

CE 3342 – Water and Wastewater Engineering – Fall 2022

The University of Texas at El Paso
Department of Civil Engineering
Class Meeting: MW 10:30-11:20 am
LART 319
Lecture CRN: 19189
Laboratory:
Mon 1:30-4:20 pm ENGR 204 (CRN 17204)
Wed 1:30-4:20 pm ENGR 204 (CRN 17205)
CE 4171 CRN: 20395
Prerequisites: CE 2375 and Junior Standing

Instructor: W. Shane Walker, Ph.D., P.E.
Email: wswalker2@utep.edu
Office: Engineering A-215
Phone: (915) 747-8729
Office hours: Wed, 2:00-3:00 pm
<https://utep-edu.zoom.us/my/shanewalkertexas>

NOTICE:

Class meetings, laboratory meetings, and exams will be IN-PERSON according to the schedule provided at the end of this syllabus. Homework assignments will be administered asynchronously online, and communication will be sent by email through Blackboard (<https://my.utep.edu/>).

PRECAUTIONS for the spread of communicable disease

Please stay home if you are sick. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations.

NOTICE: Degree Plan Change

Years ago, CE 3342 was only lecture, and the CE 3153 laboratory was a separate course. However, in the new degree plans, CE 3342 is now an integrated lecture and laboratory. Thus, students taking this course this semester need to be aware of two options:

- If you are on the new degree plan which does NOT require CE 3153 (lab), then you will need to register for both the lecture (26172) and one of the labs (26173 and 26174).
- If you are on an old degree plan that requires both CE 3342 (lecture only) and CE 3153 (lab), then you will need to register for CE 3342, including the lecture (26172) and one of the labs (26173 and 26174), as well as CE 4171 Engineering Problems (20395), so that you can satisfy the four credit-hour requirement for your degree plan. (You will also need to submit a course substitution request prior to graduation.)

Philosophy

I believe that *teaching* and *learning* are interdependent; you cannot have one without the other. You and I are partners and colleagues, working together to help you grow as a knowledgeable, curious, intrinsically motivated, and confident engineer. I want to help you grow as a critical thinker with sharpened skills in analysis, evaluation, and synthesis. I incorporate team-based projects to help you prepare for professional practice and to help you develop as a more robust and intrinsically-motivated engineer. I have also realized that it is important to provide weekly homework assignments and quizzes, which help reinforce understanding and application of the main concepts. Thus, I have implemented a combination of homework assignments, book reading, quizzes, online forum discussions, exams, and team projects in this course.

Required Textbook: Davis (2020) Water and Wastewater Engineering (Second Edition), McGraw Hill (9781260132274)

You can access this textbook at UTEP online FREE OF CHARGE from the UTEP campus network or VPN: <https://www.accessengineeringlibrary.com/content/book/9781260132274> (Click on “My account” at the top right corner, and scroll down until you see “You are logged in as ... The University of Texas at El Paso *via IP address*”, and then click “Return to the website”).

You can also set up off-campus access (<https://www.accessengineeringlibrary.com/off-campus-access>) that will provide access to the site even when not on the UTEP network. If you have any questions about accessing the site, please ask your librarian.

Supplemental Texts:

- AWWA & ASCE (2012) Water Treatment Plant Design, 5th Ed, McGraw Hill, <https://accessengineeringlibrary.com/browse/water-treatment-plant-design-fifth-edition>;
- AWWA (2011) Water Quality & Treatment, 6th Ed, <https://accessengineeringlibrary.com/browse/water-quality-and-treatment-a-handbook-on-drinking-water-sixth-edition>;
- Metcalf & Eddy (2007) Water Reuse, McGraw Hill, <https://accessengineeringlibrary.com/browse/water-reuse-issues-technologies-and-applications>;
- Viessman et al (2009) Water Supply & Pollution Control, 8th Ed., Prentice Hall;
- Benjamin and Lawler (2013) Water Quality Engineering: Physical & Chemical Trt. Proc., Wiley;
- MWH (2012) Water Treatment: Principles and Design, 3rd Ed., Wiley;
- Metcalf & Eddy (2014) Wastewater Engineering: Treatment and Reuse, 5th Ed., , McGraw Hill

Required Laboratory Personal Protective Equipment:

- Lab coat (available at UTEP bookstore)
- Goggles or protective eyeglasses (available at UTEP bookstore)

Description and Objectives

This course involves a study of theory and preliminary design of basic physical, chemical, and biological processes involved in drinking water and sanitary wastewater treatment systems. The objectives of this course are to develop:

- awareness of the environment in which we, as a society, live and the significance of the local, state, national, and global water problems that face the engineering community. (ABET Student Outcome 4)
- design background required to solve problems dealing with water quality, water & wastewater treatment, water storage, and water regulation. (ABET Student Outcome 1)
- preliminary design of conventional coagulation, flocculation, sedimentation, and granular media filtration treatment processes. (ABET Student Outcome 2)
- preliminary design of membrane filtration and desalination processes. (ABET Student Outcome 2)
- preliminary design of conventional activated-sludge wastewater treatment processes. (ABET Student Outcome 2)
- the ability to work in teams on complex design problems with written and oral communication. (ABET Student Outcome 5)
- design knowledge sufficient to pass the water and wastewater problems on the Fundamentals of Engineering (FE) exam and the Professional Engineering (PE) exam. (ABET Student Outcome 2)

Topics Covered

The topics covered in this course are:

1. Water Resources Planning and Management
2. Water Quality Parameters and Regulations
3. Conventional Drinking Water Treatment Processes
4. Advanced Water Treatment Processes
5. Biological Wastewater Treatment Processes
6. Sludge Processing
7. Water Reclamation and Reuse

A more detailed list of topics is provided in the course schedule on the last page of this syllabus.

Expectations

Participation: More than simply attending class, you are invited to *think*, and *participate* in the lectures and discussions. I encourage you to be curious and inquisitive during class discussions and online forums. Take time to think about what you are learning and consider the meaningfulness of this subject matter. This topic is literally essential for daily life for every person on the planet.

Preparedness: I recommend that you bring the textbook, a personal course notebook, a pen or pencil, a calculator, completed homework assignments, and questions from the homework and assigned reading.

Punctuality: You are expected to be on time to class, laboratory exercises, and plant tours. Late assignments will not be accepted, and there are no makeup exams.

Ethics: In engineering, personal integrity is of utmost importance, especially in the assessment and reporting of environmental conditions. Also, in most cases, it is necessary to work in teams to develop and design optimal solutions to problems and challenges, and it is essential that each team member contributes to the productivity of the team. In this course, I strongly recommend that you work together in teams to complete homework assignments; in many cases, you will help each other through the solution of difficult problems. My goal for the homework is for you to develop proficiency in the basic application and calculations in design. Thus, every student is accountable for *understanding* the concepts, analyses, and solutions. My goal for the projects is for you to have the opportunity to apply this theory in a deeper and more meaningful way than homework. Each student is accountable for understanding and *contributing* (equitably) to the team projects. Any student committing plagiarism (*e.g.*, copying another's work without understanding) or any other form of academic dishonesty will be reported to the Dean of Students for disciplinary action (which may include expulsion from the University). For a concise summary of engineering ethics, I have provided here the Fundamental Canons within the [Code of Ethics](#) of the American Society of Civil Engineers (ASCE):

1. *Engineers shall hold paramount the safety, health and welfare of the public and shall strive to comply with the principles of sustainable development³ in the performance of their professional duties.*
2. *Engineers shall perform services only in areas of their competence.*
3. *Engineers shall issue public statements only in an objective and truthful manner.*
4. *Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.*
5. *Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.*
6. *Engineers shall act in such a manner as to uphold and enhance the honor, integrity, and dignity of the engineering profession and shall act with zero-tolerance for bribery, fraud, and corruption.*
7. *Engineers shall continue their professional development throughout their careers, and shall provide opportunities for the professional development of those engineers under their supervision.*

Homework Assignments

Homework assignments and exams will be completed through Quest Learning and Assessment (<https://quest.cns.utexas.edu>), a web-based content and homework delivery system maintained by The University of Texas at Austin. Please go to <https://wikis.utexas.edu/display/questla/Obtaining+a+University+of+Texas+EID> for instructions on how to sign up for the Quest system. During the beginning of this course, when you log into Quest, you will be asked to pay \$30 via credit card on a secure payment site (<https://getquest.cns.utexas.edu/subscriptions/>),

which goes toward the maintenance and operation of the resource. You can enroll in the homework portal for this course by searching for the lecture CRN (listed on the first page of this syllabus).

Homework assignments will typically be open two to seven days before the due date, and students will be notified by email when assignments are posted on Quest.

Exams

Exams will be IN-PERSON according to the schedule provided at the end of this syllabus. Exams are closed book, closed notes, and closed homework. You will be provided a hardcopy of select formula sheets from the FE manual, and you are allowed to use a calculator. You are NOT allowed to use a cell phone or tablet in any way during the exam. During the exam, you are NOT allowed to communicate in any way with anyone (except the instructor or a TA) about the exam.

Online Quizzes during Class Meetings

I will be using a cloud-based student response software by iClicker in class this semester for quizzing and polling. You will need to download the “iClicker Reef (REEF Polling)” app ([Android](#), [Apple](#)) create an iClicker Reef Student account to participate in class using your laptop, smart phone, or tablet connected to the university’s Wi-Fi (UTEPSecure) or to your mobile data plan. If you have not used iClicker Reef before, then you can see these instructions: <https://www.utep.edu/technologysupport/Files/docs/iClicker-Reef-Student-Signup-Instructions.pdf> **When creating your account, use your university email address** (username@miners.utep.edu). You will NOT need to purchase a subscription to use iClicker REEF this semester because it is provided to you for FREE. After logging in, click the “plus” button to add a new course, select The University of Texas at El Paso, and then search for CE 3342, and select this course.

Online Lab Presentations and Quizzes

Laboratory presentations and quizzes are administered weekly through Blackboard (<https://my.utep.edu/>).

Packback Discussion Forum

The reading options are: (1) [Cadillac Desert](#) (566 pages), a classic text in the field of water resources engineering in the arid and semi-arid southwestern United States, covering the origins of much of the large water storage reservoirs and conveyance infrastructure, as well as the modern challenges of overallocation and long-term sustainability; (2) [Thirst](#) (314 pages), a recent autobiographic text on the life and work of Founder & CEO of Charity: Water, describing the background, maturation, and professional development of author Scott Harrison as his career evolved and he created a non-profit to help provide people around the world with safe drinking water, and (3) [Tuscon Water Turnaround](#) (441 pages), a recent documentary text on the quest for water sustainability and resiliency by a municipal water utility in an arid desert landscape.

- Option 1:** **Marc Reisner (2017) [Cadillac Desert: The American West and Its Disappearing Water, Revised Edition](#) Penguin Books (ISBN 9780140178241)**
- Option 2:** **Scott Harrison (2018) [Thirst: A Story of Redemption, Compassion, and a Mission to Bring Clean Water to the World](#), Currency (ISBN 9781524762841)**
- Option 3:** **McGuire & Pearthree (2019) [Tuscon Water Turnaround: Crisis to Success](#), AWWA 20844 (ISBN 9781625763433)**

You can compare the chapter titles of each book in the reading schedules listed here:

Packback Schedule: Option 1 – Cadillac Desert

Week	Reading Assignment	Description	Packback Assignment
1	Introduction	A Semidesert with a Desert Heart	1
2	Chapter 1	A Country of Illusion	2
3	Chapter 2	The Red Queen	3
4	Chapter 3	First Causes	4
5	Chapter 4	An American Nile (I)	5
6	Chapter 5	The Go-Go Years	6
7	Chapter 6	Rivals in Crime	7
8	Chapter 7	Dominy	8
9	Chapter 8	An American Nile (II)	9
10	Chapter 9	The Peanut Farmer and the Pork Barrel	10
11	Chapter 10	Chinatown	11
12	Chapter 11	Those Who Refuse to Learn ...	12
13	Chapter 12	Things Fall Apart	13
14	Epilogue	A Civilization, If You Can Keep It	14

Packback Schedule: Option 2 - Thirst

Week	Reading Assignment	Description	Packback Assignment
1	Ch. 1-3	Numb, Poison, Family	1
2	Ch. 4-6	Getting Pure, Slide, “Wishy-Washy ...”	2
3	Ch. 7-9	Lord Scott Harrison, Pursuit, Captured	3
4	Ch. 10-12	Escape, Mercy, A New Day	4
5	Ch. 13-15	Patient No. 1, Ship Time, Homesick	5
6	Ch. 16-18	“Actions, ...”, “They Drink This?”, mercy.	6
7	Ch. 19-21	Better to Beg, Africa Time, No Strings Attached	7
8	Ch. 22-24	Nonprofits for Dummies, charity: water, Three Pillars	8
9	Ch. 25-27	True Believers, Vik, Born in September	9
10	Ch. 28-30	Oblivious, Running on Empty, Radical Transparency	10
11	Ch. 31-33	Do Something, Totally Undisciplined, Do Better	11
12	Ch. 34-36	Rachel’s Gift, Dirty Brown Laundry, With No One Looking Over Your Shoulder	12
13	Ch. 37-39	Just Keep Going, All the Sound Bites ..., Chief Water Boy	13
14	Ch. 40-41	The Spring, Someone Like You, You Are Invited	14

Packback Schedule: Option 3 – Tuscon Water Turnaround

Week	Reading Assignment	Description	Packback Assignment
1	Ch. 1-3	October Surprise for Tuscon, Water in the Sonoran Desert, Extending the Straw to Tuscon	1
2	Ch. 4	Selling the New Water Supply	2
3	Ch. 5	Designing Treatment for CAP Water	3
4	Ch. 6	Distribution System Woes	4
5	Ch. 7	Hayden-Udall Water Treatment Facility Operations	5
6	Ch. 8	Debacle Begins	6
7	Ch. 9	Wake-Up Calls	7
8	Ch. 10	Initial Efforts to Control the Problem	8
9	Ch. 11	Bifurcation to Abandonment	9
10	Ch. 12	Moving Beyond CAP Direct Delivery	10
11	Ch. 13-14	Searching for Solutions, Putting Customers First	11
12	Ch. 15	At the Tap Meets a New Leader	12
13	Ch. 16	Turnaround and Success	13
14	Ch. 17	Epilogue	14

Packback is an online curiosity community where you can be fearlessly curious and ask big questions about how what we are studying relates to life and the real world. Packback will be assisting you with developing writing skills while enhancing your ability to critically analyze the discussions of this course to draw real-world conclusions. For a brief introduction to Packback Questions and why we are using it in class, watch this video: <https://vimeo.com/163888277>. I believe that your life-long learning is more affected by seeking to know WHY than WHAT. In this course, I want you to empower yourself through deep connections between the course materials and your why. Your time in my course will be brief, but your potential to make the most of your life is great. I hope that through this forum you are able to be inspired by your peers to make the most of your learning.

Before you start posting, be sure to read the Community Guidelines found in the tutorial on Packback. If your post doesn't follow the Packback Community Guidelines, there is a chance it will be removed and you won't receive points for that post. **There will be a weekly deadline of Sunday at 11:59 pm Mountain Time for submitting posts.** Note: it takes 24 hours for the Packback team to moderate a post and send a coaching email. If by any reason your post is moderated because it does not meet the Community Guidelines, you will need to edit and re-publish your post to receive credit for the week. It is important that you complete your Packback questions and responses several days in advance of the deadline in case your post is moderated.

How to Register on Packback: You will receive a welcome email from help@packback.co prompting you to finish registration and payment (\$29). Packback has already created an account for you with your UTEP email address, so all you need to do is reset your password. This email may be directed to spam or filtered out, so make sure you do a thorough scan of your inbox if you cannot find the email. If you have ANY questions or concerns regarding Packback throughout the semester, please contact the customer support team at help@packback.co.

Since this involves weekly professional writing, I encourage you to use this opportunity this semester to improve your technical and professional writing skills. I strongly encourage you to use a grammar check (e.g., <http://www.grammarly.com>) and proofread your questions and responses before posting. Unfortunately, popular culture includes making opinionated statements on social media, but in this platform, we want to postulate questions and make statements based on factual information.

For students enrolled in CE 3342, your participation on Packback will count towards 10% of your overall CE 3342 course grade. For students NOT enrolled in CE 4171, your Packback grade is based on weekly

participation: post one Question and two Responses per week, relevant to the assigned chapter that week. By the end of the semester, you should have posted 14 Questions and 28 Responses to other students' Questions (*i.e.*, a total of 42 posts). Part of your Packback grade will be based on your average Curiosity score; an average Curiosity score of 90 will constitute full-credit for the Curiosity score component, and an average Curiosity score of 40 or less will receive no-credit. The Packback Participation Score (*PPS*) for students enrolled in CE 3342 and not enrolled in CE 4171 will be calculated according to the following equation:

$$PPS_{CE\ 3342} = \left(\frac{N_Q}{14}\right)\left(\frac{N_R}{28}\right)\left(\frac{ACS - 40}{50}\right)\left(1 - \frac{N_{IW} - 1}{14}\right)$$

Where N_Q is the number of questions posted, N_R is the number of responses posted, ACS is the Average Curiosity Score of all of your posts for the semester, and N_{IW} is the number of inactive weeks (no posts).

For CE 4171, your participation on Packback will count towards 100% of your overall CE 4171 course grade. Your Packback grade is based on weekly participation: post one Question and three Responses per week, relevant to the assigned chapter that week. By the end of the semester, you should have posted 14 Questions and 42 Responses to other students' Questions (*i.e.*, a total of 56 posts). Part of your Packback grade will be based on your average Curiosity score; an average Curiosity score of 90 will constitute full-credit for the Curiosity score component, and an average Curiosity score of 40 or less will receive no-credit. The Packback Participation Score (*PPS*) for CE 4171, as well as the PPS for CE 3342 for students enrolled in both CE 3342 and CE 4171, will be calculated according to the following equation:

$$PPS_{CE\ 4171} = \left(\frac{N_Q}{14}\right)\left(\frac{N_R}{42}\right)\left(\frac{ACS - 40}{50}\right)\left(1 - \frac{N_{IW} - 1}{14}\right)$$

Students who already passed CE 3153 (lab) will need to complete the same book reading and Packback assignments as the students enrolled in CE 4171 (Engineering Problems), and your Packback score will substitute for the laboratory score in the rubrics below.

Team Project (optional)

Team projects are optional. You may form a team of up to four members, and your team will choose a project. A two-page project proposal must be submitted by the team and approved by me prior to Exam 1. Projects could be a hypothetical design of a conventional water treatment plant or desalination plant for a city, etc.

Course Grade

Assessment of your performance in this course will be determined by homework, quizzes, exams, a team design project, and a peer evaluation. (No makeup exams will be offered.) Handwritten homework calculations must be submitted on engineering paper. The course average will be computed by the one of the following grading schemes:

Evaluation 1 (w/Project)	Fraction (%)
Homework Avg	25
iClicker Quiz Avg	5
Packback Participation Score	10
Laboratory Avg	10
Exam Avg (3)	20
Final Exam	20
Project	10
<i>Total</i>	<i>100</i>

Evaluation 2 (w/o Project)	Fraction (%)
Homework Avg	25
iClicker Quiz Avg	5
Packback Participation Score	10
Laboratory Avg	10
Exam Avg (3)	30
Final Exam	20
<i>Total</i>	<i>100</i>

Graduate students taking this course for graduate credit (not a leveling requirement) are required to complete an individual project and will be graded according to the first evaluation scheme above.

A final exam score of at least 50% is required to pass the course. The final course letter grade for CE 3342 and CE 4171 will be determined according to the following grade ranges:

Course Average (%)	Grade
≥ 90	A
80-89	B
70-79	C
60-69	D
< 60	F

I reserve the right to modify or augment this grading scheme for the sake of improving the educational effectiveness of this course.

Copyright Statement for Course Materials

All materials used in this course are protected by copyright law. The course materials are only for the use of students currently enrolled in this course and only for the purpose of this course. They may not be further disseminated.

General Student Services and Support:

UTEP provides a variety of student services and support:

Technology Resources

- [Help Desk](#): Students experiencing technological challenges (email, Blackboard, software, etc.) can submit a ticket to the UTEP Helpdesk for assistance. Contact the Helpdesk via phone, email, chat, website, or in person if on campus.
- [Engineering Technology Center \(ETC\)](#): Engineering software and computer support.
- [UTEP My.Apps](#): server-based software access

Academic Resources

- [UTEP Library](#): Access a wide range of resources including online, full-text access to thousands of journals and eBooks plus reference service and librarian assistance for enrolled students.
- [University Writing Center \(UWC\)](#): Submit papers here for assistance with writing style and formatting, ask a tutor for help and explore other writing resources.
- [Engineering Tutoring Center \(ACES\)](#): Tutors are recruited from engineering and science student organizations and honor societies.
- [Math Tutoring Center \(MaRCS\)](#): Ask a tutor for help and explore other available math resources.
- [History Tutoring Center \(HTC\)](#): Receive assistance with writing history papers, get help from a tutor and explore other history resources.
- [RefWorks](#): A bibliographic citation tool; check out the RefWorks tutorial and Fact Sheet and Quick-Start Guide.

Individual Resources

- [Military Student Success Center](#): Assists personnel in any branch of service to reach their educational goals.
- [Counseling and Psychological Services](#): Provides a variety of counseling services including individual, couples, and group sessions as well as career and disability assessments.

Special Accommodations

The University of Texas at El Paso provides, upon request, appropriate academic accommodation for students with disabilities. For more information, contact the Center for Accommodations and Support Services (<https://www.utep.edu/student-affairs/cass/>).

Course Schedule

Week	Day	Lesson	Description	Text	HW
1	Aug 22	1	Water Resources Planning and Mgmt.	1.1-8, 2.1-2	1
	Aug 24	2	Water Quality and Treatment Processes	2.3-7; 16.1-3	2
2	Aug 29	3	CO ₂ /Carbonate System and Alkalinity	6.3.3	3
	Aug 31	4	Coagulation	6.1-4	3
3	Sep 05	-	<i>Labor Day Holiday (no class meeting)</i>	-	-
	Sep 07	5	Flocculation and Mixing	6.5-9	4
4	Sep 12	6	Lime-Soda Softening	7.1-9	5
	Sep 14	7	Sedimentation	10.1-6	6
5	Sep 19	8	Granular Media Filtration	11.1-8	7
	Sep 21	9	Microfiltration and Ultrafiltration	12.1-5	8
6	Sep 26	10	Disinfectants and Disinfection Byproducts	13.1-2	9
	Sep 28	-	EXAM 1	Ch. 1-2, 6-7, 10-11	1-7
7	Oct 03	11	Disinfection Design	13.4	9
	Oct 05	12	Ion Exchange; arsenic and nitrate removal	8.1-6; 14.2; 14.6	10
8	Oct 10	13	Air-Stripping and Adsorption	14.11-12	11
	Oct 12	14	Reverse Osmosis and Nanofiltration	9.1-4	12
9	Oct 17	15	Product Stability and Corrosion Control	7.8, 13.3	12
	Oct 19	16	Water Plant Residuals Management	15.1-11	12
10	Oct 24	17	Drinking Water Storage and Distribution	17	12
	Oct 26	18	Nanotechnology Enabled Water Treatment	-	-
11	Oct 31	19	Wastewater Collect. and Treatment	18.1-7, 20.1-6	13
	Nov 02	-	EXAM 2	Chapters 8-9, 12-15	8-12
12	Nov 07	20	Primary Treatment and Flow equalization	21.1-6 and 20.7	13
	Nov 09	21	Microbiology	22.1-9	13
13	Nov 14	22	Secondary Trtmnt: suspended	23.1-9	14
	Nov 16	23	Secondary Trtmnt: attached	24.1-6	14
14	Nov 21	24	Second. Settling, Disinfect., and Re-aer.	25.1-5	14
	Nov 23	25	Sludge Thickening, Digest., and Dewater.	27.1-13	15
15	Nov 28	26	Tertiary Treat. and Potable Reuse	29.1-6	15
	Nov 30	-	EXAM 3	Chapters 18, 20-27	13-15
16	Dec 09	-	FINAL EXAM, 10:00 am – 12:45 pm	(comprehensive)	1-15

Lab Schedule

Week	Lab	Description
1	-	<i>No labs this week (first week of classes)</i>
2	1	Documentary: Last Call at the Oasis (2011)
3	-	<i>No labs this week (Labor Day holiday)</i>
4	2	Drinking Water Treatment Plant Tour
5	3	pH and alkalinity
6	4	Turbidity, conductivity, TSS, & TDS
7	5	Spectrophotometers (chlorine); IDEXX Most Probable Number (Coliforms & <i>E. coli</i>)
8	6	Hardness, sulfate; ion chromatography
9	7	W & WW Engineering Consulting Office Tour
10	8	Desalination Plant Tour
11	9	Wastewater Treatment Plant Tour
12	10	DO, COD
13	11	Ammonia, nitrate, and phosphorous
14	12	Potable Reuse Treatment Pilot Tour