

Big Data Small Firm

Thomas Blackburn PE, GE, F. ASCE, F. ACEC
Bryce Moore

HELLO



**Thomas Blackburn, PE, GE,
F. ASCE, F. ACEC**
Principal Geotechnical Engineer



Bryce Moore
Director of Construction Services

Case History #1

4-Mile Long North Delta Levee



Design/Build Delivery Method

Owner: Large Regulatory Agency

Financer: Private Equity Group

Designer: Blackburn and Others



Case History #1

4-Mile Long North Delta Levee



LARGE REGULATORY AGENCY:

Has extensive historical field and laboratory data on levees.

They recently designed a 7-mile long levee ~20-miles away. Their program included:

- 182 borings,
- 117 CPT's,
- 34 CU triaxial,
- 11 UU triaxial, and
- 49 1-D consolidation tests.

The agency took a conservative approach with settlement and strength for section design.



Case History #1

4-Mile Long North Delta Levee



Blackburn:

- Drilled 44 borings,
- Excavated 47 test pits and
- Performed many laboratory tests including CU, UU, and consolidation.



Case History #1

4-Mile Long North Delta Levee



SETTLEMENT

- We developed 4 critical cross sections.
- The worst of these 4 sections included soft clay zones from about 14' to 20' and 30' to 33' below existing ground.
- We calculated 5" to 6" of consolidation settlement.
- The large regulatory agency reviewed our work. They requested us to use one profile of continuous clay - yielding about 12" of consolidation settlement.



Case History #1

4-Mile Long North Delta Levee



STRENGTH:

- Blackburn developed cross sections through the levee for variable foundation conditions and tie-in locations.
- We based our strength data on laboratory tests for various soil types (fat clay, lean clay, clayey sand).
- The regulatory agency recommended lower in-situ and remolded strength parameters.
- While the more conservative approach didn't change the design sections, it sets a precedent for future projects and does not facilitate good engineering practice.



CHALLENGE

It's important to overcome the tendency for large agencies to apply generic “safe” data, when site specific data is available.



Case History #2

100 Miles of Levee



A large AE firm hired Blackburn to review 100-miles of levee.

Blackburn performed the preliminary evaluation. We walked the entire 100-miles, researched over 50-years of historical data and conducted interviews with RD and LD employees.



Case History #2

100 Miles of Levee

Through our research, site walks and interviews, we found and recorded 84 data points on the levee system, which included:

- Old seepage areas
- Boils
- Erosion areas
- Crown and slope subsidence areas
- Levee slumps and slides
- Sinkholes
- Levee penetrations

Case History #2

100 Miles of Levee

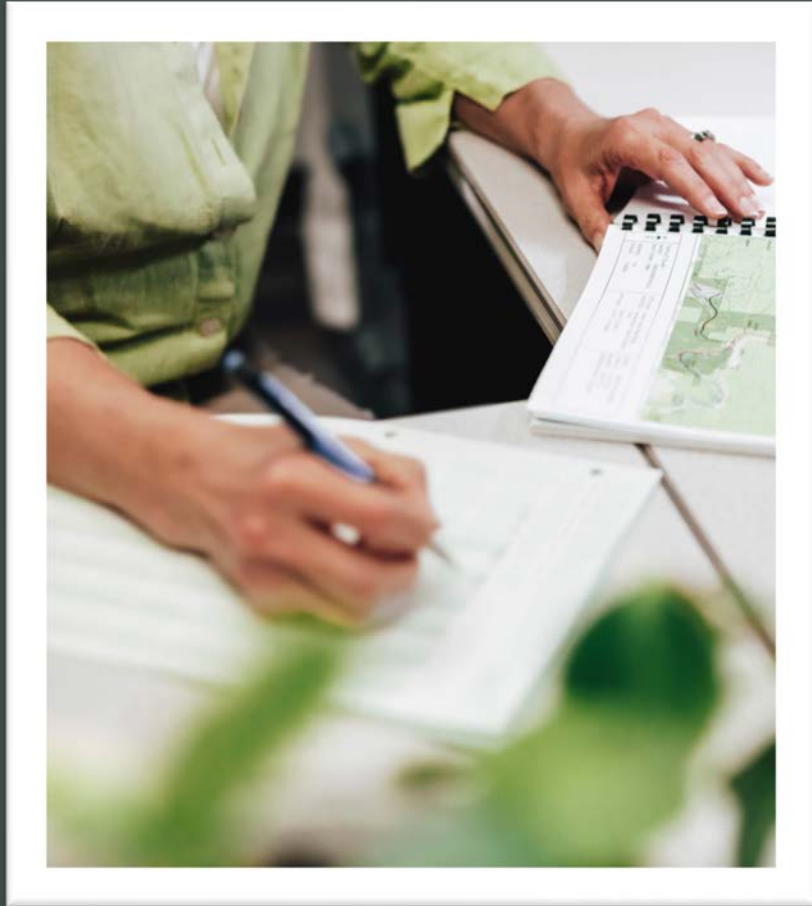


The second phase of work included a more in-depth look at the 100-miles of levee. The large AE firm chose another entity to do this second phase without our involvement.



Case History #2

100 Miles of Levee

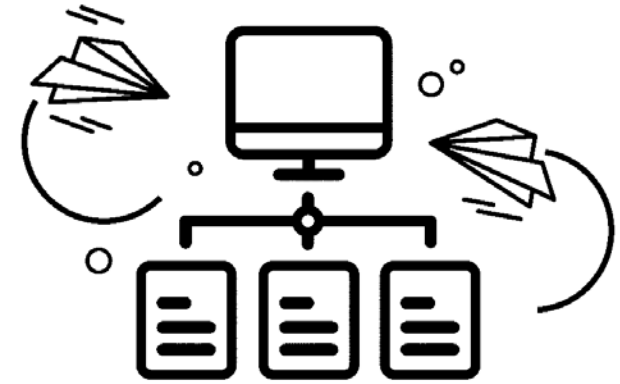


The third phase of work included senior reviews of the phase 2 work. I happened to be on the senior review panel that reviewed some of the levee segments – including our original phase 1 work for this 100-mile stretch of levee. The team that presented their Phase 2 work to us had never seen our phase 1 work.



What is Big Data?

- Information with such high volume, variety and velocity that it requires technology and analytical methods to transform it into something of value
- Huge amounts of frequently updated data in various formats
- Extremely large data sets that can be analyzed for trends, patterns and associations



Big Data Characteristics

- VOLUME
- VELOCITY
- VARIETY
- VERACITY

Feather River West Levee Project																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Project D, Earthwork QA Summary (TS 31 00 00)																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Date	No. QC Tests Performed	Test Result ID	Result of Test	Station	Elev.	Offset L/R	Feature	No. Tests	Lab Proctor (ASTM D 698/701)					Nuclear in-Place Density (ASTM D 698/701)					Sand Cone (ASTM D 1556)					Atterberg Limits (ASTM D 4318)					Gradation (ASTM D 421)																																																																																																																																																																																																																																																																																																																																																																																																																																	
									Proctor ID	Maximum Dry Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)	Wet Density (pcf)

Big Data Characteristics Application to Our Project

Volume

- Quantity of Data

Velocity

- Speed in which data is generated and processed

Veracity

- Type and nature of data

Variety

- Data quality and value



Big Data for a Small Firm



- **Borings/Test pits**
- **Laboratory tests**
- **Field tests**
- **Environmental contaminants**



Big Data CoMET Project



Feather River West Levee Testing Program

- Density Tests: 3,229
- Standard Proctors: 3,186
- Atterberg Limits: 2,564
- Sieve Analysis: 3,256
- Hydraulic Conductivities: 774
- Bentonite Slurry Tests (Viscosity, filtrates, pH, mud weight): 6,540
- Soil Bentonite Tests (unit weight, slump): 1,311
- Concrete Cylinders: 720

Background

- Miles of Levee: 29.6
- On and off-site laboratories
- Peak field staffing at 15 fulltime staff
- 6 days a week, 12 hours per day. Day and night shifts
- 50,155 labor hours



Big Data CoMET Project Continued



- Project Area A1, Future
- Project Area A2, Future
- Project Area B, 2014
- Project Area C, 2013
- Project Area D1, 2014
- Project Area D2, 2014
- Project Area D3, 2014
- No Levee Work Reaches



Challenges with Big Data



- Growing Pains
 - Slow ramp up
 - Real time results
 - Speeding up the process
 - Limits on lab system
 - Integrating our data system with clients
 - Making test results searchable
- Processing and Receiving Data
 - Field data
 - Lab data



Our Solutions

- Cloud based storage
- Test results summary
- Project management protocols
- Lab management system
- Integrating our system with clients
- Processing and disseminating test results from field and lab



On-Going Challenges



Project Management Challenges

- Coordination of test results
- Results ASAP
- Multiple reviewers
- Maintaining quality & meet time requirements

Cloud Based Storage Challenges

- Multiple reviewers
- Multiple file versions
- Access restrictions

Maintaining Quality

- Disconnected lab and field
- Changes to specifications



Lessons Learned



- Establish data management protocols
- Communication
- Set expectations (staff and client)
- Maintaining quality



QUESTIONS?



**Thomas Blackburn, PE, GE, F.
ASCE, F. ACEC**

Principal Geotechnical Engineer
tom@blackburnconsulting.com



www.blackburnconsulting.com



Bryce Moore

Director of Construction Services
brycem@blackburnconsulting.com