LLS2024 Part 5 — Geoethics

5-Geoethics-Script-20241008.docx to accompany 5-Geoethics-20241011.key
By Vincent S. Cronin, revised October 8, 2024

SLIDE 01 *<lecture series slide>*

SLIDE 02 I have compiled a web page with resources that interest you. You can get to it either through the homepage for this lecture series or through the URL shown here. I recommend in particular, the work of my friend Dave Mogk in his published papers and extensive web resources for information about the responsible conduct of research and how to survive in a university.

I have been concerned with geoethics since the late 1970s as an undergraduate. I mentioned early this morning that I worked on NASA's Viking II mission with my advisor, Alex Baird. When Professor Baird submitted the first paper about the chemical composition of Martian soils, one of the journal's external reviewers took the data table and published it separately as if it were his work. Another professor made a public presentation of the work, reportedly leaving the impression that he had been directly involved when, in fact, he had nothing to do with the project. So, a single manuscript inspired two people to independently commit two serious ethical breaches.

SLIDE 03 I hasten to add that my early-career mentors were scrupulously honest, excellent geoscientists. The contrast between my mentors and these two morally bankrupt schlubs was stark.

I coauthored my first paper dealing, in part, with applied ethics in 1987, by which time I had witnessed at close hand several instances of unethical behavior in academia (concerning research ethics) and in engineering geology (concerning professional geoethics). As the years rolled on, I was the target or victim of unethical behavior -- not just an observer -- several times.

My interest in geoethics has evolved and strengthened throughout my career. The details are not necessary, but I claim experience and some knowledge about the topic.

SLIDE 04 Before we move on, I want to recall the last topic — global warming. I intended to focus on the data and not tell the history, but now it's time to mention that aspect of the issue. Two reports published by the US National Academy of Sciences in 1979 and 1983 present everything we need to know about the general problem of anthropogenic greenhouse gases, global warming, and the consequences of global warming. Since these two reports were published, **more carbon has been added to the atmosphere than in all human history before the reports were published.**

SLIDE 05 This failure to begin the energy transition promptly four decades ago places us all at much greater risk. Slow-walking the transition now is ethically indefensible if we think of ethics as being concerned with the public's safety, health, and welfare.

SLIDE 06 Geoscientists are the essential intellectual bridge between humanity and Earth's ecosystems, resources, and hazards. Professional geoscientists are educated through the expenditure of community resources. Applied geoscientists work in the public interest regardless of who pays our salaries. As professionals, we are responsible to the public.

SLIDE 07 By virtue of our advanced education, knowledge, and skills, geoscientists have a unique responsibility for the stewardship of our home — Earth and its ecosystems.

SLIDE 08 We bear our special knowledge in trust for all humankind.

Anyway, when I get home tomorrow, I will begin helping the National Association of State Boards of Geology (ASBOG) develop video resources to educate students and early-career geoscientists about professional ethics. Perhaps because of this, most of my presentation today will involve practical matters related to applied geoscience.

SLIDE 09 Let's start with a small case history...

SLIDE 10 Here is an oblique aerial photo of Big Rock Mesa in Malibu as it was in 1962 -- the year that this young consulting geologist was hired to do pre-development geological survey of the mesa.

Quoting Jim Slosson's published account, "At that time, the owner/developer of several hundred largely unimproved hillside building sites, located on ...Big Rock Mesa...employed the [consultant] to perform an engineering geologic investigation and report. The report was required for issuance of a permit for the grading and development of a residential subdivision of the property.

In the course of his geologic field investigation, the [consultant] discovered what he considered to be evidence of a deep-seated ancient landslide underlying Big Rock Mesa and the property, a feature not then shown on the usually reliable USGS maps."

"Still acutely naive concerning the ways and wiles of big-city developers, he disclosed his suspicions to the developer and the other consultants at a project meeting. To say that all hell broke loose would be a gross understatement. The [consultant] was instantly fired and told in no uncertain terms to destroy all written notations pertaining to his wild, unfounded theory. Needless to say, he was not paid for his services and was threatened with a lawsuit if there were any leaks to the county or media..."

SLIDE 11 Here, you see Big Rock Mesa in 1927 when Malibu was confined mainly to a narrow strip along the coastline.

SLIDE 12 Here is a vertical aerial photo of Big Rock Mesa taken in 1927 by the Fairchild Aerial Survey company.

SLIDE 13 Another consultant who could not or would not recognize and map the landslide that the dismissed consultant had discovered was hired. Permits were issued, and between 1964 and 1983, 280 homes were built on the mesa.

SLIDE 14 In 1983, the consultant was vindicated when a slide block with 216 homes on 150 acres started moving at a rate of about an eighth of an inch per day. Did I mention that there are no sewers in Malibu, and so all of the houses on Big Rock Mesa had their own septic system injecting wastewater into the ancient landslide that the consultant had mapped.

SLIDE 15 A closer look at the pre-development aerial imagery suggests geomorphic evidence of the ancient slides that were reactivated once septic systems began to saturate them.

SLIDE 16 Today, the homeowners share expensive ongoing remediation costs, and the anxiety of living on a giant landslide mass.

SLIDES 17–34 < *ad libitum* until Hansch house photo> What happened to that original consultant who was fired for doing his job well?

SLIDE 35 He survived to become the State Geologist of California and one of the earliest members of AEG. Jim Slosson helped develop guidelines and standards for the work of engineering geology, along with improvements to grading codes and code enforcement, that resulted in significant decreases in losses due to landslides in California. He was also a strong advocate for professional licensure of geologists. I worked with him on geological cases on-and-off for nearly three decades.

SLIDE 36 Engineering geologic investigations by qualified professionals are searches for reliable information — for truth bounded by uncertainty. "The right to search for truth implies also a duty; one must not conceal any part of what one has recognized to be true."

SLIDE 37 Einstein wrote that "truth is what stands the test of experience." Scientific investigations done poorly or dishonestly lead us away from the truth, and perpetuate a useless ignorance.

The work we do as applied geoscientists affects the health, safety, and wellbeing of other people, and of the Earth's ecosystem. Doing our work poorly places others at risk of harm. The right to work as an applied geoscientist involves the responsibility to do our work well, in the public interest.

SLIDES 38–48 < *ad libitum* until C.P. Snow quote>

SLIDE 49 Bob Tepel notes that "licensure laws are based on the same fundamental principle as are professional codes of ethics: the professional must hold the protection of the public health, safety, and welfare to be more important than his or her interest or even the interest of the client or employer."

SLIDE 50 This principle is similar to one that the American Society of Civil Engineering considered a fundamental canon of professional practice in its 2017 Code of Ethics: "Engineers shall hold paramount the safety, health, and welfare of the public and strive to comply with the principles of sustainable development in the performance of their professional duties."

A common definition of sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

SLIDE 51 Bob Tepel has promoted the idea of a "primacy principle" in engineering geology in AEG Special Paper 7 and elsewhere.

SLIDE 52 Primacy principles are the most important ethical constraints for our work, just as primacy clauses in professional codes of ethics remind us of the most important considerations for a given profession.

SLIDE 53 For example, the Hippocratic Oath is an ancient expression of primacy principles under which a medical healer must work.

SLIDE 54 In our professional work, the health, safety, and wellbeing of the public are paramount.

SLIDE 55 In my view, there are two other primacy principles for engineering geoscience. The ethical imperatives, standards, and norms that apply to any scientist also apply to professional geoscientists. We must be good scientists.

SLIDE 56 And this: Because of our specialized knowledge and skills, professional geoscientists have a responsibility to act in ways that promote, protect, and sustain the health of the Earth environment. This is the stewardship and sustainability principle.

SLIDE 57 These three primacy principles cover public safety and welfare, scientific standards and norms, and environmental health and sustainability.

SLIDE 58 Here's another case history...

SLIDE 59 At Christmas in 1981, the Velez Family consisted of father Bill, mother Barbara, older daughter Michelle, son Billy, and Melissa as the youngest.

SLIDE 60 In pre-development site reports that I reviewed while working for Jim Slosson's consulting company, the developer's team wrote, "We have completed an investigation of the soil/geologic conditions of the subject site...

SLIDE 61 The investigation consisted of a soils and foundation study and a geologic reconnaissance of the local area...

SLIDE 62 Our findings indicate that the site is suitable for the proposed residential use..."

SLIDE 63 On January 4, 1982, during a major rainstorm, heavy saturated soil that had accumulated in a hillside swale behind their house rushed down a 280-foot-long path and crashed into the house next to the Velez home, pushing it over and through their house.

SLIDE 64 In this aerial photo taken weeks later, you can see the two empty lots at the bottom of the debris flow track.

SLIDE 65 This is what it looked like early the morning after the debris flow. The parents survived, but all three children perished under the mud and collapsed structures.

SLIDEs 66-69 < *ad libitum* until site photo>

SLIDE 70 The results indicate that it was essential to have understood the site geology. Safety is always a major, controlling, essential consideration.

This photo was taken the morning after the debris flow occurred. You can see water cascading down the debris flow scar. Had the original developer recognized the hazard, this simple and inexpensive mitigation would have saved the lives of the Velez children.

After the disaster in 1982, Bill and Barbara Velez divorced, completing the destruction of their family.

SLIDES 71-82 *ad libitum*

SLIDE 83 I have one final case history to offer, which was brought to my attention by Bill Bryant of the California Geological Survey.

SLIDE 84 I work on active faults in my research, but when it comes to the practical use of this work, I have heard some variant of the following many times: "I consider all faults to be inactive unless the State officially designates the fault as being active." (Makes me crazy.)

SLIDE 85 The study site is located within the San Andreas fault zone, marked by yellow arrows in this aerial photo. The next image will be of the area within the white rectangle.

SLIDE 86 Most of this area is a vacant lot in this aerial photo from 1993. The reason is that it had not been developed prior to adoption of the Alquist-Priolo Act in the aftermath of the magnitude 6.6 San Fernando earthquake of 1971. The main active trace of the San Andreas fault passes through this empty lot, along with other splays.

SLIDE 87 The San Francisco earthquake of 1906 was a magnitude 7.8 event that caused an estimated 3000 deaths. In the area of the undeveloped lot, there was about 12 feet of strike slip during the 1906 event. In light of the Alquist-Priolo act, it was generally thought that this property was not developable.

SLIDE 88 Eventually, the potential for new housing in a very tight real estate market inspired a developer to examine whether this lot was developable within the constraints of law and established practice. So they hired consultants to trench the site extensively, looking for faults. The trenches are the double black lines with yellow in between, and the fault traces they found are marked in blue.

SLIDE 89 Then they examined legal constraints and established practice regarding the required setbacks from active fault traces for houses like the ones that had been built in the area before 1971. They marked 50-foot setbacks from the main trace of the San Andreas fault that had been active in 1906, and 30-foot setbacks from each of the splays. The setbacks are shown in yellow. The areas where houses could be built are shown in green.

SLIDE 90 So they used the average footprint of the existing houses to plot the maximum number of houses that could fit (reasonably) in the green areas. The roads and all of the buried utilities (freshwater, wastewater, electricity, cable, gas) would be located along the fault traces in the setback zones. The number was 44 houses that could fit. And they submitted the plan for approval.

Now, I want you to place yourself in the role of a second-party reviewer of this plan or even a member of the committee that would vote on whether to approve the plan. What would ***you*** do?

SLIDE 91 For context, let's find analogs for a magnitude 7.8 earthquake in modern times. The Turkey-Syria earthquake of 2023 was a magnitude 7.8 event. The confirmed death toll was more than 50 thousand, but the actual number is probably over 60 thousand. Current damage estimates exceed 119 billion dollars. Some towns were totally destroyed.

SLIDE 92 Some towns were totally destroyed. Some of the buildings that ***look*** intact have collapsed ground floors, or destroyed foundations.

SLIDE 93 The Gorkha earthquake in Nepal in 2015 was also a magnitude 7.8 event, causing about 9000 deaths and an estimated 10 billion dollars in damage.

SLIDE 94 Most of the destruction in both earthquakes occurred away from the surface trace of the faults that generated the earthquakes.

SLIDE 95 Now that you have a feel for what a magnitude 7.8 earthquake can do to a populated area, we return to our proposed housing development WITHIN the San Andreas fault.

SLIDE 96 Would you approve this development?

<pause>

Several years after I heard about this proposal, I was working on the aftermath of the Napa earthquake with some grad students. I declared a rest and laundry day, and offered to take them to see some of the geological sights in the area. So the night before our adventure, I got onto Google Earth and looked for that vacant patch of land along the San Andreas. And this is what I saw...

SLIDE 97 When I saw that they had approved and built this development, well, I had a strong physical reaction to it. The next day, we got in the car to see what we could see.

SLIDE 98 There were about 44 new houses, and all of them appeared to have been purchased and occupied.

SLIDE 99 Walking through the neighborhood, we heard all of the sounds you might expect. Music. Laughter. The sounds of children playing.

SLIDE 100 There were cracks along the middle of the new asphalt pavement that had been laid over faults that mark the main trace of the San Andreas fault and its wide damage zone. And we wondered whether any of the homeowners understood the risk. I thought in particular about the gas and communication lines located under the roads that constitute the only access to and from the neighborhood, and what it would all be like in the aftermath of even a foot of surface displacement (let alone 12 feet as in 1906).

SLIDE 101 My friend Cliff Gray of the California Division of Mines and Geology told Jim Slosson, "It's a good thing we mapped the San Andreas fault when we did. They've built too many houses on top of it to map the fault zone now."

SLIDE 102 Slosson's Law states, "Practice will drop to the lowest level permitted by the administration and enforcement of applicable law."

SLIDE 103 I think we can do better. We must do better.

SLIDE 104 So remember that the ultimate client of any licensed professional geoscientist is society.

SLIDE 105 And that business decisions do not outweigh our professional obligation to protect the public.

SLIDE 106 Jim Slosson and others wrote, "If we do not act as responsible scientists in the public interest, the contributions of engineering geologists will not be sought or valued by society."

SLIDE 107 If you are interested, please visit the website I have developed for this talk.

Thank you for your attention. Do we have any questions?