

Oceanography 320: Aquatic Pollution
Fall 2016
Tu-Th 09:00-10:15
MSB 315

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Date		Topic	Chapter
Aug	23	Introduction, Course objectives	
		First in class writing assignment	
	25	Food chain theory	1
Aug	30	Primary production	2
Sep	1	Primary production	2
Sep	6	Physical factors affecting production	3
	8	Cultural eutrophication	4
Sep	13	Cultural eutrophication	4
		Extended Outline of 1st term paper due	
	15	Cultural eutrophication and Recent research in Kaneohe Bay	4
Sep	20	Sewage treatment – primary, secondary	6
	22	Sewage treatment – tertiary and alternatives	6
Sep	27	Video: Waters of Ayole	
	29	Pathogens	7
Oct	4	Class Discussion: Water and health	-
		1st term paper due to instructor	
	6	Pathogens in water supplies	7, 5
		Second in-class writing assignment	
		Non-Point source pollution,(NPS), urban runoff	
Oct	11	NPS-Urban runoff	5
	13	First Exam	-

Oct	18	Pesticides	10
	20	Pesticides	10
Oct	25	Pesticides. Alternatives	10
		Third in-class writing assignment	
	27	Thermal Pollution	11
Nov	1	Thermal Pollution	11
	3	Metals	12
Nov	8	Metals, continued	12
		Extended Outline of 2nd term paper due	
	10	Metals, continued	12
Nov	15	Oil Pollution	13
	17	Oil Pollution	13
Nov	22	Acid Deposition	15
	24	Holiday: Thanksgiving	
Nov	29	Groundwater Pollution	16
		2nd term paper due to instructor	
Dec	1	Groundwater Pollution	16
Dec	6	Student Presentations	-
	8	Student Presentations	-
Dec	15	Final Examination, 09:45-11:45	

Oceanography 320: Aquatic Pollution

Fall 2015

TEXT BOOK

Aquatic Pollution: An Introductory Text. 3rd Edition (2000), by E. A. Laws, John Wiley and Sons, Inc. NY (ISBN 0-471-34875-9)
Library card catalog number: TD420.L38 2000

GENERAL COURSE COMMENTS

This course is not particularly difficult if you have some basic background in chemistry and biology (i.e., introductory courses) as well as the formal course prerequisite (OCN 201). Students with no chemistry or biology background will be at a potential disadvantage, because class presentations and discussions will often invoke basic concepts from these subjects. **If you have no background in chemistry or biology, you will likely need to spend additional time outside of class on your own to obtain a basic understanding of some fundamental principles.** You are encouraged to seek assistance from the course instructor, as needed, but not much time will be spent covering basic biology or chemistry in class so as not to slow down the pace of the class or inconvenience the students who already have this background.

Students are responsible for knowing and adhering to due dates for textbook readings and writing assignments unless notified otherwise by the course instructor. **The schedule of lecture topics is tentative and current events and/or special topics related to a given class topic may be given class time and cause changes in the lecture schedule.** Significant schedule changes will be announced during class time and, once announced, become the responsibility of the students. Extreme deviations from the lecture schedule will be provided in the form of an updated syllabus on the web site or handed out in class, or by email to the students.

Limited information about this course, including some old exams from the professor who wrote our textbook, is available on the OCN 320 website:
<http://www.soest.hawaii.edu/oceanography/courses.html>

Important class postings including any course changes, new reading assignments, selected (but not all) lecture notes, etc. will be available on the Lulima site for this class.

GRADING

Your grade in this course will be based on the total points you achieved in the course, curved relative to the rest of the class. The commonly used scheme of most US secondary schools and colleges of 90-100 = A, 80-89 = B, 70-79 = C, etc., will not be particularly useful as a guideline in this course. Course tasks (quizzes, exams, papers, etc.) in this course are designed so that numerical scores are broadly distributed, thereby facilitating the separation of final numerical scores and assignment of letter grades. You are encouraged to check how you are doing in the course throughout the semester by asking the course

instructor to give you an estimate of your grade based on points earned up to the time of your request. Please do keep in mind that “estimated” letter grades on individual components are not averaged to yield a final letter grade. In summary:

Final letter grades will be based on numerical scores and the class curve.

The fraction of total points achievable in the various course categories is shown below:

- a) **Periodic quizzes (15%)**
- b) **Midterm exam (20%)**
- c) **Final exam (20%)**
- d) **Short essays/writing assignments worth 10% of the total course grade and EITHER two term papers worth 10% each, OR a weekly journal (as described below) worth 20% of the course grade, for a total possible score for all writing assignments of 30% of the course grade**
- e) **One classroom presentation (10%)**
- f) **Classroom participation (5%)**

STUDENT EXPECTATIONS

YOU (THE STUDENT) ARE RESPONSIBLE FOR THE GRADE YOU OBTAIN

Because the syllabus is effectively the “contract” for this course, the successful student will read this document carefully and use it as a reference throughout the semester.

If you are like most of us who cannot remember everything we hear throughout our busy lives, it is important to write down information in a notebook dedicated to this class. This includes specific directions from the course instructor regarding assignments as well as the taking of notes during class. There is a positive correlation between note-taking in class and grades achieved in many courses, and it has long been demonstrated that note-taking is a valuable memory and learning aid.

In order to facilitate note taking in class a summary printout of the class powerpoint presentation slides for each chapter/topic will be posted on Laulima. You should print it and bring it to class with you. **NOT ALL MATERIAL PRESENTED IN CLASS WILL BE ON THE HANDOUTS.** The powerpoint slides are NOT, by any means, all you need to know to obtain high scores on the quizzes and exams. Additional note-taking is critical.

To get the most benefit from your note-taking, you should review your notes relatively soon after class (i.e., that day) and expand or clarify them. This process will help you assimilate the subject material.

When you have questions in class, do not hesitate to ask and, as necessary, follow up after class! If you have questions outside of class, please do your own research on the topic first so as to be prepared to ask informed questions and have a fruitful discussion.

Please plan your time carefully and appropriately. We are all busy and most of you are taking multiple courses, each of which likely requires work outside of class. **For this**

course, each class lecture session should generate 3-4 hours of outside work, depending on your preparation for the course and writing skills, for a total of 9-12 hours of time outside of class per week. It is imperative that you keep up in this class. If you cannot devote the time outside of class that is indicated above, maybe you reconsider your participation in the class. It is highly unlikely that you will be able to cram successfully and catch up one or two nights before an exam and do well!

Each of us has a slightly different learning style (hence a different ability to succeed following a particular approach). If you know what works for you, by all means follow it. If your current approach for learning does not work you should try a different approach.

Do not hesitate to consult the course instructor and/or TA for help and advice, and remember that this course is for you. Quizzes will be **unannounced** and based partly on material previously covered in classroom lectures and partly on the assigned readings (i.e., the material that has not yet been covered in class). There will be **NO MAKEUP** of any missed quizzes. Excused absences from quizzes, however, will be factored into the total quiz score.

Exams will test student knowledge of the material covered in classroom lectures and the assigned textbook readings (please note that not all textbook materials and other assigned readings can be discussed comprehensively in class but that knowledge and understanding of the material does remain the responsibility of the student).

The first exam will include material covered from the beginning of the course to immediately prior to the first exam. The second (final) exam will principally cover material presented **after** the first exam. Although the second exam is not specifically designed to be cumulative, knowledge is cumulative, and comprehension of certain concepts learned during the first half of the semester can be important in mastering the subject matter presented in the latter part of the course.

Exams will include a combination of multiple-choice, true/false and fill in the blank questions, short (quantitative) problems and short essay questions. **Exams will be sufficiently challenging that only well-prepared students will be able to complete the entire exam during the allocated time.**

STUDENT LEARNING OUTCOMES

Upon completion of this course students will:

- 1) Be able to understand and explain to lay and technically skilled persons the underlying principles of primary productivity and eutrophication and how natural events and human induced changes impact these processes in fresh and coastal water bodies.
- 2) Be able to understand how different human activities affect the composition of natural waters (fresh and marine) and how to evaluate “cause and effect” relationships” between pollution and the welfare of the “biology”.

- 3) Be able to understand how to make informed decisions regarding stewardship of natural waters and how to minimize the adverse impacts of human activities on natural water bodies.
- 4) Through writing formal scientific papers and group oral presentations, students will have developed organizational, collaborative, and presentation skills that lead to improved oral and written communication skills.

WRITING ASSIGNMENTS:

The University of Hawaii “writing intensive” designation for a course is defined as a minimum of 16 pages of original writing during the semester. In this class the writing intensive requirement is met through several short in-class and outside of class essays of and two research/term papers.. **Only writing (double spaced 12pt Times new Roman font with one inch margins) is counted towards the page total. Figures, tables, and reference lists in the term papers do NOT count towards the page total.**

The student group classroom presentations will be on a topic of specific interest to your group (the group membership will be assigned a few weeks before the presentations) but must be approved by the course instructor. More details on the format of the presentations are provided below.

Information presented in your research papers and the classroom presentation **must be based on material derived from a minimum of three peer-reviewed** publications from the scientific literature; other material you wish to use can be included as long as you have met the three peer-reviewed paper criterion. The course textbook, web sites, magazines, newspapers, etc. are meant to **supplement** the minimum required peer reviewed articles. When using non-peer reviewed resources, it will also be necessary for you to clearly delineate how objective, credible, or biased the opinions presented in the particular resources may be. A portion of your grade on the papers will depend on the appropriate use and citations of references.

Students must turn in complete extended outlines of the papers by dates specified in the syllabus for preliminary review by the course TA and to ensure the paper will be of sufficient scope to meet the class requirements. If you do not provide the first draft for review, you will be missing an important opportunity to obtain assistance that will ultimately lead to a better grade on the assignment. **All drafts and final papers turned in late will be penalized 5% points per day late. There will be NO EXCEPTIONS to this policy.**

The term paper extended outline/rough draft will be handed in and reviewed by the course instructor who will provide a brief assessment of the writing plan and make any necessary recommendations for improvement. After return of the outline, students will prepare a fully developed paper that will then be graded for style, grammar and scientific content. The grading will reflect the level of adherence to pre-set norms for these elements. Students are expected to pay careful attention to the nature and type of editorial comments they receive on their extended outline so as to improve their writing skills. Please remember that papers

will be evaluated in terms of their adherence to common norms of scientific (objective, expository) writing, rather than lay prose or a journalistic reporting style.

The structure of your term papers should include the following:

- 1) **The title of your paper and your name** (on the top of the first page)
- 2) **An introduction.** This should be one to two well written paragraph (not exceeding one page). Its purpose is to introduce the topic of the essay. This/these paragraph(s) should inform the reader about what you will be writing and provide the rationale for the paper as well as a brief layout of the rest of the paper. It is in your introduction that you must explain why the subject matter is important and worth the time that one would spend reading it.
- 3) **The body of your paper.** In the body of your paper you will develop several individual paragraphs that flow logically; i.e., the material in each paragraph follows from the previous paragraph and carries the reader from start to finish. Please be concise and avoid repetition. Each paragraph must stand alone and cover a topic that is specifically called out and described in the introductory sentence of said paragraph. The final sentence in a paragraph leads the reader into the topic of the subsequent paragraph.
- 4) **The final summary paragraph.** This paragraph provides the reader with a brief summary of the most important conclusions of your paper. It should also point out what information might be missing and what additional work should/needs to be done on this topic. This is also where you may express your own opinions as to whether bias and/or lack of information may have led to the topic not being treated completely or accurately.
- 5) **The reference list.** All sources of materials used in your paper, including peer reviewed journal articles, books, newspaper articles, magazine articles and web-sources, must be cited. The reference list must follow the format used for scientific literature, rather than that used in social sciences or non-science majors.

Some Hints to Help you Write

An old saying about oral presentation and papers goes as follows: 1) you tell them what you are going to tell them, 2) you then tell them, and 3) you finish by telling them what you just told them...

This seems pretty simple, but you will be surprised how many presentations and papers fail to adhere to this simple format. The value of this approach comes from reinforcing ideas in the mind of the reader by reminding the reader (frequently) what the subject is. Please avoid using “this”, “these”, “those”, etc. repeatedly. Instead, restate exactly to what you are referring to help imprint on the reader’s mind the subject.

The writing assignments in this course have two primary objectives. The first is to help reinforce some concepts that are introduced during the lectures as well as to allow you to acquire a more in-depth understanding of the material than is possible from simply listening to the instructor in lecture and/or reading the textbook. The second objective is to help you improve your critical thinking and writing skills. It is well-known that one of the better ways to learn material is to write about it. Good communication skills are also very

important in most professional occupations. I cannot overemphasize how many times I have been asked by prospective employers, who were recruiting to fill job openings, how well an applicant wrote, because the employer needed a person with “good communications skills”.

Unfortunately, as is the case with many things, the only improve your writing is to do it frequently... Practice makes perfect, as the old adage goes... The more you write, the better your writing will become and the easier it will become for you to write. Many of us may not initially like to write, but developing effective writing skills is a very important part of your professional training.

How to construct your papers:

Try to make the content of your papers follow a logical sequence. First introduce a problem and describe why it is of interest. Then present some known fact(s) (and/or data). Subsequently, present (one or more) hypotheses that have been advanced by those who have worked on the subject matter and try to present and evaluate, as much as possible, alternative hypotheses or arguments. In all cases, ensure that material in the early sentences and paragraphs leads into the subsequent discussion. Conversely ensure that material fits in and follows from what was previously stated/written (i.e., the paragraphs should not be a “brain dump” of random unrelated thoughts). Verify that the material in each paragraph relates to the introductory sentence of that paragraph. Also material in the next paragraph should follow logically from the last (transitory) sentence in the previous paragraph. Make sure that you let the reader know when you transition from one point to another or when you are explaining an opposing hypothesis/argument. Words such as “however”, “in contrast”, and “nonetheless” help the reader realize that you are changing topics or presenting a differing opinion.

The development of extended outlines, while seemingly simple yet unexciting, will prove to be very helpful to organize your thoughts. This is why you are required to prepare and turn in detailed outlines for evaluation before you turn in your written assignments. Detailed outlines are effectively a list of brief synopses of the multiple lines of evidence you will use to support the main point of the paper. As you begin to fill in an outline with increasingly more detail, you will find that its utility increases and that it can serve as a roadmap to the structure of your paper. If you take it to the extreme, the outline can become your first draft...

Your writing assignments should be concise and articulate. This is easier said than done and, to achieve this goal, you will likely have to edit your paper carefully and repeatedly! The writing assignments of this course, however, should not represent an onerous time commitment on your part. Try to begin your writing assignments early (i.e., do not procrastinate) and do not worry too much about how well you write your first draft. Your first draft can be an “idea train”, where you just put down the ideas as they develop in your head and then build upon them. Once you have looked over your reference materials and jotted down relevant information, you begin to write thoughts that come to your head about the topic, without paying great attention to grammar, structure or whether the ideas follow logically or not. Use word processor software to develop both your outlines and the

subsequent paper, as this facilitates editing and filling in material later, as well as re-arranging things that are not in a logical order.

The first draft you write will likely not be much fun or interesting for anyone else to read, but that is fine, at least at this stage. Put the first draft away for a at least one day, then come bac, re-read it and evaluate what is missing as well as look for material that does not relate to the subject at hand. An important part of your editing of the first draft will be to eliminate material that “hangs” and/or is inconsistent with what you are trying to express. Unsupported thoughts and arguments should also be eliminated at this stage.

Once you have a second draft, have **someone else** read it and provide you with feedback. Room-mates, friends, significant others, instructors from other courses, etc. can help you significantly improve your writing because they are looking at your paper with fresh (and unbiased) eyes.

Use of references in your writing assignments:

Writing assignments must be supported by a list of bibliographic references that describe the sources of material that were consulted. The use of relevant published references gives proper credit to the original authors whom you quote, and provides a historical timeline for the reader to examine at greater length if he or she desires. Keep in mind that peer-reviewed literature articles are much better references than popular literature or the various blogs, etc. on the internet because **they have already been vetted as relevant and sound by other experts in the field**. These references are less likely to be subjective and/or biased or contain unsupported opinions than what you may find in newspaper or magazine articles and blogs, etc.

A good example of what **not to use** is an article that says: “Plaxo has been proven to be 60% more efficient in enhancing digestive function”... I ask: 60% more efficient than what? Who determined this and how? What is the source of this information and how do I know that it is reliable? **Remember, you must document any argument you make.**

Citations in your text and reference lists must follow the style used in scientific publications, not liberal arts, history, English, etc. Each citation in the text should state the name of the author (or authors) followed by the year of publication. For example a text citation should read as follows: A study of school children showed that using Plaxo as a food additive helped digestion (Smith and Tanaka, 2007). Alternatively you could say: A study conducted by Smith and Tanaka (2007) demonstrated that using Plaxo as a food additive helped digestion. If there are more than two authors the citation should be: Smith et al. (2007) or (Smith et al., 2007).

The references should be listed in alphabetical order with multiple entries by a given author listed in chronological order. Again, please use the scientific literature style. Here are some examples:

- Ahad, J.M.E., Barth, J.A.C., Ganeshram, R.S., Spencer, R.G.M. and Uher, G. 2008. Controls on carbon cycling in two contrasting temperate zone estuaries: The Tyne and Tweed, UK. *Estuarine, Coastal and Shelf Sci.* 78:685-693.
- Balls, P.W. 1994. Nutrient inputs to estuaries from nine Scottish East Coast rivers: Influence of estuarine processes on inputs to the North Sea. *Estuarine Coastal and Shelf Sci.* 39: 329-352.
- Berner, R.A. and Rao, J.-L. 1994. Phosphorus in sediments of the Amazon River and estuary: Implications for the global flux of phosphorus to the sea. *Geochim. Cosmochim. Acta* 58:2333-2339.
- Caraco, N. F. 1995. Influence of human populations on phosphorus transfers to aquatic systems: A regional scale study using large rivers. *Phosphorus in the global environment*. Chichester, John Wiley & Sons. 235-244.
- Carruthers, T.J.G., van Tussenbroek, B.I. and Dennison, W.C. 2005. Influence of submarine springs and wastewater on nutrient dynamics of Caribbean seagrass meadows. *Estuarine Coastal and Shelf Science* 64:191-199.

In the case of two papers by the same author(s) in a given year, please cite them in the text as, for example, Kawahara (1998a) and Kawahara (1998b) so as to differentiate them.

For non-peer reviewed citations, please select a format and then use it consistently. You should, however, still cite by last name first, followed by first initial(s), YEAR, and then the rest of the info such as title, followed by the source of the info.

The following are topics of your writing assignment if you choose to write two term papers (see schedule for due dates):

Each of your two term papers should be about 6 pages long, double spaced, excluding references, graphs and tables. Please use Times Roman 12 pt font with your margins set at no more than 1 inch from each side as well as the top and bottom of the page. All papers must be paginated. All papers must be turned in both electronically (MS Word) and in hard copy. If you do not adhere to the above criteria you will lose points.

1) Eutrophication of coastal waters: Hypoxic and anoxic zones

The focus of this paper is to be on **cause and effect** relationships between land-derived (natural or anthropogenic) inputs of freshwater, suspended sediment and their associated nutrient loads on the coastal waters and, ultimately, how the ensuing primary productivity leads to (over) consumption of oxygen. **You must use quantitative data to substantiate any arguments presented in your paper.**

Some starting points/reference papers are given below.

- Bishop, J.M., Glenn, C.R., Amato, D.W., and Dulai, H. 2016 Effect of land use and groundwater flow path on submarine groundwater discharge nutrient flux. *Journal of Hydrology*, in press <http://dx.doi.org/10.1016/j.ejrh.2015.10.008> 2214-5818
- Caraco, N. F. 1995. Influence of human populations on phosphorus transfers to aquatic systems: A regional scale study using large rivers. *Phosphorus in the global environment*. Chichester, John Wiley & Sons. 235-244.
- Carruthers, T.J.G., van Tussenbroek, B.I. and Dennison, W.C. 2005. Influence of submarine springs and wastewater on nutrient dynamics of Caribbean seagrass meadows. *Estuarine Coastal and Shelf Science* 64:191-199.
- Cheroske A.G., Williams, S.L., and Carpenter, R.C. 2000. Effects of physical and biological disturbances on algal turfs in Kane‘ohe Bay, Hawai‘i. *Journal of Experimental Marine Biology and Ecology* 248:1–34.
- De Carlo, E.H., Hoover, D.J., Young, C.W., Hoover, R.S. and Mackenzie, F.T. 2007. Impact of storm runoff from subtropical watersheds on coastal water quality and productivity. *Applied Geochemistry*, 22:1777-1797, <http://dx.doi.org/10.1016/j.apgeochem.2007.03.034>
- Drupp, P., De Carlo, E.H., Mackenzie, F.T., Bienfang, P., and Sabine, C. Nutrient inputs, phytoplankton response and CO₂ variations in a semi-enclosed subtropical embayment, Kaneohe Bay, Hawaii. *Aquatic Geochemistry (2011)* <http://dx.doi.org/10.1007/s10498-010-9115-y>
- Garrison, G.H., Glenn, C.R. and McMurtry, G.M. 2003. Measurement of submarine groundwater discharge in Kahana Bay, Oahu, Hawaii. *Limnology and Oceanography* 48:920-928.
- Hoover, R.S., Hoover, D., Miller, M., Landry, M.R., DeCarlo, E.H., and Mackenzie, F.T. 2006. Zooplankton response to storm runoff in a tropical estuary: bottom-up and top-down controls. *Marine Ecology Progress Series* 318: 187–201.
- Hoover, D.J. and Mackenzie, F.T. 2009. Fluvial fluxes of water, suspended particulate matter and nutrients and potential impacts on tropical coastal water biogeochemistry: Oahu, Hawaii. *Aquatic Geochemistry*. DOI 10.1007/s10498-009-9067-2
- Laws, E.A. and Allen, C.B. 1996. Water quality in a subtropical embayment more than a decade after diversion of sewage discharges. *Pacific Science*, 50(2):194-210.
- Laws, E.A., Ziemann, D. and Schulman, D. 1999. Coastal water quality in Hawaii: The importance of buffer zones and dilution. *Marine Environmental Research* 48:1-21.
- Mackenzie, F.T., De Carlo, E.H. and Lerman, A. 2012. **Chapter 12: Coupled C, N, P, and O cycling at the land ocean interface**. In J. Middleberg, (Ed) *Treatise on Coastal and Estuarine Science*, Volume 5: Elsevier Publishers.
- Rabalais, N. 2004. Eutrophication. Chapter 21, pp. 819-865 in A. R. Robinson, J. McCarthy and B. J. Rothschild (eds.), *The Global Coastal Ocean: Multiscale Interdisciplinary Processes, The Sea*, Vol. 13, Harvard University Press.
- Rabalais, N. N., N. Atilla, C. Normandeau and R. E. Turner. 2004. Ecosystem history of Mississippi River-influenced continental shelf revealed through preserved phytoplankton pigments. *Marine Pollution Bulletin* 49: 537-547.
- Rabouille, C., Conley, D.J., Dai, M.H., Cai, W.-J., Chen, C.T.A., Lansard, B., Green, R., Yin, K. Harrison, P.J., Dagg, M. and McKee, B. 2008. Comparison of hypoxia among four river dominated ocean margins: The Chianjiang (Yangtze), Mississippi, Pearl and Rhône. *Continental Shelf Research* 28:1527-1537.

- Ringuet, S. and Mackenzie, F.T. 2005. Controls on nutrient and phytoplankton dynamics by storm runoff events, southern Kaneohe Bay, Hawaii. *Estuaries*.28:327-337
- Scavia, D., N. N. Rabalais, R. E. Turner, D. Justic, and W. J. Wiseman, Jr. 2003. Predicting the response of Gulf of Mexico hypoxia to variations in Mississippi River nitrogen load. *Limnology & Oceanography* 48: 951-956.
- Smith, S.V., Kimmerer, W.J., Laws, E.A., Brock, R.E., and Walsh, T.W. 1981. Kaneohe Bay sewage experiment: Perspectives on ecosystem responses to nutritional perturbation. *Pacific Science*. 35:379-395.
- Turner, R. E. and N. N. Rabalais. 2004. Suspended sediment, C, N, P, and Si yields from the Mississippi River Basin. *Hydrobiologia* 511: 79-89.
- Turner, R. E. and N. N. Rabalais. 2003. Linking landscape and water quality in the Mississippi River basin for 200 years. *BioScience* 53: 563-572.
- Solley, Pierce, and Perlman. 1998. Estimated Use of Water in the United States in 1995. U.S.G.S. Circular 1200.

2) For the second paper, you have several choices of topics. They are:

- a) Water Quality/Water Pollution in Urban Environments**
- b) Water quality issues following natural disasters (e.g., Hurricane Katrina in New Orleans, Horizon deep water well disaster in the Gulf of Mexico), the 2011 Tohoku earthquake and tsunami, water issues in conflict/war zones or in under-developed nations.**
- c) Water rights and conflicts, from local to global (e.g., Waiahole ditch-tunnel controversy, Western US water use rights, international water conflicts)**

Keep in mind that there is a large body of peer-reviewed literature available for the first topic and most aspects of the second topic. It may be more difficult to write a term paper on the third topic, because there is likely less peer-reviewed literature available. Because the third topic has both political and scientific interest, you may make more extensive use of newspaper, magazine and web resources. You must, however, still utilize **at least two peer reviewed reference papers**.

Some starting points/reference papers are given below.

- Beltran, V.L. and De Carlo, E.H. 2005. Variability of particulate metal concentrations during storm events in streams of a subtropical watershed. Chapter 15 in “Environmental Chemistry”, E. Lichtfouse, S. Dudd, S. Robert, Eds. (Springer Verlag), pp153-176.
- Bienfang, P, De Carlo, E.H., Christopher, S., DeFelice, S. and Moeller, P. Trace element concentrations in coastal Hawaiian waters. *Marine Chemistry* (2009) 113(3-4), 149-256. <http://dx.doi.org/10.1016/j.marchem.2009.01.007>
- De Carlo, E. H. and Spencer, K.J. 1995. Sedimentary records of anthropogenic inputs of heavy metals to the Ala Wai a small man-made estuary in Honolulu, Hawaii. *Pacific Science*, 49(4), 471-491.
- De Carlo, E.H. and Anthony, S.S. 2002. Spatial and temporal variability of trace element concentrations in an urban subtropical watershed, Honolulu, Hawaii. *Applied Geochemistry*, 17:475-492.
- De Carlo, E.H., Beltran, V.L., and Tomlinson, M.S. 2004. Composition of water and suspended sediment in streams of urbanized subtropical watersheds in Hawaii.

- Applied Geochemistry, 19(7):1011-1037.
[doi:10.1016/j.apgeochem.2004.01.004](https://doi.org/10.1016/j.apgeochem.2004.01.004)
- De Carlo, E.H., Tomlinson, M.S., and Anthony, S.A.. 2005. Trace elements in streambed sediments of small subtropical streams on Oahu, Hawaii: Results from the USGS NAWQA Program. Applied Geochemistry, 20(12):2157-2188
[doi:10.1016/j.apgeochem.2005.08.005](https://doi.org/10.1016/j.apgeochem.2005.08.005)
- De Carlo, E.H., Tomlinson, M.S., DeGelleke, L., and Thomas, S. 2013. Distribution and abundance of arsenic in soils and sediments of Oahu, Hawaii. Aquatic Geochemistry
<http://dx.doi.org/10.1007/s10498-013-9212-9>
- Fiedler, J., McManus, M., Tomlinson, M.S., De Carlo, E.H., and 7 others. 2014. Real-time Observations of the February 2010 Chile and March 2011 Japan Tsunamis in Honolulu, Hawai'i, as recorded by the Pacific Islands Ocean Observing System Oceanography. 27(2) <http://dx.doi.org/10.5670/oceanog.2014.34>
- McMurtry, G. M., Wiltshire, J. C., and Kauahikaua, J. P. 1995. Heavy metal anomalies in coastal sediments of O'ahu, Hawai'i. Pacific Sci. 49(4), 452-470.
- Spencer, K. J., De Carlo, E. H., and McMurtry, G.M. 1995. Isotopic clues to the sources of natural and anthropogenic lead in sediments and soils from Oahu, Hawaii. Pacific Science, 49(4), 492-510.
- Sutherland, R. A. 2000. Bed sediment-associated trace metals in an urban stream, Oahu, Hawai'i. Environmental Geology, 39(6), 611-627.
- Sutherland, R.A. and Tolosa, C.A. 2000. Multi-element analysis of road-deposited sediment in an urban drainage basin, Honolulu, Hawaii. Environmental Pollution 10: 483-495.
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As an alternative to writing the above two term papers, you also have the option of preparing a journal of current events in Hawaii and around the world that relate to aquatic pollution.

This option, however, requires that you start from the beginning of the semester and update the journal weekly. The journal must be turned in to the course instructor on **EACH MONDAY** (except holidays) and will be returned to you by the Friday of the same week. You will be assigned a score for EACH entry in the journal over the course of the entire semester. The average of the scores will then be used as your final grade for this writing assignment (worth 20% of your final grade).

The format of the journal will be to find articles in newspapers (e.g., NY Times, Washington Post, San Francisco Examiner, Honolulu Star Advertiser, etc.) or weekly magazines (e.g., The Economist, Time, Newsweek, etc.) that you will summarize in approximately one to a maximum of two type-written pages, and explain why the “event/occurrence” is important and what are its implications either locally, regionally or globally. Note: you CANNOT use reports on TV or in blogs on the internet, although use of the internet to access newspapers and magazines is acceptable. The text you prepare for each weekly event must adhere to proper writing style, with an introductory paragraph, a main body, and a concluding paragraph. Grammar and style will be graded in addition to content.

GROUP CLASSROOM PRESENTATION

This assignment is designed to provide students with the opportunity to develop their organizational, collaborative, and (oral) communications skills. As part of this assignment students will team up in small groups to develop a 10-12 minute power-point presentation on a topic of relevance to the class. All students in each group are expected to participate in all aspects of the assignment. Students will prepare a handout of the power-point slides as well as an extended text outline (lesson plan) that includes more in-depth or supplementary information not will not be covered during the classroom presentation. The extended text outline should be 2-3 pages in length and include a (peer-reviewed) reference list for supplemental reading. **The final exam will include questions from all student classroom presentations.**

IMPORTANT: Because of its “W” designation students must complete all writing assignments to pass this course, i.e., a letter grade of F for the ENTIRE COURSE will automatically be given to anyone who does not meet the writing and classroom presentation requirements, regardless of the number of points achieved on quizzes and exams.