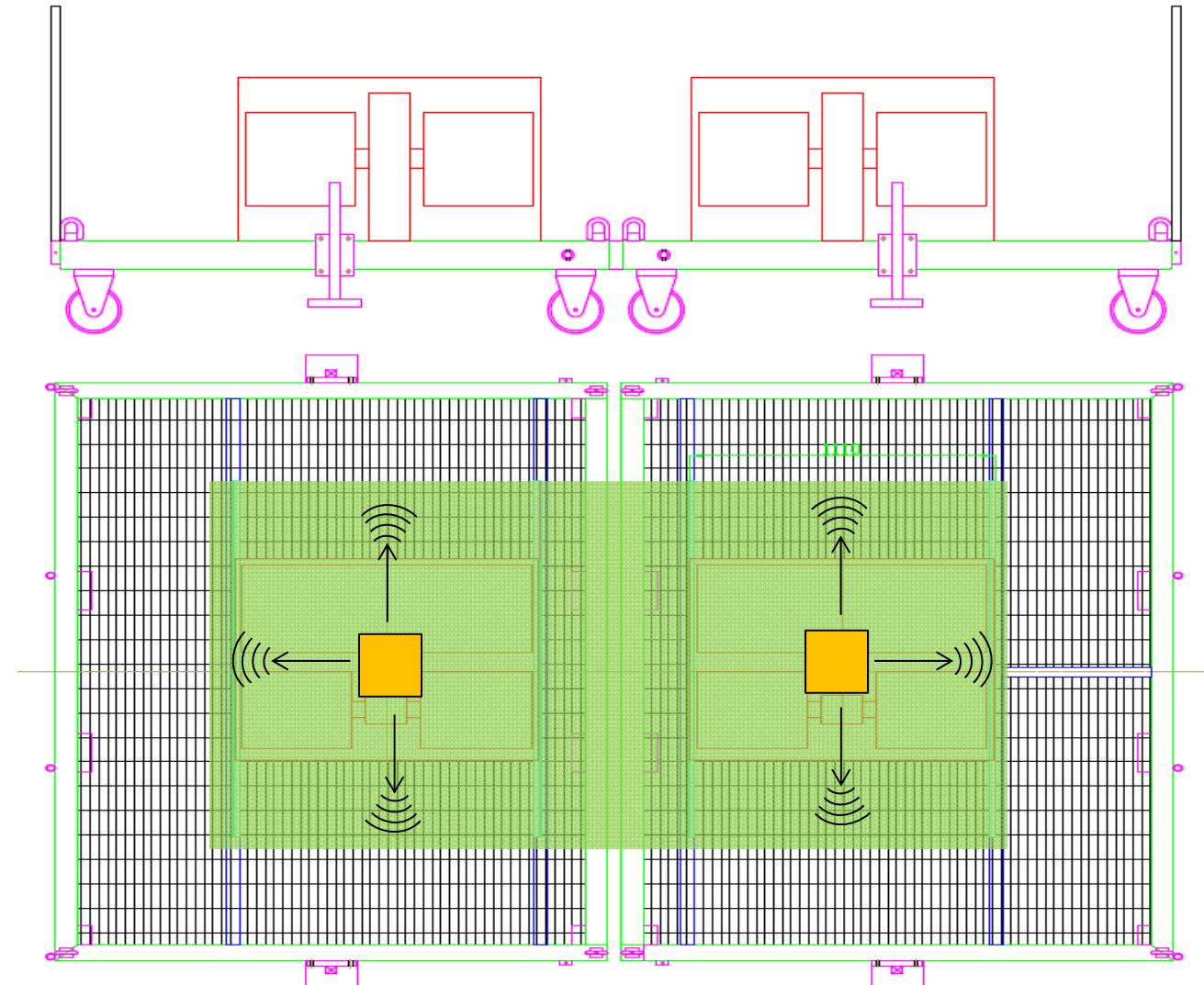
Scheduled Submittals & Reporting



SECTION - 01 00 00 GENERAL REQUIREMENTS		SECTION - 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE		SECTION - 31 56 10 BARRIER WALL CONSTRUCTION	
1	Area Use Plan	1	Air-Entraining Admixture	1	Borehole Imaging Equipment
12	Final Survey of Grout Hole Locations	16	Waterstops	2	Inclinometer Installation Plan
SECTION - 01 32 17 NETWORK ANALYSIS SCHEDULE (NAS)		SECTION - 03 37 29 CONCRETE FOR CONCRETE BARRIER WALLS		3	BW Eval. Drilling and Perm. Testing
1	Qualifications	1	Sounding Device	4	Qualifications - Barrier Wall Constr
6	Constr. Network Analysis Schedule	28	Bentonite	5	Drilling and Testing Plan - Barrier
SECTION - 01 33 00 SUBMITTAL PROCEDURES		SECTION - 13 50 00 INSTRUMENTATION		6	BW Constr. Technique Plan
1	Submittal Register	1	Drilling Log	7	BW Columnar Wall Technique Plan
SECTION - 01 35 13 AS-BUILT DOCUMENTS		2	Instrument Installation Log	8	QC Plan for BW Construction
1	As-Built Drawings	3	Inclinometer System	9	Excavation Log and Records
2	As-Built Specifications	4	Drilling, Sampling, Testing Plan	10	Drilling Log and Records
SECTION - 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS		5	Inclinometer Installation	11	Drilling Equipment
1	Accident Prevention Plan (APP)	6	Permits, Certifications, & Licenses	12	Excavation Equipment
12	Certificate of Compliance	SECTION - 31 00 00 EARTHWORK		13	Optical Televiewer Equipment
SECTION - 01 45 01 QUALITY CONTROL		1	Earthwork	14	Barrier Wall Pilot Hole/Exploration Report
1	Design QC Plan for Work Platform	SECTION - 31 05 19 NONWOVEN GEOTEXTILE		15	Pressure Testing Records
2	Contractor Quality Control Plan	1	Geotextile	16	Automated Drill Parameter Monitoring Results
3	Progress and Work Photographs	SECTION - 31 32 23 DRILLING AND GROUTING		17	Quality Control Checklist
SECTION - 01 55 26 MAINTENANCE AND CONTROL OF TRAFFIC		1	Drilling and Grouting Work Plan	18	Barrier Wall Technique Area Report
1	TDOT Encroachment Permit	16	Grouting Records	19	Columnar Wall Technique Section Report
2	Traffic Control Plan	SECTION - 31 55 00 WORK PLATFORM		20	Current Progress As-Built Drawings
SECTION - 01 57 20 ENVIRONMENTAL PROTECTION		1	Sources	21	Slurry Test Results
1	Environmental Protection Plan	3	Ramps and Access Roads	22	Periodic Reports
8	Water Quality Mitigation Plan	SECTION - 31 56 00 ENCASEMENT WALL CONSTRUCTION		23	Excavation and Placement Reports
SECTION - 01 57 23 STORM WATER		1	QC Plan for Encasement Wall Const	24	Verticality and Rotation Reports
1	Modifications to Exist Disp. Area	34	Final Report of Wall Excavation and Construction	25	Calibration Reports
2	Mill Certificate or Affidavit	SECTION - 31 56 10 BARRIER WALL CONSTRUCTION		26	Optical Survey
SECTION - 31 56 10 BARRIER WALL CONSTRUCTION		1	Haul Road	27	Barrier Wall Post-Construction Concrete Verification Report
		2	Contractor Quality Control	28	Drilling Logs
SECTION - 32 12 16 HAUL AND ACCESS ROAD		1	Fertilizer	29	Permeability Reports
SECTION - 32 92 19 SEEDING		2	Seed	30	Optical Televiewer Records
				31	Contractor's Wall Instrumentation Installation Report
				32	Bentonite
				33	Polymer Slurry
				34	Professional Geologist Credentials
				35	Material Safety Data Sheets
				36	Barrier Wall Element Records
				37	As-Built Profiles and Sections of Observation Wells
				38	Final Report of Barrier Wall Excavation and Construction

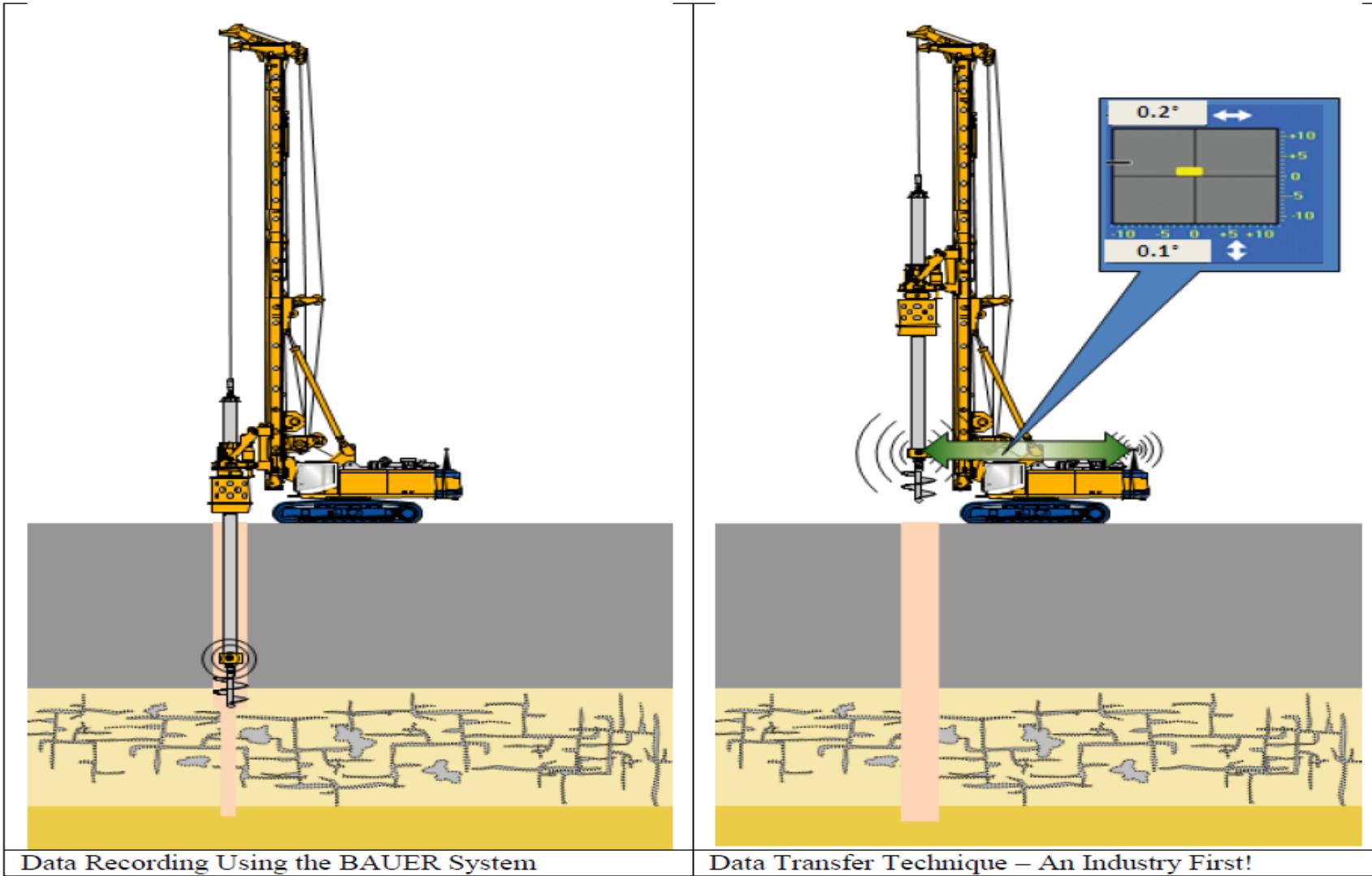
Center Hill Dam Foundation Remediation

Scheduled Survey & Monitoring



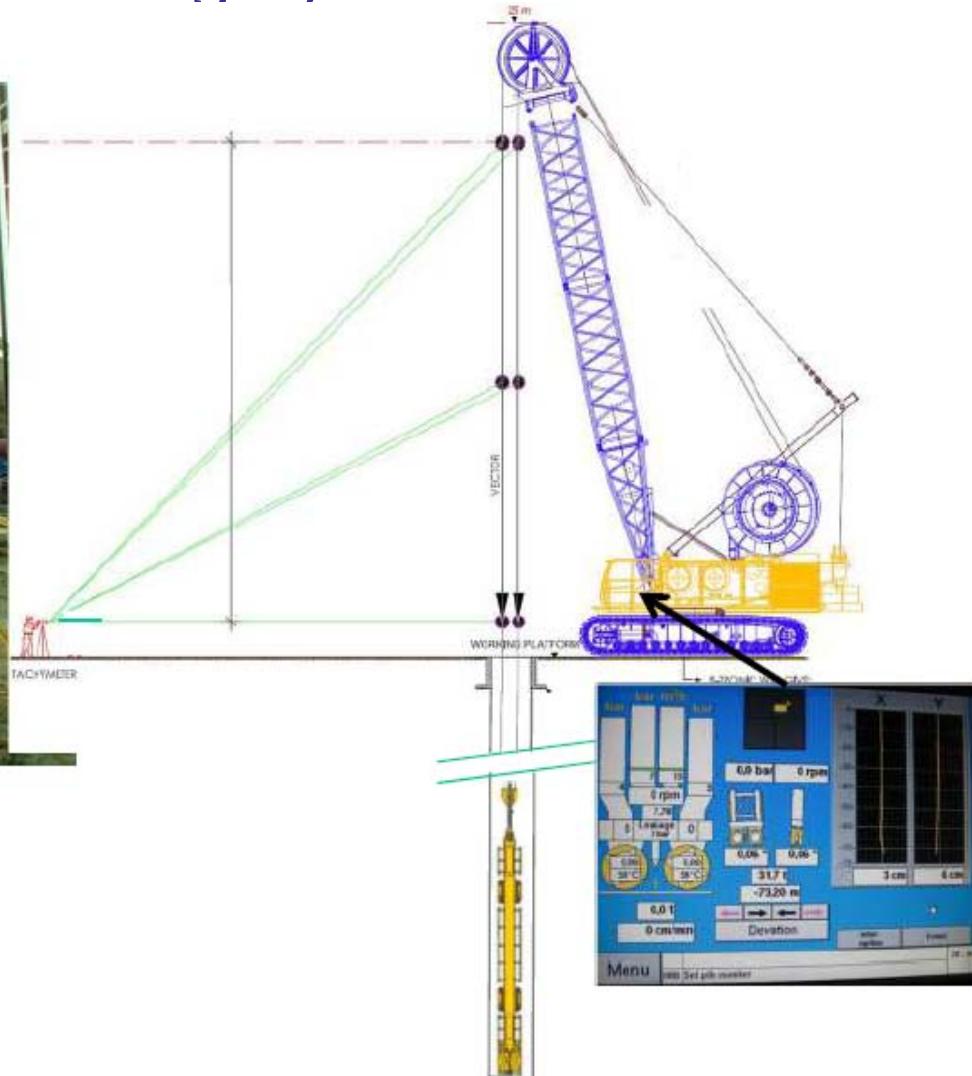
Center Hill Dam Foundation Remediation

Scheduled Survey & Monitoring



Center Hill Dam Foundation Remediation

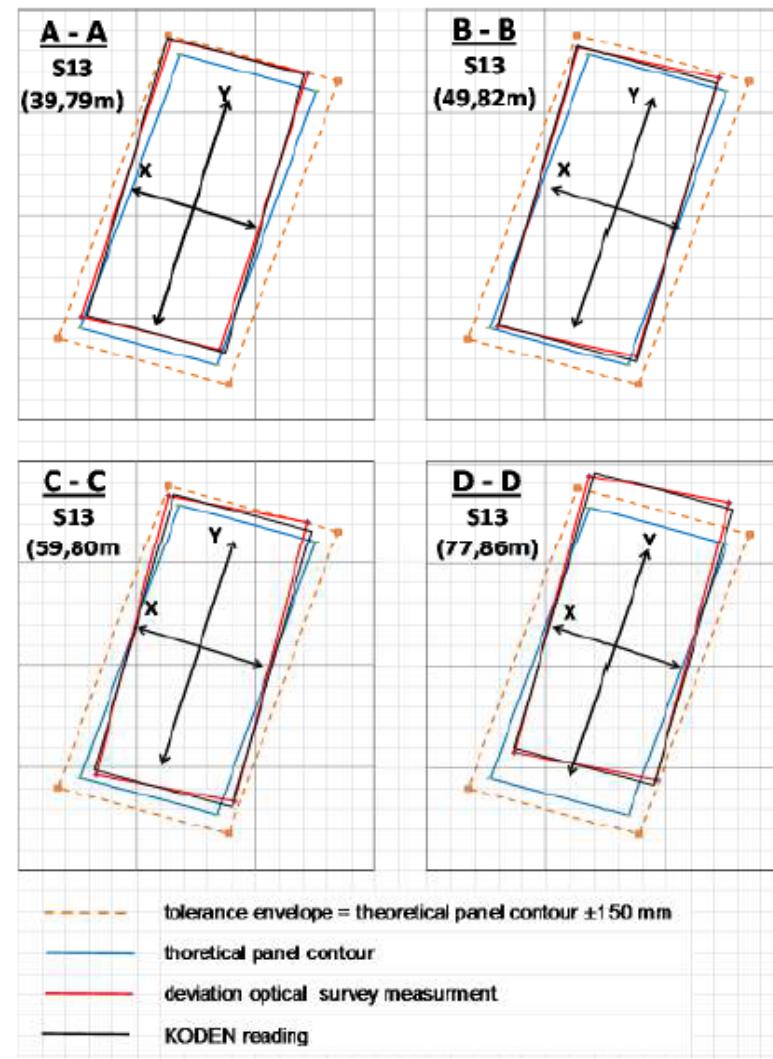
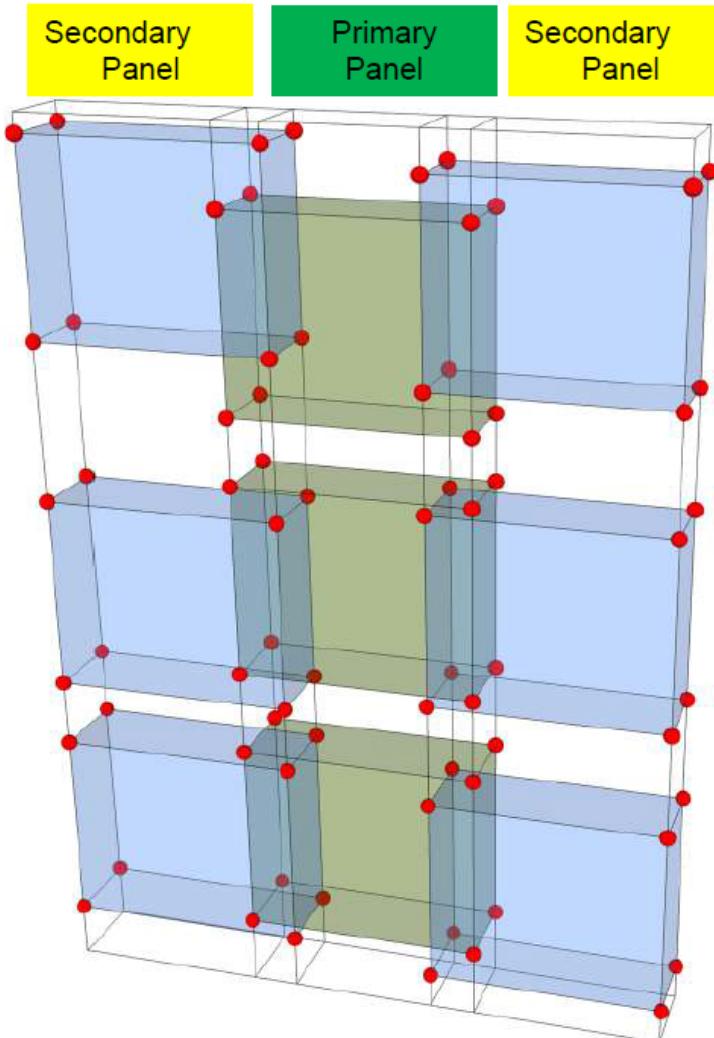
Scheduled Survey & Monitoring by CIS



- Online communication between B-Tronic and Tachymeter
- Less than 10 min per measurement

Center Hill Dam Foundation Remediation

Scheduled Survey & Monitoring by CIS



WallTracker

Dokumentation und Visualisierung von Projektdaten



Herbert Hoover Dike Rehabilitation Seepage Cutoff Wall
Visualization Tool

walltracker

BETA



Geosyntec[▷]
consultants

v.15Jul-09
©2009, Geosyntec Consultants
and Bauer Foundation Corporation

WallTracker

Dokumentation und Visualisierung von Projektdaten



Zweck und Ziele

- 1. Zeitnahe Qualitätskontrolle / -überwachung (z.B. erreichte Tiefen, Überschritte, Testergebnisse, ...)**
- 2. Zeitnahe Datenanalyse (Tiefe-Soll-Ist, Überschnitt-soll-Ist, ...)**
- 3. Zeitnahes Produktions-Controlling (Massen, Soll-Ist-Vergleiche)**
- 4. Visualisierung der erbrachten Leistung**
- 5. Übersichtliche Dokumentation von geographisch zugeordneten Daten (geocoded data)**

WallTracker

Visualisierung und Dokumentation von Projektdaten



Software-Hintergrund

1. Visualisierung von verschiedenen Daten aus verschiedenen Datenbanken über die ArcGIS-Software von Esri (ArcGIS: GeoInformationssystem)

2. ArcGIS-Reader ist kostenlos und wird bei Bedarf von IT installiert



ArcGis Explorer Online

Info aus Wikipedia:

Geoinformationssystem

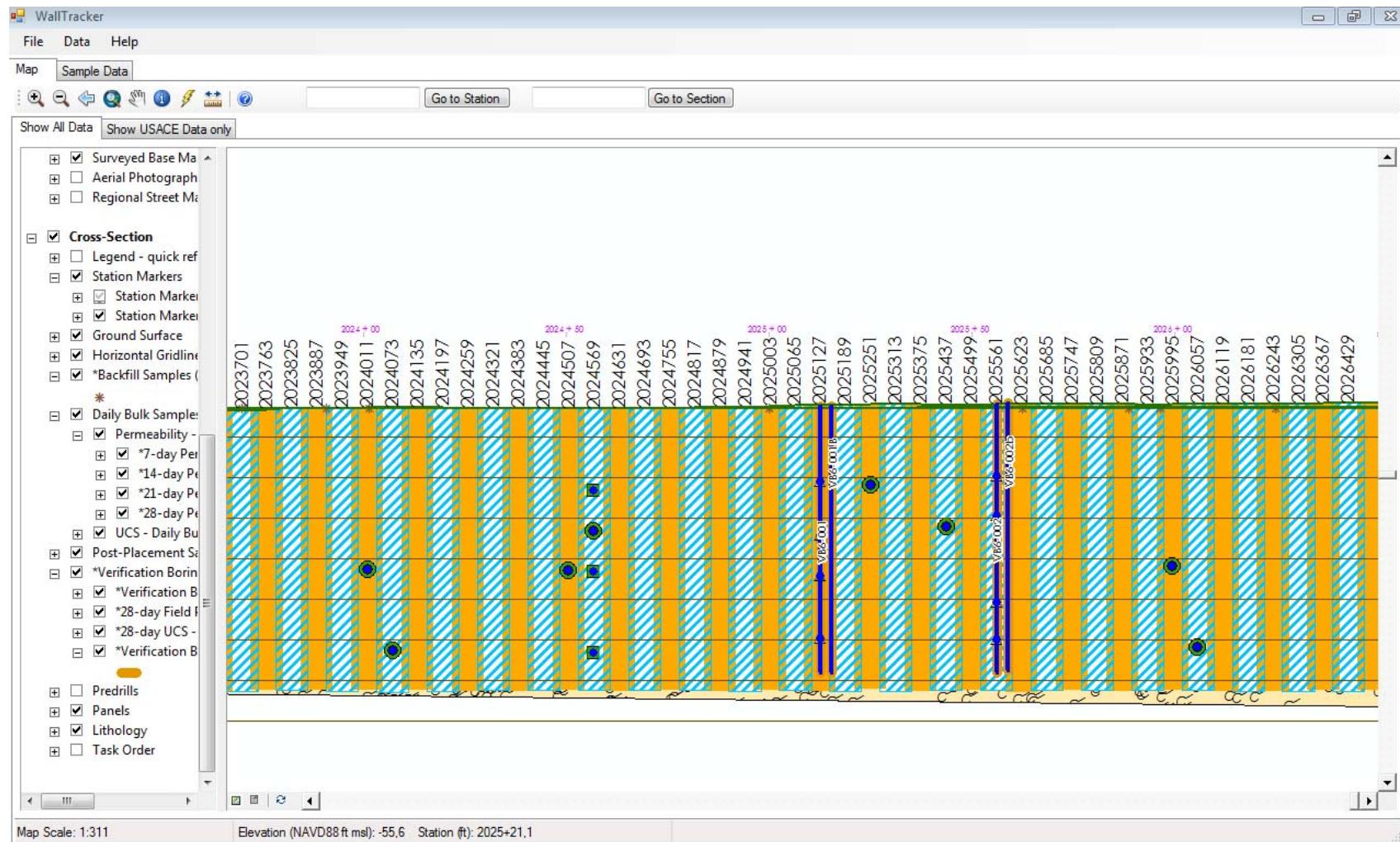
Geoinformationssysteme (GIS), Geographische Informationssysteme oder Räumliche Informationssysteme (RIS) sind Informationssysteme zur Erfassung, Bearbeitung, Organisation, Analyse und Präsentation geografischer Daten. Geoinformationssysteme umfassen die dazu benötigte Hardware, Software, Daten und Anwendungen.



WIKIPEDIA
Die freie Enzyklopädie

WallTracker

Dokumentation und Visualisierung von Projektdaten



WallTracker

Dokumentation und Visualisierung von Projektdaten



Map Sample Data

Go to Station Go to Section

Show All Data Show USACE Data only

Plan View

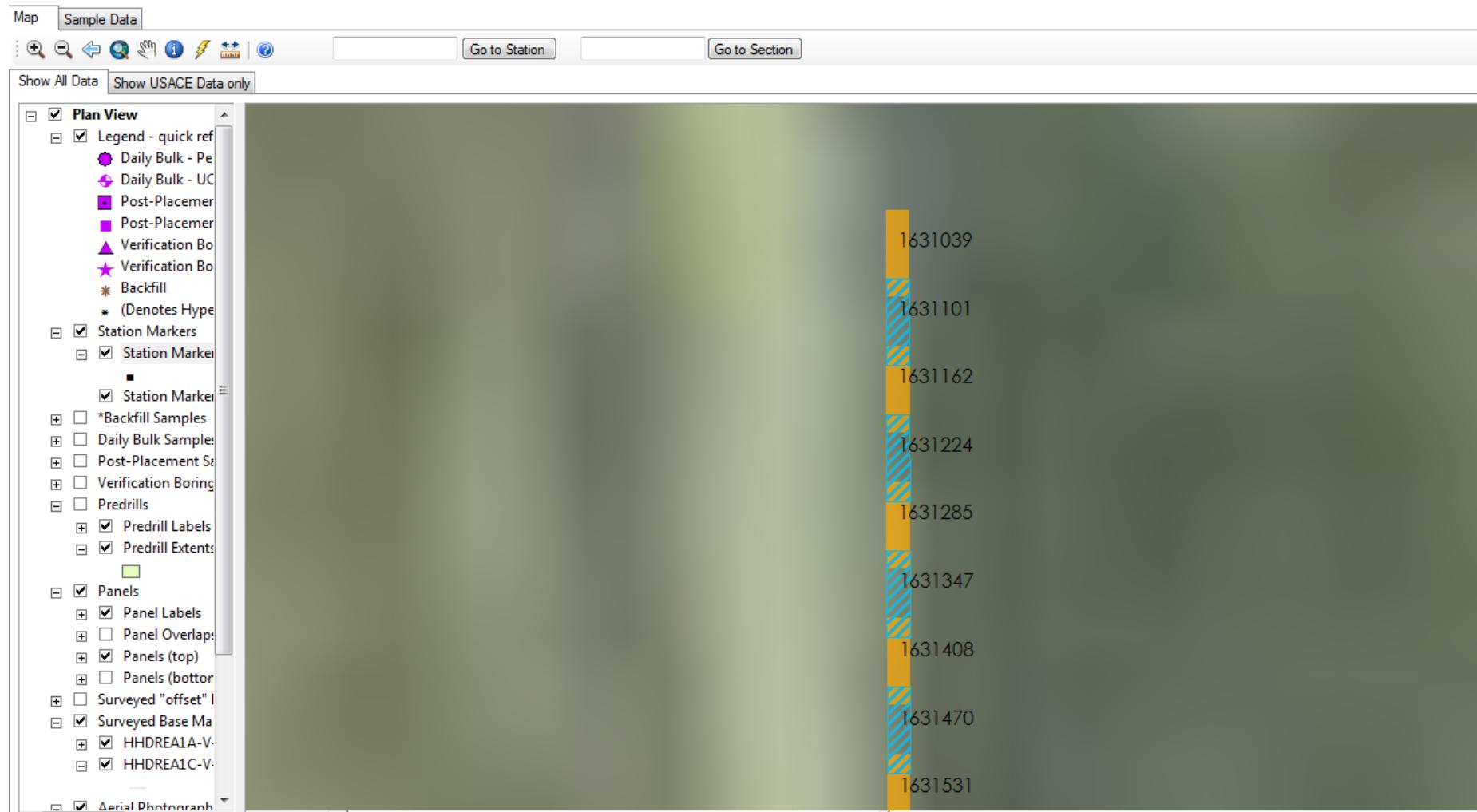
- Legend - quick ref
 - Daily Bulk - Pe
 - Daily Bulk - UC
 - Post-Placemer
 - Post-Placemer
 - ▲ Verification Bo
 - ★ Verification Bo
 - * Backfill
 - * (Denotes Hyper
- Station Markers
 - Station Marker
 - *Backfill Samples
 - Daily Bulk Samples
 - Post-Placement Sa
 - Verification Boring
 - Predrills
 - Predrill Labels
 - Predrill Extents
 - Surveyed "offset" I
 - Surveyed Base Ma
 - HHDREA1A-V
 - HHDREA1C-V
- Panels
 - Panel Labels
 - Panel Overlay:
 - Panels (top)
 - Panels (bottom)
- Surveyed "offset" I
- Surveyed Base Ma
- HHDREA1A-V
- HHDREA1C-V

- Aerial Photograph

16311621631224
16316541631716
16321461632208
16326381632700
16331301633192
16336221633684
16341141634176
16346061634668
16350981635160
16355901635652
16360821636144
16365741636636
16370661637128
16375581637620
16380501638112
16385421638604
16390341639096
16395261639588
16400181640080
16405101640572
16410021641064
16414941641556
16419861642048
16424781642540

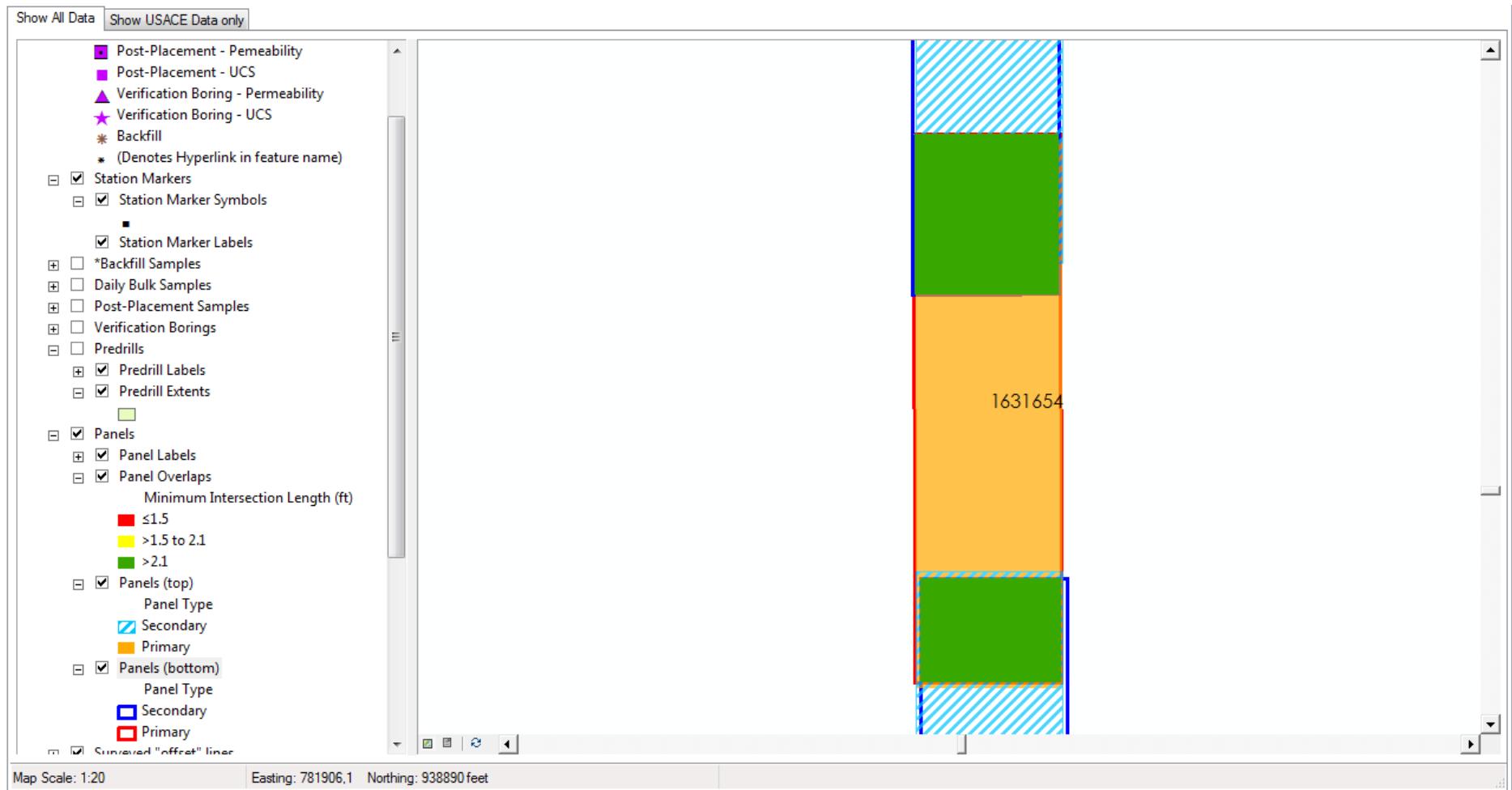
WallTracker

Visualisierung und Dokumentation von Projektdaten



WallTracker

Visualisierung und Dokumentation von Projektdaten



WallTracker

Visualisierung und Dokumentation von Projektdaten



WallTracker ©

for

Center Hill Dam Seepage
Rehabilitation

CHD – Data Flow: Principles and Concepts



Single comprehensive data structure

- Described in **Data Management Plan** to be submitted to Government
- **Master database** serves as *single authoritative repository* of **all project data**
- Relational database structure

Balance between automation and QC

- Data flow is automated to eliminate transcription, but transparent to allow QC at all steps

CHD – Data Flow: Principles and Concepts



Data integrity built into each stage of process:

- Raw data uploaded to Government FTP site immediately on generation
- All data are verified on appending to database:
 - Checks for completeness
 - Checks for compliance with valid values
- Normalization within database allows for efficient management:
 - All locations related by coordinates and stations
 - Consistent unit nomenclature across entire database

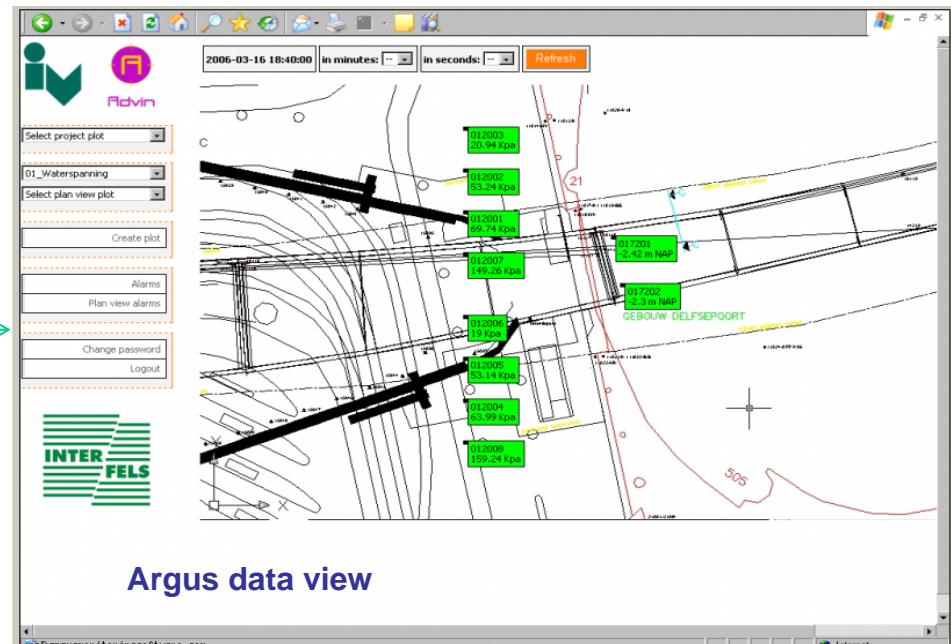
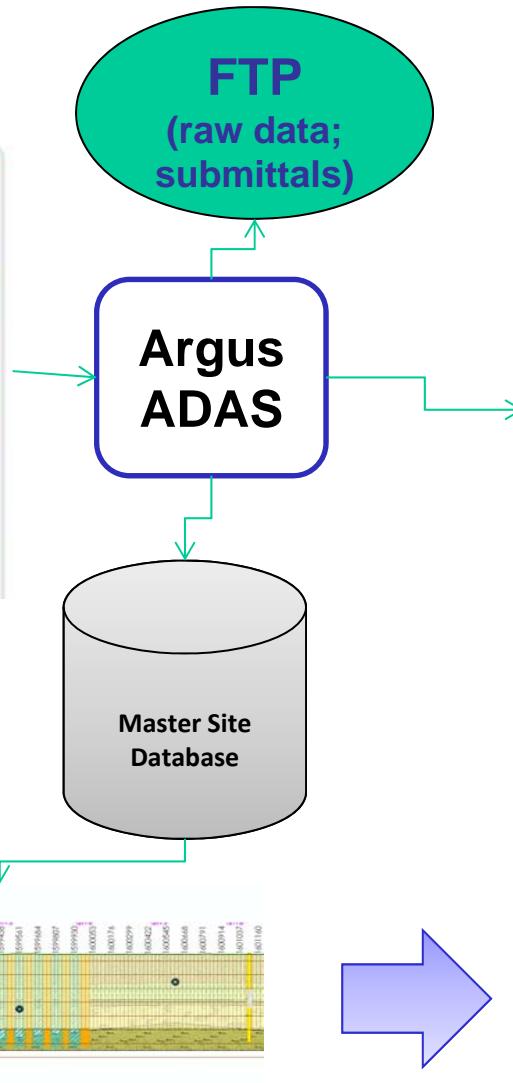
Government and QCS can remotely view operator screens and access all data with WallTracker



CHD – Data Flow: Instrumentation and Survey



Inputs



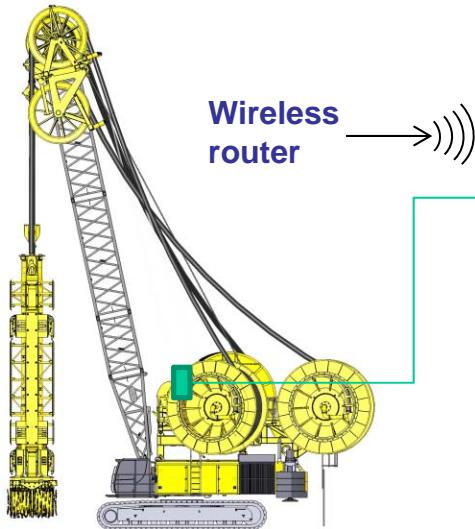
Argus data view



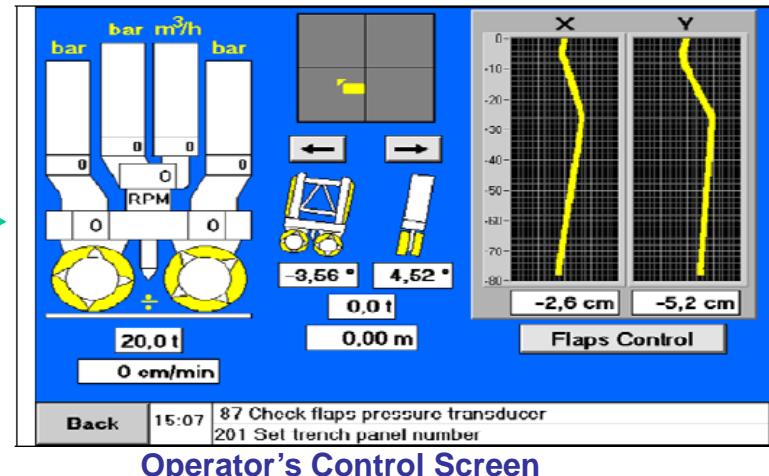
Government's or QCS's Tablet PC:
• Mirror of Argus data view
• WallTracker view



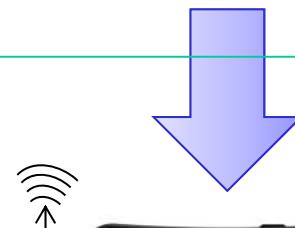
CHD – Data Flow: Wall Installation



Bauer equipment with B-Tronics



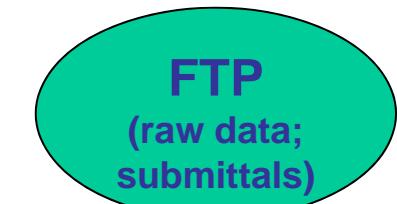
Operator's Control Screen



Government's or QCS's Tablet PC:
• Mirror of Operator's Control
Screen (within 1,000m)



WallTracker



B-Tronics .dat file

Master Site Database



Master Site Database

History

... almost 1.000.000 m² of concrete cut-off walls for dam-barrier walls installed

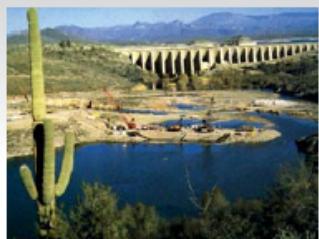
1984



Brombach Main Dam, Germany



Rothensee Dam, Germany



New Waddell Dam, USA



Shwaib Dam, United Arab Emirates



Kingsley Dam, USA



Shikawa Dam, Japan



Wister Dam, USA

1990

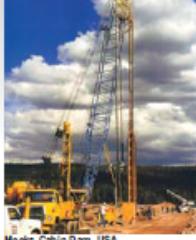
1994



Pleuelsch Hydroelectric Weir Structure, Germany



Laakirchen, Austria



Meeks Cabin Dam, USA



Power Station Dam, Szechuan



Eastside Reservoir, USA



Al Hatta Dam, United Arab Emirates



Ahrental, Austria



Pudahol Dam, Chile

2000



Hodges Village Dam, USA



Diavik, Canada



Dhaulighanga Dam, India



Borcka & Muratli Dams, Turkey



Naga Hamadi, Egypt



Kebir Dam, Tunisia

2004



Penobscot Dam, Canada



Maroua Dam, Sudan



Hinze Dam, Australia



Herbert Hoover Dike, USA

2011