CE185 Capstone Design 1 and CE 186 Capstone Design 2

Fall 2017 Schedule
Lectures – MWF 2:20 -3:10 Kalkin 004
Recitation – Tuesday 6-9PM Kalkin 004
Spring 2018 Schedule TBD

Course Instructor: John Lens, P.E., jelens@uvm.edu
Office: Votey 233A Office Phone 802-656-8156 Cell: 802-272-2796
Fall Office Hours: Monday and Wednesday 12-2PM and 3:30-4:30PM
Friday 9:30-10:30AM and 12-1PM

These hours are for drop-in or appointments. Prior scheduled appointments, faculty meetings, or unanticipated circumstances may alter my availability to meet with you during these hours, so please make an appointment by phone or email if it is critical to meet. I will do my best to accommodate all reasonable meeting requests at these hours or other times, as needed.

Teaching Assistant: Soham Banerjee sbanerj1@uvm.edu
Jack Reed Jack.Reed@uvm.edu
Office Hours to be announced in class.

COURSE DESCRIPTION

This is a required course for 3-credits in each semester of a two-semester capstone design course sequence.

COURSE OBJECTIVES

The overall course objective is to provide students the opportunity to learn what is expected of entry-level, and more experienced, engineers working in professional engineering and construction practice and offer opportunity for students to develop their skills to meet and excel in those expectations. This objective is pursued by providing opportunity for students:

1) To experience and learn about civil and environmental engineering "project work" through doing it. The different facets of "project work" will include learning what the client needs, technical problem solving, analysis and design, as well as non-technical aspects (e.g. communication, teamwork, leadership, ethics, and following professional standards of practice).
2) To follow a systems approach to problem solving by investigating social, regulatory, environmental, economic, and overall sustainability aspects of assignments and projects.
3) To design engineering systems that include considerations of risk, uncertainty, sustainability, life-cycle principles, and environmental impacts.

4) To learn how effective engineering leaders conduct themselves both on project levels, and on entrepreneurial and policy making levels, and the importance of high standards of ethical practice.

5) To apply civil and environmental engineering design principles in a comprehensive project typically involving two or more sub-disciplines of civil engineering (e.g. transportation, geotechnical, structural, environmental) and/or environmental engineering (e.g. water, land, air). Projects may involve other interdisciplinary components.

6) To learn and practice skills for communicating in written and graphic formats using notes, sketches, drawings, plan sheets, specifications, and reports explaining their design and construction recommendations.

7) To learn and then rigorously practice skills for successfully working in teams.

8) To learn and practice skills for communicating in one-on-one settings such as with clients and colleagues and in formal presentations such as to a review panel of faculty and practitioners.

COMMUNITY SERVICE LEARNING PROJECTS: This course is structured around real projects for community and nonprofit partners in a service-learning format. Service-learning is a form of experiential education in which students engage in activities that address human and community needs together with structured opportunities intentionally designed to promote student learning of academic materials and personal development. Research has shown that service learning promotes student learning and development in areas such as academic and intellectual development, civic engagement, career development, ethical judgment, and personal/interpersonal skills. Service learning is a two-way process in which students provide a service which offers them learning opportunities from both doing the work and interacting with their community partner clients.

Successful project experiences require students to reach out to their clients with frequent and meaningful communication, and above-and-beyond effort to understand and then meet their client's needs. Following those precepts offers students an often-unique opportunity early in their engineering practice careers to experience working directly with high-level client managers, something that can otherwise sometimes take several years after graduation.

COURSE POLICIES

STUDENT ACCESSIBILITY SERVICES: In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact ACCESS, the office of Disability Services on campus. ACCESS works with students to create reasonable and appropriate accommodations via an accommodation letter to their professors as early as possible each semester. Contact ACCESS: A170 Living/Learning Center; 802-656-7753; access@uvm.edu; or www.uvm.edu/access.

ATTENDANCE AND PARTICIPATION: Every class and recitation counts. Prompt attendance is expected and counts in your grade. If you cannot make a class or will be late, notify the TA by email sufficiently before the class. Absences will only be excused for appropriate circumstances.

RELIGIOUS HOLIDAYS: Students have the right to practice the religion of their choice. You should submit in writing to me by the end of the second full week of classes your documented religious holiday schedule for the semester so we can develop a plan to accommodate that schedule.

WRITTEN ASSIGNMENTS: Submit all assignments per the instructions. Late submittals without adequate prior explanation and approval by the instructor are not acceptable and will not be graded.

BLACKBOARD: Please check Blackboard for important correspondence and course updates. Blackboard will be generally be used to notify you of class messages regarding assignment changes or notices. Also, check your e-mail regularly for similar information. In the event of inclement weather, please check your Blackboard e-mail for any notice of cancellation or delay of class and/or activities.

SYLLABUS: This syllabus is subject to change with verbal and electronic notice.

ACADEMIC HONESTY: The University of Vermont and the College Engineering & Mathematical Sciences are learning communities. Consistent with the University's mission and purpose, and the values the College seeks to foster within its community, we expect that academic honesty and integrity guide the actions of all its members. It is the responsibility of every person in the academic community to ensure that dishonesty is NOT tolerated. Academic dishonesty (cheating and/or plagiarism) violates the Academic Integrity Policy and may result in an "F" on the work involved or in the course. **Cheating not only violates the Academic Integrity Policy, but also may be grounds for probation, suspension, and/or expulsion.**

http://www.uvm.edu/~uvmppg/ppg/student/acadintegrity.pdf

TEXTBOOK:

Principles of Applied Civil Engineering Design, by Ying Kit-Choi, ASCE Press The original 2004 edition is replaced by a second addition now available through ASCE.

Engineering Your Future: The Professional Practice of Engineering, by Stuart G. Walesh, available through ASCE.

Purchasing these through the American Society of Civil Engineers (ASCE) online bookstore as an ASCE member (student members included) is the lowest price that I have found. The following three links reach the ASCE membership portal and the books, respectively. ASCE student membership is free and strongly recommended.

http://www.asce.org/membership/student/

http://www.asce.org/templates/publications-book-detail.aspx?id=7301

http://www.asce.org/templates/publications-book-detail.aspx?id=25211

ADDITIONAL TEXT REFERENCES: I will provide other civil and environmental engineering references which you need for the course reading assignments.

GRADING: All course assignments and team participation criteria must be satisfactorily completed for a passing grade to be achieved. Late submittals will not be accepted unless there are special circumstances accepted by the instructor, in advance of the due date.

Course Element	CE185	CE186
Attendance	10%	10%
Quizzes (drop lowest 2)	10%	10%
Homework	5%	5%
Ethics Essay	5%	5%
Economics Exam	10%	10%
Project Work	Sum of 8 elements at 7.5% = 60%	Sum of 6 elements at 7.5% = 45%
Photo Story	-	5%
Design Night Presentation	-	5%
Final Presentation	-	5%
Totals	100%	100%

Attendance will be given full credit provided there are no unexcused absences. No attendance credit will be given if there are more than three unexcused absences. Anything between will receive credit at the instructor's discretion.

Project submittals will be graded according to the attached grading rubric.

The final project grade given to each student on a team will be based on their performance within the team as reflected by peer reviews, client reviews, and instructor observations. High performing team members will receive the same grade as the project receives. Under-performing team members will have grades which are lower than the project grade, dependent on how much they contributed to the success of the project.

Final numeric percentages will translate into final letter grades as follows:
98-100 = A+; 93-97 = A; 90-92 = A-
88-89 = B+; 83-87 = B; 80-82 = B-
78-79 = C+; 73-77 = C; 70-72 = C-
68-69 = D+; 63-67 = D; 60-62 = D-
Below 60 = F

University of Vermont
CE 185 and 186 Capstone Design I and II
Fall 2017/Spring 2018
Course Deliverables and Schedule
August 25, 2017

Week	Date			Class Session Topics	Speaker	Reading Assignment Source	Homework Assignment	Project Assignment Due (end of week)	Recitation Topic
1	28-Aug	30-Aug	1-Sep	Introduction and Project Presentations	Some Clients	Walesh		Submit project choices by 11PM on September 1	Project Presentations
2	-	6-Sep	8-Sep	Project Expectations, Team Function, Resources		Choi			TBD (1)
3	11-Sep	13-Sep	15-Sep	Project Scoping, Construction Documents (CD's), Project Field Safety		Walesh	Econ	Applicable Standards/Resources/Examples Report	Field Equipment Refresher
4	18-Sep	20-Sep	22-Sep	Economics, Project Research Skills, Project Lab Safety	G. Sherriff	Walesh	Econ	Project Meeting and Preliminary Work Scope Report and Video	TBD (1)
5	25-Sep	27-Sep	29-Sep	Economics, Project Scheduling		Walesh	Econ	Project Task List/Work Breakdown Structure	Lab Safety and TBD(1)
6	2-Oct	4-Oct	6-Oct	Economics		Walesh	Initial Project Reflection	Project Scope and Deliverables Report	TBD (1)
7	-	11-Oct	13-Oct	Economics, Teamwork, Project Cost Estimating		Choi		50% Data Collection and Presentation Report	Economics Exam 1
8	16-Oct	18-Oct	20-Oct	Construction Document Preparation, Project Cost Estimating		Choi			TBD (1)
9	23-Oct	25-Oct	27-Oct	Project Permitting (I), Review Economics Exam 1, NEWEA Speakers	TBD	Instructor Provided		Project Precedents and State of Practice Report	TBD (1)
10	30-Oct	1-Nov	3-Nov	Project Permitting (II), Preliminary Design Report Elements		Choi		100% Complete Data Report	Precedents/Practice Presentations
11	6-Nov	8-Nov	10-Nov	Ethics, Uncertainty and Risk		Walesh			Precedents/Practice Presentations
12	13-Nov	15-Nov	17-Nov	Uncertainty, Risk, and Reliability		Instructor Provided		Preliminary Design Report	Precedents/Practice Presentations
13	-	-		Thanksgiving Break					
14	27-Nov	29-Nov	1-Dec	AEC Industry Procurement Practices, Project Financing	TBD	Instructor Provided	Ethics Essay 1		Project Reviews
15	4-Dec	6-Dec	8-Dec	Interviewing Skills, Job Searching, Project Team Dynamics	TBD	Instructor Provided		Preliminary Design Report to Client	Project Reviews
16	11-Dec	-		Final Exam Period					

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Week	Date			Topic	Speaker	Reading Assignment Source	Homework Assignment Due	Project Assignment Due	Recitation Topic
1	-	17-Jan	19-Jan	Economics-Life Cycle Cost Analysis, Design Drawing Preparation		Choi	Econ	Schedule/Scope Update Report for S2	TBD(1)
2	22-Jan	24-Jan	26-Jan	Economics-Life Cycle Cost Analysis, Design Drawing Preparation		Choi	Econ		TBD(1)
3	29-Jan	31-Jan	2-Feb	Sustainable Design Practices, Project Visualization Methods		Choi		Uncertainties/Risks/Mitigation Report	TBD(2)
4	5-Feb	7-Feb	9-Feb	Sustainable Design Practices, Project Visualization Methods		Instructor Provided			Economics Exam 2
5	12-Feb	14-Feb	16-Feb	Advanced Cost Estimating, Interviewing Skills		Instructor Provided		Project Sustainability Report	TBD(2)
6	-	21-Feb	23-Feb	Professional Legal and Insurance Issues, Ethics Part II		Instructor Provided		Project Visualization Submittal	TBD(2)
7	26-Feb	28-Feb	2-Mar	Entrepreneurship and Business Practices	TBD	Walesh			TBD(2)
8	5-Mar	7-Mar	9-Mar	Adapting to Workplace and Market Change Case Histories		Walesh			TBD(2)
9	12-Mar			Spring Break					
10	19-Mar	21-Mar	23-Mar	Construction Project Inspection and Administration		Instructor Provided	Ethics Essay 2		TBD(2)
11	26-Mar	28-Mar	30-Mar	Construction Project Management		Instructor Provided		Final Project Submittal for Senior Review	TBD(2)
12	2-Apr	4-Apr	6-Apr	Project Loss and Loss-Prevention Case Histories		Instructor Provided	Case History		TBD(2)
13	9-Apr	11-Apr	13-Apr	Project Loss and Loss-Prevention Case Histories		Instructor Provided		Final Project Submittal to Client	TBD(2)
14	16-Apr	18-Apr	20-Apr	Final Presentation Practice				Design Night Visualization Submitted for Printing and Project Photo Story Submitted for Posting	TBD(2)
15	23-Apr	25-Apr	27-Apr	Final Presentation Practice				Design Night on Friday April 27, 2018 3-8PM	TBD(2)
16	30-Apr	2-May	4-May	Formal Project Presentations			Final Project Reflection		
		9-May		Final Project Presentations for Selected Projects 8AM-5PM					

Notes:

TBD(1)	Open for FE Exam Review or Project Team Meeting/Review
TBD(2)	Open for Project Team Meetings and Reviews

Part A: Meeting deadlines						
	Item	Notes	Fail/Poor	Poor/Fair	Good	Excellent*
Meeting Deadlines	Project Submittal		Submitted late.	No credit if late.	Submitted by the deadline.	Submitted a day or more in advance.
	Homework Assignments	Includes Monthly Project Updates to Clients	Submitted late.	No credit if late.	Submitted by the deadline.	Submitted by the deadline.

Part B: Project Work						
	Item	Notes	Fail/Poor	Poor/Fair	Good	Excellent*
Quality and Thoroughness of Work (subject to the nature of the project): as reflected in the submittals	Precedents and State of the Practice Review		Did not attempt to review the literature	The review was not thorough and reported appropriately.	Researched and presented the relevant literature.	Researched, synthesized (used appropriately in the analysis and design) and presented the relevant literature.
	Field work		Missing required components.	Field work was not thorough and/or reported appropriately.	Minimum suggested field work completed and reported appropriately.	Field work completed beyond suggested and reported appropriately.
	Laboratory testing		Missing required components.	Lab work was not thorough and analyzed and reported appropriately.	Minimum suggested lab work completed and analyzed and reported appropriately.	Lab work completed beyond minimum suggested, analyzed properly, used in the design appropriately, and reported clearly.
	Analysis		Missing required components.	Analysis was not thorough and reported appropriately.	Minimum suggested analysis completed and reported appropriately.	Analysis completed beyond the minimum suggested, used in the design appropriately, and reported clearly.
	Alternative designs		Did not consider alternatives.	Recommended improper alternatives.	Evaluated multiple and recommended an acceptable alternative(s).	Considered novel, and practical approaches.
	Considered each of social and environmental sustainability		Did not consider sustainability.	Considered it, but did not follow through.	Considered ways to achieve these and reported appropriately.	Considered and applied novel or innovative, and appropriate ideas.
	Considered economic sustainability		Did not consider.	Considered it, but neglected to consider important aspects.	Considered most of the important aspects and reported appropriately.	Completed beyond minimum suggested, applied appropriately, and reported clearly.

* All requirements of 'Satisfactory' must be met, in addition to the requirements for 'Excellent', to receive an 'Excellent' grade.

Part C: Quality of Reports						
	Item	Notes	Fail/Poor	Poor/Fair	Good	Excellent*
Quality of the Submittals	Required sections of the report		Missing required components.	Has all components, but formatted incorrectly or with errors.	Formatted and error-free, but unprofessional looking.	Meets a high standard of accuracy, appearance, completeness, and clarity.
	Grammar, Usage, Mechanics, Format		Poor grammar/spelling, missing required components, clearly not proofread.	Minor grammar and/or formatting mistakes, generally unprofessional.	Clearly proofread, some inconsistencies in accuracy, appearance, completeness, clarity.	Clear and concise, no unnecessary jargon, clearly edited.
	Nomenclature and abbreviations		Missing	Incorrect and/or missing units used throughout. Abbreviations not specified.	Inconsistent use of units. Abbreviations and acronyms not fully explained.	Consistent and clear use of units, symbols, etc. Meets expectations; minor formatting mistakes.
	Data		Missing.	Damaged photocopy of original data, or a messy replication of the raw data.	Adequate and mistake-free copy of the raw data.	Data has been clearly summarized and formatted.
	Graphs		Missing one or more graphs.	Missing/incorrect axes, labels, scales, equations, trend lines, or legends.	Clearly formatted graphs.	Relevant trend-lines and equations presented. Clear and professional formatting.
	Analysis and Design		Essential components missing, unprofessionally reported.	Some missing components, some missing supporting calculations in appendices.	Clearly presented with supporting calculations in appendices, including supporting graphs, tables, etc. used from literature.	Considered novel approaches, clearly presented with supporting calculations in appendices, including supporting graphs, tables, etc. used from literature.
	References		Missing, incorrect, or not formatted.	Bare minimum number of references, with editing/formatting mistakes.	References were correctly formatted and appropriate to the project.	References were professionally presented and correctly placed in text.

Part D: Presentations

	Item	Notes	Fail/Poor	Poor/Fair	Good	Excellent*
Group Presentations	Quality of presentation as a group including visual aids		Significant elements missing, unclear and unprofessional, could not answer questions.	Some missing elements, unclear in some parts and unprofessional, could not answer some questions.	All important elements included and professionally presented, could answer most questions.	Very clear and concise, articulated in answering all questions.
Poster and Video Story	Quality of presentation as a group including visual aids		Significant elements missing, unclear and unprofessional, could not answer questions.	Some missing elements, unclear in some parts and unprofessional, could not answer some questions.	All important elements included and professionally presented, could answer most questions.	Very clear and concise, articulated in answering all questions.

Part E Professionalism

	Item	Notes	Fail/Poor	Poor/Fair	Good	Excellent*
Individual Rating	Peer evaluation, instructor and TA observations.		Performance meeting below 65% of expectations.	Performance meeting between 65% and 80% of expectations.	Performance meeting between 80% and 90% of expectations.	Performance meeting above 90% of expectations.
	Individual work assignments		Significant elements missing, unclear and unprofessional, could not answer questions.	Some missing elements, unclear in some parts and unprofessional, could not answer some questions.	All important elements included and professionally presented, could answer most questions.	Thorough, clear and concise, well articulated answers to all questions.
Reflection	Final Course Reflection		Significant elements missing, unclearly written, and grammatical and spelling error.	Some missing elements, unclear in some parts, and minimum grammatical and spelling errors.	All important elements included, clear thought process, and no grammatical and spelling errors.	Very clear and concise, well articulated thoughts, no grammatical and spelling errors. Evidence of considerable review and editing.

* All requirements of 'Satisfactory' must be met, in addition to the requirements for 'Excellent', to receive an 'Excellent' grade.

Deliverable	**30% Stage (1st Semester Preliminary Design Report) Minimum Requirements**	**60% Stage (Optional 2nd Semester Interim Submittal) Minimum Requirements**	**Final Submittal (2nd Semester Final) Requirements**
Construction Documents			
Plan Sheets (11 x 17 inch)	Drawing Set Cover Page	Drawing Set Cover Page	Drawing Set Cover Page
	Existing Conditions Plan Sheet(s)	Existing Conditions Plan Sheet(s)	Existing Conditions Plan Sheet(s)
	Proposed Construction Plan and Detail Sheets (Minimum of scaled schematic drawings of all key elements)	Proposed Construction Plan and Detail Sheets (Minimum of scaled detailed drawings of all key elements and schematic drawings of remaining elements)	Proposed Construction (Scaled drawings of all elements)
Specifications	List expected technical specification items for key project elements.	Identify standard technical specification items for all key project elements shown on the drawings. Use VTrans, NHDoT, ASTM, or CSI/BSD, as applicable.	Identify all applicable standard technical specifications for the project elements, the source(s), and outline the key modifications required for the project, if needed.
Cost Estimates	Preliminary quantities and construction costs for all key elements – pricing can be based on historical data (e.g., VTrans, NHDoT, or RS Means, etc.)	Quantities and construction costs for all elements – some pricing can be based on historical data (e.g., VTrans, NHDoT, or RS Means, etc.) but key elements require comparison with bottom-up/contractor type estimates with constructability considered.	Final quantities and construction costs for all elements – all pricing requires bottom-up/contractor type estimates with constructability considered.
	Contingency budget must be included to account for missing and incomplete elements.	Contingency budget must be included to account for incomplete elements.	Contingency budget only for legitimate uncertainties outlined in Basis of Design report. All other contingencies to be accounted for in estimated total project costs
	Construction follow-through engineering costs required.	Construction follow-through engineering costs required.	Construction follow-through engineering costs required.
	Life-cycle cost (including operations and maintenance) analysis required to support alternatives evaluation and recommended concept choice and needs to include sustainability aspects.	Life-cycle cost analysis (including risk, and operations and maintenance) required to support final options and needs to include sustainability aspects.	Life-cycle cost analysis (including risk, and operations and maintenance) required to support final options and needs to include sustainability aspects.

Basis of Design Report*	Executive Summary	Executive Summary	Executive Summary
	Background Information	Background Information	Background Information
	Existing Conditions, Constraints, and Identified Needs	Existing Conditions, Constraints, and Identified Needs	Existing Conditions, Constraints, and Identified Needs
	Alternatives Evaluated	Alternatives Evaluated	Alternatives Evaluated
	Alternatives Findings	Alternatives Findings	Alternatives Findings
	Outstanding Considerations to be Evaluated before 60% Submittal	Conclusions and Recommended Design and Construction Features	Conclusions and Recommended Design and Construction Features
	Preliminary Conclusions and Recommendations	Draft Operations and Maintenance Recommendations	Final Operations and Maintenance Recommendations

Refer to the document entitled: "CE185-186ProjectReportElements2017", dated details on the required report content.

THESE INSTRUCTIONS ARE INTENDED TO LIMIT THE AMOUNT OF WRITING AND COMPILATION EFFORT YOU NEED TO PUT INTO DEVELOPING A QUALITY REPORT. YOU SHOULD READ THIS CAREFULLY AND CLOSELY FOLLOW THE TEMPLATE. IF YOU FIND ELEMENTS WHICH DO NOT SEEM TO BE APPROPRIATE FOR YOUR PROJECT, DISCUSS THOSE WITH THE INSTRUCTOR IN ADVANCE AND SUGGEST AN ALTERNATIVE.

(NOTE: THE FINAL SUBMITTAL IN APRIL 2018 IS TO BE SUBMITED IN DUPLICATE (ONE TO THE COMMUNITY PARTNER AND ONE TO THE INSTRUCTOR) AND IS TO INCLUDE ONE PRINTED COPY OF THE FINAL REPORT INCLUDING CONSTRUCTION DOCUMENTS AND A THUMB DRIVE CONTAINING THE DOCUMENTS AND REPORT IN ELECTRONIC FORM, THE FINAL PRESENTATION SLIDES, THE PHOTO STORY, THE POSTER, AND RELATED DATA AND FILES, ALL CLEARLY LABELLED ON THE THUMB DRIVE. THE PROJECT TEAM MUST CONFIRM THAT THEY HAVE CHECKED THAT THESE FILES CAN BE READ ON A PC COMPUTER).

FORMAT AND STYLE

- Use single line spacing, 12 point font for all text (except cover page), use Times New Roman or Arial.
- Use a consistent header throughout the document.
- Use the active voice and follow the course writing and reporting recommendations.
- This report is to be a concise summary with a narrative which ties together each of the individual project assignments. Those assignment "reports" are to be placed in individual appendices. If portions of those individual reports are no longer relevant or are subsequently determined to be incorrect or recommendations change, they should be revised with strike out/revisions noted (and new information/corrections added as applicable).

REPORT SECTIONS

Title page – Must contain the following information:

Descriptive title of your project

A photograph or schematic illustration relevant to the project
Community Partner: _____Organization and Individual Name(s)

UVM CE 185/186 Capstone Design Project
Submission stage: *i.e., Preliminary or Final*

Instructor: Professor John Lens

Submitted by: Team member names in alphabetical order
Civil and Environmental Engineering
The University of Vermont
Burlington, VT 05405
Date____

Cover letter – See template

Table of Contents – cite the sections and pages starting with the Executive Summary

Executive Summary – This is a synopsis of the project and work performed. Explain the more important aspects and conclusions of the report. Include costs and final recommendations. This section has its own page following the title page.

Limitations. This section has its own page following the title page and must be included verbatim as stated below.

The intent of this report is to present the data collected, evaluations, analysis, design, cost estimates, and recommendations for the _____ project. The work presented here was performed as a two-semester project as part of the CE 185 and 186 Capstone Design course sequence instructed by Professor John Lens. Although we have exercised care while working on all components of this project, the reader should be aware that the work was performed within a limited time period and with limited resources by students. This work was reviewed by Professor Lens, other UVM faculty and external evaluators; however, it has not been formally reviewed in sufficient extent suitable to be issued for final use and construction. The reader is advised that before using any part of this report, the work presented here must be independently evaluated by a qualified Professional Engineer licensed in *project location, e.g., Vermont, New Hampshire, etc.*

1. BACKGROUND INFORMATION

Reference the final scope of work from your Agreement (including any modifications) and place that in Appendix 1.

Provide a brief overview (~1-2 paragraphs) of how the project fits into a larger context and describe the project motivation as you understand it.

Introduce your specific project location (include map with north and scale) and photos.

Provide a summary of available data (e.g. maps, boring logs, accident data, and hydraulic flow records) and the data collected by the team (e.g. survey, traffic counts, water samples) and explain which was provided by your client and which you obtained on your own.

Explain and reference the field and laboratory data which you obtained for the project.

List and briefly explain the applicable design standards for your project work and what you have found to be the appropriate state of practice guidance for your key technical work. Where applicable, reference your literature research on the state of the practice/art for the key technical aspect(s) of your project.

2. EXISTING CONDITIONS, CONSTRAINTS, and IDENTIFIED NEEDS

This section summarizes conclusions about the existing conditions derived from the available data, cites and describes the constraints on the project, and what you identify to be the underlying needs which you address in your analysis of alternatives. Identify permitting constraints here. Discuss permitting considerations in detail either here or later in the report if that is more appropriate.

3. ALTERNATIVES EVALUATED

This section describes design and construction alternatives which you considered including "Doing Nothing". Explain why you considered these. Explain the methodologies you followed including the calculations you made (cite where they are in the appendices). Provide enough explanation for your client and technical reviewers to understand what you did. Use photos, figures, and tables instead of writing, wherever appropriate.

4. ALTERNATIVE FINDINGS

Describe the findings from your analyses, and corresponding conclusions for each design alternative you consider. In addition to the technical considerations for alternatives, include specific constraints (e.g., permits, among other items) affecting for each design alternative considered. All necessary permits must be identified as much as possible and included in an appendix. Also include cost information applicable to your project. At minimum provide an analysis that puts all future operation, maintenance, expected upgrade costs on a present worth basis to add to initial capital costs. Show cost comparisons among design alternatives considered.

9. CONCLUSIONS and RECOMMENDATIONS

This section summarizes your conclusions from the alternatives analysis and your resulting recommendations. Include:

- Briefly stating the project objectives.
- Design alternatives considered.
- Alternatives ranking (from highest to lowest preference) including their advantages and disadvantages, and how they each address the stated project objectives. Include discussion on the uncertainty, risk, sustainability considerations, and life-cycle costs of each of the alternative.
- Your preferred alternative and why you recommend it.
- Recommendations for implementing your preferred alternative including measures to mitigate uncertainty and risk.
- Project operations and maintenance recommendations.

ACKNOWLEDGMENTS

At a minimum, acknowledge your community partner and anyone who was helpful (professionally) for the project.

REFERENCES

Use proper citations and follow ASCE guidelines for citations. All references must be cited in the main body of the report.

FIGURES

TABLES

APPENDICES (1 through n)

Supporting materials should be arranged neatly in **Appendices** (1, 2, 3 etc. with a descriptive title for each). Use sub-appendices as needed. Numerical values work best with conventional report tabs.

APPENDIX 1 –Agreement (Deliverables, Scope of Work, Schedule)
APPENDIX 2- Title
APPENDIX 3 - Title

……..

APPENDIX (n-2) – Monthly Client Update Reports
APPENDIX (n-1) – Important communications with responses
APPENDIX n – Design Review Meeting Records

- Use subsections as necessary to make it easy to refer back to prior report sections, if needed.
- Pay particular attention to grammar and significant digits for the numbers used; describe all symbols and abbreviations.
- In general, analysis methods should be briefly described and cited. For example, do not just mention SLOPE/W and assume that the readers will know what it is; briefly describe it (e.g. SLOPE/W (reference) is a computer program that is based on limiting equilibrium method of two-dimensional slope stability analysis. It has a number of analysis methods including Morgernstern and Price, Spencer, …. The Morgernstern-Price method was selected because….).
- Data should be summarized in tables and graphs in the main body of the report with exhaustive details in relevant appendices. For example, if you conducted grain size analysis, the grain size curve can be included as a figure, but the data should be in an appendix.
- All tables must be numbered consecutively per section followed by a brief descriptive title (e.g. Table 3.1 – Soil parameters used in the slope stability analysis). The title should go above the table.
- Figures should also be numbered in the same way, (e.g. Figure 1.2 – Aerial view of Memorial Auditorium with planned parking lot highlighted). The figure titles should be under the figures.
- All fonts in table and figures must be large enough to be legible; all plots should have appropriate axis titles, units, etc.
- All figures and tables must be cited in the text before they appear in the body of the report.
- The layout of any design, to a reasonable scale, should always be included in the main report.