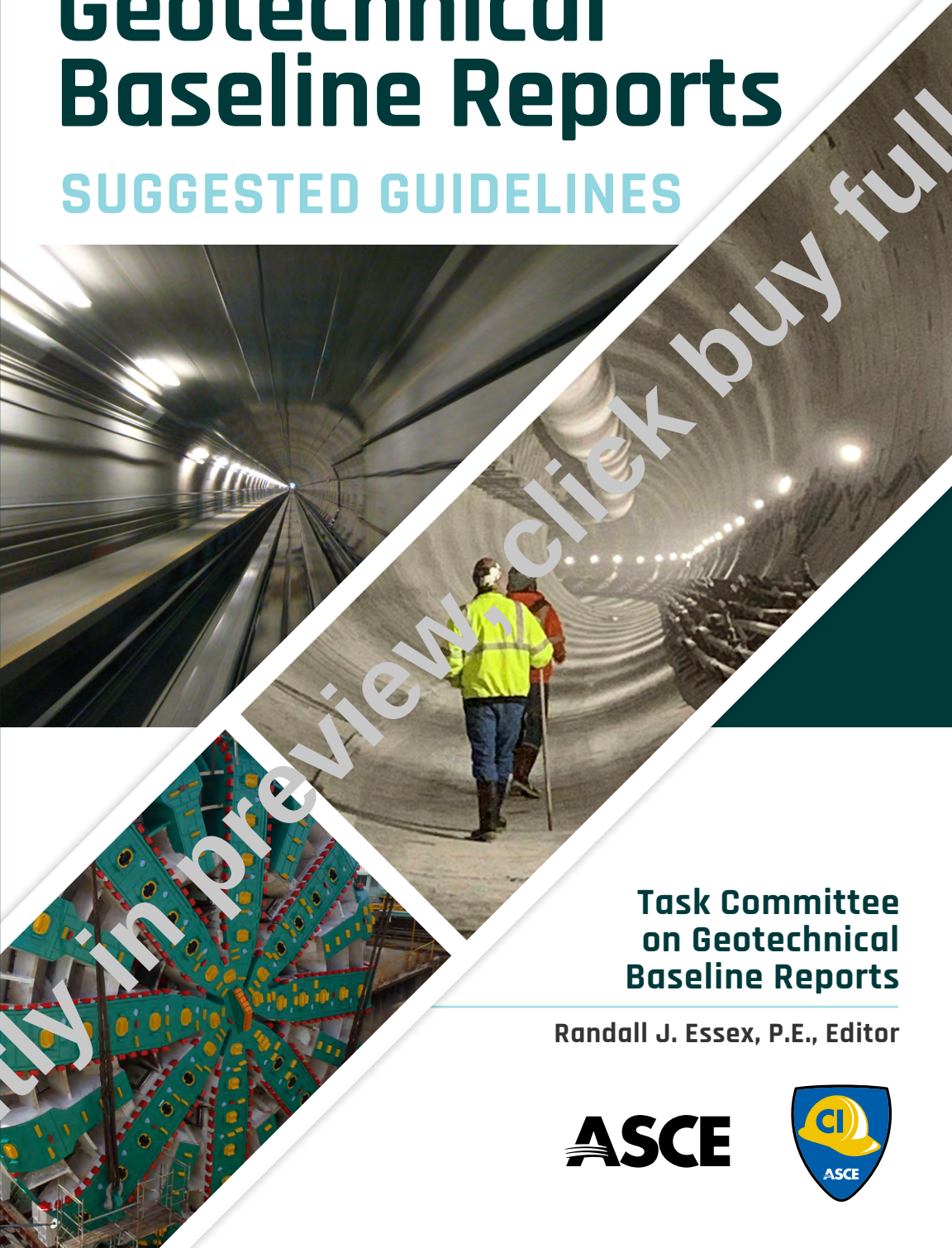
ASCE Manuals and Reports on Engineering Practice No. 154

Geotechnical Baseline Reports

SUGGESTED GUIDELINES



Task Committee on Geotechnical Baseline Reports

Randall J. Essex, P.E., Editor

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Geotechnical Baseline Reports

Other Titles of Interest

Geotechnical Testing, Observation, and Documentation, 3rd Edition, by Tim Davis. (ASCE Press, 2022). This book provides an in-depth field manual for soil technicians, inspectors, and geotechnical engineers for use during the investigation, grading, and construction phases of geotechnical projects. (ISBN 978-0-7844-1604-4)

The Engineer's Project Delivery Method Primer: Uniform Definitions and Case Studies by Douglas Gransberg, Michael Loulakis, and Ghada Gad. (ASCE Press, 2022). This book defines prevalent terms in the US design and construction industry and provides diagrams that explain the Big Three fundamental project delivery methods, visually displaying each method's contractual relationships among the owner, design, and contractor. (ISBN 978-0-7844-1601-3)

Construction Quality in the Alternate Project Delivery Environment, by Tara L. Cavalline, Dennis Morian, and Clifford J. Schexnayder. (ASCE Press, 2021). This book provides detailed guidance on all aspects of construction quality in the heavy/highway, building, and industrial fields. (ISBN 978-0-7844-1582-5)

Construction Contract Claims, Changes, and Dispute Resolution, 3rd Edition, by Paul Levin. (ASCE Press, 2016) Paul Levin and a team of construction experts and attorneys guide contractors, engineers, owners, and construction managers through the complex process of construction contracting, focusing on claims and change orders in construction projects. (ISBN 978-0-7844-1429-3)

Identifying, Quantifying, and Proving Loss of Productivity, ASCE/CI Standard 71-21 (ASCE, 2021) This standard provides guidance on tracking and measuring labor productivity to help prevent, mitigate, and recover cost overruns and loss of productivity disputes and claims. (ISBN 978-0-7844-1549-0)

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Suggested Guidelines

Prepared by the
Task Committee on Geotechnical Baseline Reports

Edited by
Randall J. Essex, P.E.

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MANUALS AND REPORTS ON ENGINEERING PRACTICE

Manuals or reports in this series generally consist of an orderly presentation of facts on a particular subject, supplemented by an analysis of limitations and applications of these facts. In the case of this Manual of Practice book, the contents involve a presentation of experience and recommendations based on those experiences, rather than facts. It is not in any sense a "standard," however, nor is it so elementary or so conclusive as to provide a "rule of thumb" for the uninformed.

(As developed by the ASCE Technical Procedures Committee, July 19[illegible], and revised March 1935, February 1962, and April 1982).

[M]aterial in this series, in distinction from a paper (which expresses only one person's observations or opinions), is the work of a committee or group selected to assemble and express information on a specific topic. As often as practicable, the committee is under the direction of one or more of the Technical Divisions and Councils, and the product evolved has been subjected to review by the Executive Committee of the Division or Council. As a step in the process of this review, proposed manuscripts are often brought before the members of the Technical Divisions and Councils for comment, which may serve as the basis for improvement. When published, each manual shows the names of the committee members by which it was compiled and indicates clearly the several processes through which it has passed in review, so that its merit may be definitely understood.

In February 1962 (and revised in April 1982), the Board of Direction voted to establish a series titled "Manuals and Reports on Engineering Practice" to include the manuals published and authorized to date, future Manuals of Professional Practice, and Reports on Engineering Practice. All such manual or report material of the Society would have been refereed in a manner approved by the Board Committee on Publications and would be bound, with applicable discussion, in books similar to past manuals. Numbering would be consecutive and would be a continuation of present manual numbers. In some cases of joint committee reports, bypassing of journal publications may be authorized.

DEDICATION TO AL MATHEWS

Previous editions of this book were dedicated to Eugene B. Waggoner and James P. Gould, who were industry leaders in the application of engineering geology and geotechnical engineering principles that overcame challenges in underground construction. This third edition is dedicated to Al Mathews, a leader in the development of improved contracting practices that have helped to avoid and resolve construction disputes without resorting to costly litigation.

Albert A. Mathews was born in Pentwater, Michigan, on June 15, 1915 and passed away on August 17, 2007. He received a BS degree with honors in Mining Engineering in 1936 from the Michigan College of Mining and Technology. He was a registered professional engineer in nine states. Al had a diversified career in the mining and construction industries before starting his own consulting firm in Arcadia, California, in 1953. A.A. Mathews, Inc. specialized in heavy construction projects including the Pennsylvania Turnpike tunnels, underground powerhouses in Oroville, California, Churchill Falls, Labrador, and Portage Mountain, British Columbia; dams in Oregon, Washington, Texas, Philippines, New Zealand, and Pakistan; water system tunnels in Austin, New York City, and Buenos Aires; and subway systems in Washington, DC, San Francisco, and Mexico City.

In 1972, the U.S. National Committee on Tunneling Technology sponsored a study of contracting practices throughout the world to develop recommendations for improved contracting methods in the United States. Al served as chairman of the Steering Group that led the study. The results were published in 1974 as the cornerstone document "Better Contracting for Underground Construction." The publication became a catalyst for change and many consulting engineers and project owners adopted its recommendations.

In 1975, Al Mathews served on the first Dispute Review Board, assembled for the Eisenhower Memorial Tunnel on I-70 in Colorado. Other successful DRBs followed, and soon, other sectors of the construction

industry began to recognize the unique features of DRBs for avoiding and resolving disputes. As a troubleshooter, Al was called to complete the First Wilson Tunnel in Hawaii after a collapse during construction; to attend to the Carmen Smith diversion tunnel in Oregon after it encountered unprecedented water flows; and coped with bad ground in the Big Walker Mountain highway tunnels in Virginia.

In 1976, Al moved to Federal Way, Washington, where he started the Al Mathews Corporation, specializing in feasibility, design, and contractual problems on tunnels and large construction projects. His consulting projects included the Los Angeles and Portland Metros; power tunnels in Niagara Falls and Canada, India, and the People's Republic of China; and the Second Manapouri Tailrace Tunnel in New Zealand.

Al was a member of the Presidents Club, Century II Campaign, McNair and Second Century Societies, and was awarded the Board of Trustees Silver Medal in 1986. He was a well-known speaker and author and was recognized in 1976 with the Golden Beaver Award for outstanding achievement in heavy engineering construction. He was a member of the National Academy of Engineering, ASCE, the US Committee on Large Dams, and the Geological and Mining Engineering and Sciences Academy.

Al was the driving force behind the 1989 publication *Avoiding and Resolving Disputes in Underground Construction* and its 1991 update *Avoiding and Resolving Disputes During Construction* and was one of four authors of the 1996 textbook *Construction Dispute Review Board Manual.* He was one of the four founding members of The Dispute Resolution Board Foundation (DRBF) formed in 1996. To honor his pioneering work in disputes resolution, the DRBF created an annual award in 2001 titled the Al Mathews Award for Dispute Review Board Excellence.

Al was recognized and respected throughout the international tunnel contracting industry for developing a number of contracting practices aimed at avoiding and resolving disputes, of which the Geotechnical Baseline Report was one. Al carried this initiative forward by being a member of the initial committee that created the first edition of this GBR guidelines publication in 1997.

CONTENTS

EXECUTIVE SUMMARY

BACKGROUND

Since the 1970s, the underground construction industry in North America has made significant advances in the development and implementation of methods to avoid and resolve disputes during construction. Publications recommended that certain provisions added to the construction contract could work together, including a Differing Site Conditions (DSC) clause, a geotechnical interpretive report, Escrow Bid Documents, and a Dispute Review Board. A 1991 publication reexamined the role of the geotechnical report and its benefit in contracting. It emphasized that the interpretations were vital, and that ambiguous content and inconsistencies between the interpretations and other contract documents were doing more harm than good in the effort to avoid and resolve construction disputes. The need for a guideline to address what would be known as a Geotechnical Baseline Report (GBR) was recognized.

In the 15 years following the second edition, several industry trends developed that prompted an update; more owners were using GBRs but were employing individuals who lacked sufficient skills and construction experience to prepare the reports properly; design-build delivery expanded with an increasing number of owners viewing this contract delivery approach as a means to transfer subsurface risk to the contractor, thereby subverting the risk-sharing purpose of the GBR; and DSC claims were being made and evaluated largely on the basis of indications in the GBR alone rather than on the contract as a whole. In view of these developments, the need for a third edition of the guideline document was warranted. This third edition is based on feedback obtained from industry forums in late 2021 and mid-2022 and from opinions and perspectives conveyed in numerous technical papers and by specific individuals.

This guideline is intended to serve as a reference for preparers and users of GBRs and to inform owners of the importance of using GBRs to allocate financial risk fairly between the parties. This guideline focuses on subsurface projects involving tunnels, shafts, and other underground openings, as well as deep foundations, cut and cover excavations, pipelines, and earthworks.

The information contained in this document represents consensus opinions within the industry on a range of issues. Nevertheless, the opinions of practitioners vary on a number of topics. The recommendations in this document are therefore intended as guidelines and should not be interpreted as rules, requirements, or standards of care.

RECOMMENDATIONS

It is recommended that a single interpretive report be included in the contract documents and be called a GBR. The primary purpose of the GBR is to establish a single set of interpretations that describe certain subsurface conditions anticipated to be encountered during subsurface construction. The anticipated conditions are expressed using baselines, which can be presented as charts, figures, diagrams, tabulations, or statements. Risks associated with conditions consistent with or less adverse than the baselines are the responsibility of the contractor, and those that are more adverse and cause an increase in the cost or schedule of the work are accepted by the owner. Ground behaviors should reflect the means and methods actually applied on the project. For Design-Build (DB) delivery, the GBR should be initiated by the owner and completed in collaboration with the design-builder, so that the baselines reflect the means and methods that the design-builder intends to employ. The means of accomplishing this are discussed in Chapter 6.

Baseline statements in the GBR are representations of certain anticipated subsurface conditions that the parties agree to use for purposes of risk allocation and contract administration. The baselines should be realistic, clear, fair to both parties, and consistent with the information contained in the Geotechnical Data Report (GDR). However, if factual data are not available or are misleading and not representative of field conditions, baselines may be based on other information (e.g., previous tunneling experience in similar geology) and engineering judgment, provided the reasoning is clearly explained.

The factual information gathered during the project investigations should be summarized in a GDR. The GDR should be included as a contract document for two reasons. If the GBR is silent on a particular matter in dispute, the GDR should be available in the contract as a supplement to the GBR. For DB delivery, the GDR should be available in

the contract as a basis for design by the design-builder. Because the GBR interpretations are based on more than the GDR data, including an assessment of the geologic conditions and relevant project experience, the GBR should take precedence over the GDR within the contract documents hierarchy.

The GBR presents baseline descriptions of certain anticipated conditions during construction. Interpretive documents related to design may be prepared within the owner's team. Such reports should be referred to as Geotechnical Design Memoranda and should be disclosed as documents for information only. Preparation of other "reports" that address possible construction conditions, such as a Geotechnical Interpretive Report (GIR), are superfluous and a potential source of confusion and are therefore strongly discouraged.

A DSC clause adhering in substance to the federal model required by CFR 52.236.2 should be included in the contract. The DSC clause relieves the contractor of the financial burden of encountering conditions differing materially from those indicated in the contract (Type 1). The clause provides a remedy under the contract to facilitate dispute resolution through contract administration.

The owner should be involved in qualitative and quantitative risk analyses carried out to scope the risks to be allocated in the GBR. In a number of respects, the GBR serves as a mitigation measure for specific subsurface conditions identified in the initial risk analyses. A second risk analysis should be conducted to support a contingency fund to address potential conditions not included in the bid. The quantitative analyses consider the probability of certain "unknown unknowns" occurring and the impacts to cost and schedule if they do occur.

The authors of the GBR should be familiar with the local geology and hydrogeology, have substantial design and construction experience with similar projects, and have significant experience in the preparation and application of GBRs. GBR preparation should not be left to the inexperienced. It is strongly recommended that owners retain individuals with substantial experience with the preparation and application of GBRs as reviewers of the final product and its compatibility with the other contract documents.

Owners should be engaged during GBR development so that they understand the risks being allocated. The use of realistic baselines will tend to lower bid prices because bidders are not pricing certain low probability events that are excluded from the baselines. However, this may tend to increase the number of claims if and when such low probability events occur. Properly managed, this approach will result in a lower total cost.

The manipulation of baselines intended to transfer all construction risk to the contractor is a genuine threat to the underground industry because

it fosters contractor distrust in designers and owners and defeats the purpose and intent of having a GBR in the contract.

This document contains recommendations for what should and should not be included in the GBR, provides a chapter outline and a checklist of topics to consider, provides suggested page lengths, makes suggestions that will improve clarity and understanding, and presents examples of problematic and improved practice in stating baselines.

Focus of the Third Edition

This third edition provides new perspectives in the following areas:

- Improvement of GBRs through a more concise organization and better presentation and wording of baselines;
- Guidance on collaboration between the owner's team and the DB team during GBR development for DB delivery;
- Importance of having experienced professionals engaged in the GBR writing, review, and integration with other contract documents;
- Discussion of conditions and obstructions that have led to claims on past projects;
- Broadened discussion of applications of GBRs to geotechnical construction other than tunnels and shafts;
- Discussion of legal and contractual perspectives that address trends in contractor claims and lawsuits by owners or contractors;
- Practices and lessons learned based on experience over the last 15 years; and
- Case histories that illustrate how baselines were utilized to resolve disputes.
- Application of GBRs, along with other contracting practices that have evolved, can be improved upon if the industry captures the experiences of practitioners through guidelines such as this one. The industry's challenge is to remember why GBRs were initially developed and appreciate what is needed to avoid returning to the "old ways" when scoping, writing, reviewing, and interpreting GBRs on new projects.

ACKNOWLEDGMENTS

This document is the product of hundreds of practitioners' contributions over the last 25 years. The first edition reflected input from three industry workshops held between 1993 and 1996. The second edition benefitted from a working group's revisions and input from two industry forums. This third edition, created by the Task Committee for Geotechnical Baseline Reports, was motivated by 15 years of industry trends and lessons learned since the second edition and reflects two industry workshops held in late 2021 and mid-2022. The chair of the Task Committee was Randall Essex. The work was carried out under the auspices of the Construction Institute of ASCE.

The following Task Committee was assembled in mid-2021 to create this third edition:

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LIST OF ABBREVIATIONS

ASTM	American Society for Testing and Materials
ATC	Alternative technical concept
CFR	Code of Federal Regulations
CM	Construction Manager
CMAR	Construction Manager at Risk
CMGC	Construction Manager/General Contractor
DB	Design-build
DBB	Design-bid-build
DRB	Dispute Review Board
DRBF	Dispute Resolution Board Foundation
DSC	Differing Site Condition
EBDs	Escrow bid documents
ECI	Early Contractor involvement
EPB	Earth pressure balance
GBR	Geotechnical Baseline Report
GBR-B	GBR for bidding
GBR-C	GBR for contracting
GCCM	General Contractor/Construction Manager
GDR	Geotechnical Data Report
GDSR	Geotechnical Design Summary Report
GIR	Geotechnical Interpretive Report
GMP	Guaranteed maximum price
ISRM	International Society of Rock Mechanics
P3	Public–private partnership
PDB	Progressive design build
SPT	Standard penetration test
TBM	Tunnel boring machine
tsf	Tons per square foot
UCS	Unconfined compressive strength
USNCTT	US National Committee on Tunneling Technology
UTRC	Underground Technology Research Council

CHAPTER 1
INTRODUCTION

EVOLUTION OF NEED FOR GEOTECHNICAL BASELINE REPORTS

The underground construction industry in North America has made significant advances in the development and implementation of methods to avoid and resolve disputes during construction. This evolved in the wake of years of disruptive and antagonistic project disputes and ensuing time-consuming and costly litigation. Problems developed with the interpretive geotechnical report that was often included as a contract document. Some in the industry felt the need to reexamine the role and benefit of a contractual interpretive report in the contracting process. Others felt that poorly written, overly general, and ambiguous interpretive reports, and inconsistencies between interpretive reports and other contract documents, were doing more harm than good.

In the early 1970s, important reference documents were developed within the construction industry to address the rising costs and amount of litigation associated with underground projects and ways to reverse the adverse trends. The first of these reports was published in 1974 by the US National Committee on Tunneling Technology (USNCTT), within the National Research Council. The report, titled *Better Contracting for Underground Construction*, had a profound, positive influence on the tunneling industry. The document identified the fundamental need to improve the overall approach to contracting for underground construction projects, including the disclosure of geotechnical data and interpretations of that data to bidders:

> In sum, all subsurface data obtained for a project, professional interpretations thereof, and the design considerations based on these