U.S. Department of Transportation
Federal Highway Administration

California Division

650 Capitol Mall, Suite 4-100
Sacramento, CA 95814
(916) 498-5001

February 6, 2013

In Reply Refer To:
HDA-CA

Mr. Malcolm Dougherty
Director
California Department of Transportation
1120 N Street
Sacramento, CA 95814

Subject: Gamma-Gamma Logging Peer Review Report

Dear Mr. Dougherty:

The Federal Highway Administration (FHWA) California Division is transmitting the attached Gamma-Gamma Logging Peer Review Report.

The Gamma-Gamma Logging (GGL) Peer Review Report was performed at your request. The review panel was made up of FHWA and non-Federal Subject Matter Experts (SMEs). Their task was to provide an objective review of the methodologies used by the Caltrans Gamma-Gamma Logging Data Integrity Review Team **(GamDat).**

The results of their work are summarized in the executive summary of the report. The peer review panel recommended Caltrans develop the following:

- A written Standard Operating Procedure (SOP) manual for GGL testing
- A formal training program for GGL technicians and engineers
- A systematic approach to archiving and maintaining the GGL test data
- A written quality control and quality assurance program for GGL testing

We anticipate working closely with Caltrans to assist in implementing the recommendations of the attached report.

If you have any questions on the report, please direct them to Mr. Christopher Long at (916) 498-5042 (Christopher.Long@dot.gov) of the Infrastructure Team within our office.

Sincerely,

Vincent P. Mammano
Division Administrator

GAMMA-GAMMA LOGGING PEER REVIEW
California Department of Transportation

Conducted September through December, 2012

By

FEDERAL HIGHWAY ADMINISTRATION

January 31, 2013

MEMBERS OF THE GAMMA-GAMMA LOGGING REVIEW PANEL

Silas Nichols, Principal Bridge Engineer
FHWA Office of Bridge Technology

Bob Crowder, President
R.E. Crowder Consulting, LLC

Benjamin Rivers, Geotechnical Engineer
FHWA Resource Center

W. Allen Marr, Chief Executive Officer
Geocomp Corporation

Mark Tufenkjian, Professor of Civil Engineering
California State University, Los Angeles

Fred Paillet, Adjunct Professor
University of Arkansas

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LIST OF ABBREVIATIONS

ASDE – After Survey Depth Error
Caltrans – California Department of Transportation
CIDH – Cast-in-Drilled Hole
CSU – California State University
DOT – Department of Transportation
DES – Division of Engineering Services
GGL – Gamma-Gamma Logging
GamDat – Gamma-Gamma Logging Data Integrity Review Team (Caltrans)
FHWA - Federal Highway Administration
FTB – Foundation Testing Branch
GS – Geotechnical Services
LAS – Log ASCII Standard File
NDT – Non-Destructive Testing
RD – Raw Data File
SME – Subject Matter Expert
SOP – Standard Operating Procedure
XLS – Microsoft Excel Spreadsheet Extension

1.0 EXECUTIVE SUMMARY

This report presents the commendations, findings, conclusions, and recommendations of a review of an in-depth analysis on gamma-gamma logging (GGL) data by an internal California Department of Transportation (Caltrans) Gamma-Gamma Logging Data Integrity Review (GamDat) Team. A review panel made up of Federal Highway Administration (FHWA) and non-Federal Subject Matter Experts (SMEs) was assembled by the FHWA to provide an objective review of the methodologies used by the Caltrans GamDat Team to analyze GGL data. The review process was initiated in response to concerns raised regarding evidence of GGL test data falsification, which occurred in September 2008, and subsequent public disclosure and legislative oversight hearings which occurred in November 2011.

Gamma-gamma logging is a non-destructive, post-construction test method for assuring quality of concrete placement in cast-in-hole drilled (CIDH) piles, also referred to as drilled shafts. In combination with quality construction and inspection practices, non-destructive testing (NDT) provides a tool for ensuring that an as-built foundation element satisfies the construction specifications and will perform as assumed in the design. A second use of NDT is to evaluate CIDH piles when there is reason to suspect that a defect exists. Gamma-gamma logging is the primary NDT method used by Caltrans as a part of quality assurance for these types of foundations.

The GamDat Team was assembled in December 2011 at the request of Caltrans' Structure Policy Board and tasked with conducting a comprehensive technical review of the integrity of GGL data collected in the State. The review included identifying and documenting all evidence of irregular or manipulated GGL data, conducting a fully transparent review considering the advice and review of external stakeholders, and identifying opportunities to strengthen Caltrans practice. The team is carrying out the work through development of sophisticated data analysis tools that subject all available testing records to a high level of scrutiny. The tools identify potential irregularities in the data collection and processing, which are then further examined through a manual analysis process by team members.

FHWA has reviewed the methodologies used by the GamDat Team and findings developed from the investigation. The team of FHWA and non-Federal SMEs conducted a comprehensive literature review of the materials provided and met with the GamDat Team. The external review was performed to assess Caltrans' test procedures and practices for performing GGL testing; and to evaluate the analysis methodology developed by the Caltrans GamDat Team to discover potentially irregular GGL test files. The review was conducted during the months of September through December 2012.

An overall summary of the GamDat results are shown in Table 1. The primary findings of the review panel are that the GamDat Team has reasonably and comprehensively searched, compiled, and cataloged all available electronic GGL data files. The suite of analysis tools developed and applied to the GGL data files has to a high degree of certainty uncovered any data irregularities. The suspect rate of the GGL files searched is exceptionally low and would

generally be considered as an acceptable rate of defects in quality assurance testing. The results of the GamDat investigation has shown no appearance of systemic or unit-wide intention of data falsification, or a pattern in the types of projects targeted. Ten (10) out of the eleven (11) identified cases involved the same technician. The results do not suggest that there is a safety risk to the traveling public.

Table 1. Summary of GamDat Results

Discovered GGL Data files	Unique GGL Data Files	Date-Matched GGL Data Files	Irregular GGL Data Files	Cases Established	Data Set Completeness	Suspect Rate
224,104	22,944	17,194	20	11	75%	0.1%

The GamDat team is commended for packaging several screening tools into quality control processes to prevent issues with falsification of GGL data or improperly generated data files in the future. The data check tool was launched in October 2012, and combined with a GamDat team recommendation to eliminate field generated MSLog ASCII Standard (LAS) files, should greatly reduce a technician's ability to manipulate data files. The review team recommends that Caltrans continue its focus on future prevention measures including those outlined in this report.

A detailed explanation of each finding and recommendation is contained in Section 4 of this report. In summary, Caltrans should consider developing the following:

- A written Standard Operating Procedures (SOP) manual for GGL testing.
- A formal training program for GGL technicians and engineers.
- A systematic approach to the archiving and maintenance of GGL test data.
- A written quality control and quality assurance program for GGL testing.

2.0 INTRODUCTION

In response to concerns regarding the handling of evidence of GGL data falsification that occurred in September 2008, and the subsequent public disclosure and State of California legislative oversight hearings in November 2011, a team of Caltrans engineers (GamDat Team) was formed by the Caltrans Structural Policy Board to review the integrity of their archived GGL test data. A technical investigative report of their findings is currently being finalized.

In conjunction with that effort, the Federal Highway Administration (FHWA) assembled an external review panel (GGL Review Panel) in August of 2012 for the purpose of reviewing Caltrans' test procedures and practices for conducting GGL tests used for quality assurance during construction of CIDH concrete piles. The review panel collectively consisted of SMEs in field testing, data acquisition and management, and down-hole geophysical testing using GGL. The review panel was joined by FHWA geotechnical experts and a civil engineering professor who served as report writer. The team members are identified in Table 2 below.

Table 2. Members of GGL Review Panel

Name	Affiliation	Title
Silas Nichols	FHWA Headquarters	Geotechnical Engineer
Ben Rivers	FHWA Resource Center	Geotechnical Engineer
Bob Crowder*	R.E. Crowder Consulting	Consultant
W. Allen Marr*	Geocomp Corporation	Chief Executive Officer (CEO)
Fred Paillet*	University of Arkansas	Adjunct Professor
Mark Tufenkjian	CSU, Los Angeles	Professor of Civil Engineering Author of GGL Report

*Subject Matter Experts (SMEs)

The objectives of the FHWA GGL Peer Review were to:

1. Evaluate Caltrans' current test procedures and practices for conducting GGL tests.

2. Perform a technical evaluation of the analysis methodology used by the Caltrans GamDat Team to discover data irregularities among GGL test files.

3. Provide constructive recommendations for improvements that can be made to the GamDat Team's analysis methodology.

3.0 GGL PEER REVIEW FORMAT AND PROCEDURES

The GGL Peer Review was conducted between September and December 2012. A related, but separate review of the Caltrans Foundation Testing Branch was also conducted concurrently by another review panel assembled by FWHA.

An initial web conference kickoff meeting was followed by four webinars and one face-to-face meeting of the GGL Peer Review Panel at Caltrans Headquarters (Trans Lab) in Sacramento, CA. Table 3 below outlines the review team meeting schedule.

Table 3. Type, Location, and Date of Review Meetings

Meeting Type	Meeting Place	Date
Kickoff Meeting	Webinar	September 5
Teleconference	Webinar	September 17
Face-to-Face	Caltrans HQ (Trans Lab)	September 27
Teleconference	Webinar	October 17
Teleconference	Webinar	November 14
Teleconference	Webinar	December 6

The face-to-face meeting was one day in duration and held concurrently with the Peer Review Team evaluating the Caltrans Foundation Testing Branch. Each meeting included discussions with the Caltrans GamDat Team on the status of their investigation and dialogue about methods and procedures related to GGL testing and their analysis methodology to discover

data irregularities among their GGL test files. During the September 27, 2012 face-to-face meeting, an outdoor demonstration of GGL test equipment was performed at the Trans Lab test facility. The purpose of the demonstration was to show the panel how Caltrans GGL probes are calibrated and how a GGL test is performed from beginning to end. Photographs from the test demonstration are shown in the Appendix.

Much of the information used to evaluate Caltrans' GGL test procedures and practices was derived from information shared at the meetings, as well as by examining documents provided to the review panel. These documents included portions of the GamDat Team's preliminary draft report, PowerPoint presentations, GamDat status reports, and Caltrans' GGL test manual. A complete list of the reviewed documents is shown in the Appendix.

The meeting agendas, list of meeting participants, and information about summary meeting notes compiled from each meeting is also shown in the Appendix.

The Peer Review Team wishes to express its appreciation to members of the GamDat Team for their time and cooperation with this effort. The team was impressed with the professional manner and cooperation of all of the Department personnel who participated in this review.

4.0 OVERALL RESULTS

This section details the review panel's Commendations, Findings, Conclusions, and Recommendations. The Findings associated with each Conclusion and Recommendation provides the background information and rational as to why the recommendation is being made.

4.1 Commendations

- The GamDat Team is comprised of highly competent individuals with the expertise to carry out the tasks identified in their charter.

- The GamDat team is to be commended for packaging several screening tools into quality control processes to prevent issues with falsification of GGL data or improperly generated data files in the future.

- The GamDat Team is to be commended for their thoroughness in retrieving and reviewing the available GGL data, their development of a suite of sophisticated diagnostic tools to detect potentially irregular data files, and their persistence to identify all possible anomalies in data sets without restriction.

- The GamDat Team is to be commended for being forthcoming and open with the GGL Review Panel. The Review Panel felt that the GamDat Team was honest in their approach and worked in an independent and unbiased manner.

4.2 Findings, Conclusions, and Recommendations

Finding 1:

The GamDat Team has reasonably and comprehensively searched, compiled, and cataloged all available electronic GGL data files from a variety of sources. They located and identified a total of 224,104 data files associated with GGL testing covering an 18-year time period (1994-2011). These were reduced to 17,194 unique data files that could be date-matched to 22,944 reported GGL tests. Therefore, their data set completeness (defined as the date-matched data files found divided by the reported tests; i.e. 17,194/22,944) is about 75%. This leaves 5,750 files (22,944 – 17,194 = 5,750) that could not be date-matched against the reported files. The data set completeness is remarkable considering they did not have a means of systematically archiving data over the 18-year timeframe.

The GamDat Team has also developed and applied a creative and appropriate suite of screening tools to evaluate each GGL data file in sufficient detail to uncover any suspect data to a reasonable degree of certainty. The primary analyses techniques developed to identify irregularities are: pattern matching, calibration constant, depth consistency, fidelity, and time stamp.

Further, GGL data sets were collected in three electronic file formats: Logshell (LS); MSLog Raw Data (RD); and MSLog ASCII Standard (LAS). The LS data acquisition system and format was discontinued by Caltrans in 2003 and replaced with MSLog RD and LAS file formats. No apparent data irregularity issues were observed with the data in the LS format. The integrity of the MSLog RD files (when preserved) is easy to check and is nearly impossible to falsify because it is encoded in hexadecimal format. The only irregularities discovered have occurred with alteration or manipulation of data saved in the LAS format.

Conclusion and Recommendation 1:

Additional effort to locate, identify, and analyze any missing data files has reached the point of diminishing returns. A significant amount of person months of labor would be required to locate any additional data files and further filter the data, and would result in a low possibility of uncovering any issues not already identified.

The suite of screening tools developed by the GamDat team has to a high degree of certainty discovered potential data irregularities. While it may be possible for other data irregularities to exist, it may be impossible to uniquely identify them due to nuclear statistics associated with the test equipment and data collection process. Caltrans will be better served to focus on future prevention measures given in this report.

Finding 2:

The GamDat Team discovered a total of 20 GGL data files containing an irregularity. Assuming a conservative estimate of 17,194 GGL files as the data set, this corresponds to a suspect rate of about 0.1% (20/17,194), which is an exceptionally low rate that would generally be considered as an acceptable rate of defects in quality assurance testing.

Expressed differently, the rate of suspect files is about 1:850. Therefore, using this ratio for the remaining 5,750 GGL tests in which date-matched data files could not be located, the expected number of suspect files would be about seven with less than 10% chance of there being eight or more. The consequence of not locating these possible additional files can be considered as acceptably low.

The GamDat Team identified eleven (11) cases that indicated irregularities in files flagged by the screening analysis tools as shown in Table 4 below. These 11 cases represent 20 GGL data files and one Excel file. Nine of the cases have been grouped according to project location (Cases 3 through 11), while the other two cases represent data files obtained during equipment calibration procedures (Cases 1 and 2). Three of the identified cases were known prior to GamDat's investigation and can be traced back to a single technician. Seven out of the other eight cases also involved the same technician.

Table 4. Summary of Suspect Cases

Case	GamDat ID Number	Number and Type of Irregular Data Files	Issue as Reported by GamDat Team
1	2, 15	9 LAS	Data duplicated, replaced and deleted for testing of Standard Reference Block.
2	4	1 LAS	Altered density and gamma count data in calibration file.
3	10	1 LAS	Irregular testing chronology indicating plausible retest.
4	11	1 LAS	Irregular testing chronology indicating plausible retest.
5	12	2 LAS	Duplicated, replaced, and deleted data.
6	13	2 LAS	Duplicated and replaced data.
7	17	1 LAS	Irregular testing chronology indicating likely retest.
8	18	1 LAS	File rename.
9	33	1 LAS	Plausible retest.
10	52	1 LAS	File rename.
11	76	1 XLS	Irregular testing chronology and duplicated data.

Conclusion and Recommendation 2:

The GamDat Team's work has shown no systematic or unit-wide intention of data falsification, nor pattern in the types of projects targeted. Rather, all but one of the cases indicates isolated instances where a single technician may have been indolent or careless in their duties during testing. Further, the mechanisms of irregularity in each case are common and have been specifically identified as either copy/paste/deletion of blocks of recorded data; renaming of a test file to represent another test file; or manual alterations to recorded data.

Caltrans should consider developing a written Standard Operating Procedures (SOP) manual for GGL testing. The SOP manual should provide a systematic approach to checking equipment, running the test and recording data. It also needs to describe how to identify and handle errors, anomalous results, equipment issues, and unusual test conditions. Once developed, the manual should be fastidiously used and updated as necessary. The manual should be a part of an overall set of practices and procedures for training, calibration, assigning tests, recording project information, running the tests, managing the data reduction and evaluation, reporting

of results, and archiving of the work. Adoption and enforcement of the SOP manual would help in avoiding similar data falsification issues in the future.

Finding 3:

GGL operators are typically trained by apprenticeship with available personnel at the time of training. This results in a lack of consistency in training in GGL testing and data collection procedures. There was no evidence of a formal training period or criteria to know when their training was finished. There was no evidence that GGL operators were advised about how to handle field testing issues or what procedures should be followed for unusual testing conditions. There appears to be rapid turnover of GGL operators with most having less than a few months of experience.

There also appeared to be disconnection between the GGL operator's test routine and what is understood by the supervising engineers. This disconnect was apparent during the field demonstration when the GGL operator indicated that all operators "free-spool" the winch while lowering the probe down-hole instead of at a controlled winch-powered down rate, which was unknown to the engineers using the data. This technique can result in depth errors and impact file timing/chronology besides risking damage to the equipment.

Conclusion and Recommendation 3:

Caltrans should consider developing and using a formal training program for GGL technicians and engineers. Caltrans should improve training and maintenance for the technicians conducting GGL testing to ensure consistency in testing and data collection procedures. Formal training criteria should be established and documented that includes a written and hands-on testing assessment component to ensure GGL operators are proficient and adequately trained. Ideally, a single individual should be in charge of training to ensure consistency and periodic verification that the testing is being performed in compliance with Caltrans procedures and practices. Engineers involved in data evaluation and reporting should be involved in a training program as well.

Finding 4:

Maintenance and archiving of GGL test data appears inadequate for efficient access and review. Although the GamDat Team was able to retrieve and analyze a large number of tests spanning approximately 18 years, the effort expended by the team was substantial and time consuming. There is no central repository for GGL test data or other types of tests, and there appears to be no system in place to ensure that the test data are properly collected and maintained. In addition, there appears to be no policy for keeping and maintaining test data over a specific timeframe.

Conclusion and Recommendation 4:

Caltrans should develop a systematic approach to the archiving and maintenance of their GGL test data. The benefit will be a centralized system to provide comprehensive data quickly to address issues such as those found in this study with much less cost and time. A centralized

information storage and retrieval system will also provide a powerful tool to support improvements in the quality control, quality assurance, and work practices of all GGL activities.

A central repository for all test data should be considered that includes an organized system of document labeling and identification (numbering and indexing). A standard file contents directory is also recommended (e.g., Raw Data [RD], Log ASCII Standard [LAS], and an engineer's report file).

Finding 5:

There appears to be a lack of quality assurance and quality control of the collected GGL data in the field. For example, it was not apparent that the GGL technicians understood good data from bad data or anomalous tubes from good tubes (e.g., what is an acceptable number of data errors?). It appears that most of the logging checklists are recorded by an engineer after the data is collected and are not witnessed. Suggested improvements in operating practices include the following:

- More frequent calibration checks (at least at start and end of each project).
- A second log standardization model representing a lighter density material is needed for field checks. Additionally, field checks need to be based on the standard deviation of log of count rates and not the standard deviation of the count rates alone.
- Documentation of cable re-heads along with a complete repair history for each probe and logger needs to be maintained.
- The software header design should be updated to better suit Caltrans' needs. The header should require only the pertinent information for achieving and interpreting the GGL test data. An error message should be generated if the operator fails to update the header field from the previous probe run.
- Consider using automation for collecting and processing of data in the field and office, which would circumvent the need for intermediate LAS data files. Consider submission of a field verified and signed printed paper copy (Field Log Print) along with the raw data files to a central processing engineer.
- The after survey depth error (ASDE) should be recorded.
- Immediate GGL operator feedback on data is needed to catch any obvious errors (e.g., equipment malfunction or data transmission glitches, lapses in documentation, etc.).
- Consider re-logging any piles that show anomalous zones in a tube.

- Document GGL tube location and conditions by using photographs taken at the time of logging and include them on the final processed logs. Consider using foam markers to identify tubes prior to grouting.

Conclusions and Recommendation 5:
Caltrans should develop and adhere to a written quality control and quality assurance program for the GGL activity. The State Quality Assurance Plan (QAP) should include an overall set of practices and procedures for training, calibration, assigning tests, recording project information, running the tests, managing the data reduction and evaluation, reporting of results, and archiving of the work.

APPENDIX

1. Meeting Agendas – FHWA GGL Panel Review.
2. List of Meeting Participants.
3. GGL Test Demonstration.
4. List of Reference Material Reviewed.
5. Summary Notes from GGL Panel Review Meetings.

1. Meeting Agendas – FHWA GGL Panel Review

September 5, 2012 (with FTB Peer Review Panel)
Kick-Off Meeting by Teleconference
8:00 am to 10:00 am

- Welcome and Introductions
- Overview and Purpose of Review Panels
- Team Roles and Responsibilities
  - Peer Review Panel
  - GGL Review Panel
- Read Ahead Materials and Meeting Preparation
- Final Report Development
- Meeting Scheduling

September 17, 2012
Webinar Teleconference No. 1
10:00 am to 12:00 pm

- Caltrans introduction of the GamDat team and its work in more detail.
- Answer any questions that the GGL review panel has on initial information provided.
- Receive direction on material to be reviewed in advance of the face-to-face meeting.

September 27, 2012 (with FTB Peer Review Panel)
Caltrans Trans Lab
Sacramento, California
8:00 am to 5:00 pm

- Welcome/Goals for Meeting
- Discussion on Gamma-Gamma Testing
- Outdoor Demonstration of Gamma-Gamma Testing
- GamDat Analysis Methods, Results, and Significant Findings
- GamDat Analysis Methods, Results, and Significant Findings
- Summary, Action Items for GGL Review Team, Next Meeting Scheduling

October 17, 2012
Webinar Teleconference No. 2
9:00 am to 11:00 am

- Overview of Correlation Methods; An Empirical-Based Approach
- Application of Retest Discrimination Method
- Discussion/Action Items/Questions from Last Meeting

November 14, 2012
Webinar Teleconference No. 3
8:00 am to 9:00 am

- Summarize information collected from presentations and documentation provided by Caltrans
- Outline a draft report

December 6, 2012
Webinar Teleconference No. 4
12:00 pm to 2:00 pm

- Discussion of GGL Panel Draft Report Version 1.
- Draft report revisions.

2. List of Meeting Participants

FHWA GGL PANEL REVIEW
September 5, 2012; Joint Teleconference with FHWA FTB Peer Review Panel

Anderson, Scott	Geotechnical Technical Service Team Manager, FHWA Resource Center
Brittsan, Doug	Senior Transportation Engineer, Foundation Testing Branch, Caltrans
Castellanos, Juan	State Construction Geotechnical Engineer, Florida DOT
Crowder, Robert	R.E., Crowder Consulting
Cuthbertson, Jim	Chief Foundation Engineer, Washington DOT
Dasenbrock, Derek	Geomechanics Engineer, Minnesota DOT
Dunbar, Christine	Managing Director, DRT Strategies
Hickerson, Clara	Project Manager, DRT Strategies
Kolle, Greg	Infrastructure Team Leader, FHWA California Division
Lawndy, Laura	Program Administration, FHWA Office of Asset Management
Marinucci, Tony	Director of Operations, ADSC
Marr, Allen	Chief Executive Officer, Geocomp Corporation
McLain, Kevin	Geotechnical Engineer, Missouri DOT
Newton, Barton	State Bridge Engineer, Caltrans
Nichols, Silas	Principal Geotechnical Engineer, FHWA Headquarters
Paillet, Fred	Adjunct Professor, University of Arkansas
Rajendra, Shira	Chief, Office of Geotechnical Support, Caltrans
Rivers, Ben	Geotechnical Engineer, FHWA Resource Center
Roblee, Cliff	Senior Research Engineer, Division of Research & Innovation, Caltrans
Roe, John	Corporate Vice President, Malcolm Drilling
Skeen, Sarah	Structural Engineer, FHWA California Division
Slomski, Stephen	Foundation Engineering Coordinator, Ohio DOT
Stolarski, Phil	Chief, METS&GS, Caltrans
Tufenkjian, Mark	Professor of Civil Engineering, CSULA
Turner, Loren	Senior Transportation Engineer, Division of Research & Innovation, Caltrans

FHWA GGL PANEL REVIEW
September 17, 2012
Teleconference; Webinar No. 1

Crowder, Robert	R.E., Crowder Consulting
Flores, Emilio	Auditor, Audits & Investigations, Caltrans
Hannenian, Craig	Senior Transportation Engineer, Geotechnical Services, Caltrans
Morgan, Mike	Engineering Geologist, Caltrans
Newton, Barton	State Bridge Engineer, Caltrans
Nichols, Silas	Principal Geotechnical Engineer, FHWA Headquarters
Paillet, Fred	Adjunct Professor, University of Arkansas
Rajendra, Shira	Chief, Office of Geotechnical Support, Caltrans
Rivers, Ben	Geotechnical Engineer, FHWA Resource Center
Skeen, Sarah	Structural Engineer, FHWA California Division
Stolarski, Phil	Chief, METS&GS, Caltrans
Tufenkjian, Mark	Professor of Civil Engineering, CSULA
Turner, Loren	Senior Transportation Engineer, Division of Research & Innovation, Caltrans
Wahleithner, Jason	Engineer, Foundation Testing Branch, Caltrans
Zhu, Yang	Software Materials Engineer, Alta Vista Solutions

FHWA GGL PANEL REVIEW
September 27, 2012
Joint Meeting with FHWA FTB Peer Review Panel
Caltrans Trans Lab
5900 Folsom Boulevard, Sacramento, CA

Crowder, Bob	R.E., Crowder Consulting
Cuthbertson, Jim	Chief Foundation Engineer, Washington DOT
Dasenbrock, Derek	Geomechanics Engineer, Minnesota DOT
Flores, Emilio	Auditor, Audits & Investigations, Caltrans
Hannenian, Craig	Senior Transportation Engineer, Geotechnical Services, Caltrans
Marinucci, Tony	Director of Operations, ADSC
Marr, Allen	Chief Executive Officer, Geocomp Corporation
McLain, Kevin	Geotechnical Engineer, Missouri DOT
Morgan, Mike	Engineering Geologist, Caltrans
Newton, Barton	State Bridge Engineer, Caltrans
Nichols, Silas	Principal Geotechnical Engineer, FHWA Headquarters
Paillet, Fred	Adjunct Professor, University of Arkansas
Rajendra, Shira	Chief, Office of Geotechnical Support, Caltrans
Rivers, Ben	Geotechnical Engineer, FHWA Resource Center
Roblee, Cliff	Senior Research Engineer, Division of Research & Innovation, Caltrans
Skeen, Sarah	Structural Engineer, FHWA California Division
Slomski, Stephen	Foundation Engineering Coordinator, Ohio DOT
Tufenkjian, Mark	Professor of Civil Engineering, CSULA
Zhu, Yang	Software Materials Engineer, Alta Vista Solutions

FHWA GGL PANEL REVIEW
October 17, 2012
Teleconference; Webinar No. 2

Crowder, Robert	R.E., Crowder Consulting
Flores, Emilio	Auditor, Audits & Investigations, Caltrans
Hannenian, Craig	Senior Transportation Engineer, Geotechnical Services, Caltrans
Marr, Allen	Chief Executive Officer, Geocomp Corporation
Morgan, Mike	Engineering Geologist, Caltrans
Nichols, Silas	Principal Geotechnical Engineer, FHWA Headquarters
Paillet, Fred	Adjunct Professor, University of Arkansas
Rajendra, Shira	Chief, Office of Geotechnical Support, Caltrans
Rivers, Ben	Geotechnical Engineer, FHWA Resource Center
Roblee, Cliff	Senior Research Engineer, Division of Research & Innovation, Caltrans
Skeen, Sarah	Structural Engineer, FHWA California Division
Tufenkjian, Mark	Professor of Civil Engineering, CSULA
Turner, Loren	Senior Transportation Engineer, Division of Research & Innovation, Caltrans
Zhu, Yang	Software Materials Engineer, Alta Vista Solutions

FHWA REVIEW OF FOUNDATION TESTING BRANCH
November 14, 2012
Teleconference, Webinar No. 3

Crowder, Robert	R.E., Crowder Consulting
Nichols, Silas	Principal Geotechnical Engineer, FHWA Headquarters
Paillet, Fred	Adjunct Professor, University of Arkansas
Rivers, Ben	Geotechnical Engineer, FHWA Resource Center
Skeen, Sarah	Structural Engineer, FHWA California Division
Tufenkjian, Mark	Professor of Civil Engineering, CSULA

FHWA REVIEW OF FOUNDATION TESTING BRANCH
December 6, 2012
Teleconference, Webinar No. 4

Crowder, Robert	R.E., Crowder Consulting
Long, Chris	Infrastructure Team Leader, FHWA California Division
Nichols, Silas	Principal Geotechnical Engineer, FHWA Headquarters
Paillet, Fred	Adjunct Professor, University of Arkansas
Rivers, Ben	Geotechnical Engineer, FHWA Resource Center
Skeen, Sarah	Structural Engineer, FHWA California Division
Tufenkjian, Mark	Professor of Civil Engineering, CSULA

3. GGL Test Demonstration

An outdoor demonstration of GGL test equipment was conducted during the September 27, 2012 meeting at the Trans Lab test facility. The purpose of the demonstration was to show how Caltrans' GGL probes are calibrated and then using a pre-installed test shaft, a GGL test was simulated from beginning to end. Photographs from the test demonstration are shown below.

GGL Spool, Winch, Data Acquisition System.

GGL Test Demonstration on Pre-Installed Shaft.

Concrete Calibration Samples.

Influence of Determination Unit (IDU) used to find Radius of Detection for a Gamma-Gamma Probe.

4. List of Reference Material Reviewed

1. Draft Final Report, Caltrans GamDat Team; prepared by The Gamma-Gamma Logging Data Integrity Review (GamDat) Team; dated November 2012, 560 pages.
2. "Application of Retest Discrimination Method: Summary of Initial Findings for GamDat Potential Irregularity ID's," by Cliff Roblee, dated October 14, 2012.
3. Draft GamDat Terminology List.
4. RD Extension File Example
5. LAS Extension File Example
6. T1 Extension File Example
7. "Interim Report to Sponsors for Task 5, Automated Screening Analyses of All Available GGL Tests for Potential Irregularities"; Memorandum; dated July 27, 2012; 5 pages.
8. "Status of Work of the GamDat Team," Memorandum; dated June 28, 2012; 5 pages.
9. GamDat Team Charter; Gamma-Gamma Logging Data Integrity Review Team, California Department of Transportation, dated December 21, 2011.
10. Gamma-Gamma Logging (GGL), FAQ, dated October 14, 2003; 8 pages. http://www.dot.ca/gov/hq/esc/geotech/ft/gamma.htm
11. "Method of Ascertaining the Homogeneity of Concrete in Cast-in-Drilled-Hole (CIDH) Piles Using the Gamma-Gamma Test Method," Department of Transportation Division of Engineering Services, California Test Method 233, dated November 2005; 21 pages.
12. Gamma-Gamma Logging (GGL), Test Method, Proactive Measures, Checklists and Field Report, Testing Special Provision, Probe Calibration, Typical Report; Foundation Testing Branch Manual; undated.
13. Gamma-Gamma Logging Data Integrity Review (GamDat) Team, Briefing for the FTB Status Meeting; PowerPoint Presentation, February 2, 2012; by Loren Turner.
14. Gamma-Gamma Logging Data Integrity Review (GamDat) Team, Briefing on Current Status of Work for the Toll Bridge Seismic Safety Peer Review Panel; PowerPoint Presentation, August 20, 2012; by Loren Turner.
15. "Gamma-Gamma Logging Acceptance Test Results: CIDH Pile 3C at Bent 3; File 05-Mon-1-PM21.3/21.6; 05-0E9604; Pitkins Curve Bridge; Bridge No. 44-0290; dated September 16, 2010.
16. Gamma-Gamma Logging Data Integrity Review (GamDat) Team, Briefing for the GamDat Advisory Team; PowerPoint Presentation, September 17, 2012; by Loren Turner.
17. Gamma-Gamma Logging Data Integrity Review (GamDat) Team, Briefing; PowerPoint Presentation, September 27, 2012.
18. "Procedures For Determination of Density Precision and Sampling Time for a Gamma-Gamma Probe;" California Department of Transportation, Division of Engineering Services, Foundation Testing Branch, by Brian Liebich, dated October 2002; 15 pages.
19. Overview of Retest Discrimination Methods, PowerPoint Presentation, September 17, 2012, by Cliff Roblee.
20. Correlation Approach, PowerPoint Presentation, September 17, 2012, by Loren Turner.

5. Summary Notes from GGL Panel Review Meetings

Summary notes were prepared at the conclusion of each teleconference webinar and face-to-face meeting. These notes included items such as meeting place, attendance list, agenda, action items, and a summary of information shared and discussed at the meeting.

These notes may be obtained upon request from FHWA:

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