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MONTANA FIRST JUDICIAL DISTRICT COURT
LEWIS AND CLARK COUNTY

RIKKI HELD, ET AL., PLAINTIFFS, V. STATE OF MONTANA, ET AL., DEFENDANTS.	Cause CDV-2020-307 Hon. Kathy Seeley **DEFENDANTS' EXPERT WITNESS DISCLOSURE**

Pursuant to this Court's December 27, 2021, scheduling order (Doc. 61) and Mont. R. Civ. P. 26(b)(4), Defendants State of Montana, et al., provide the following expert witness disclosure:

1. Dr. Howard C. Hayden
Professor Emeritus of Physics
University of Connecticut
785 S. McCoy Drive
Pueblo West, CO 81007

Dr. Howard "Cork" Hayden is a retired physics professor who has written and published extensively on environmental, energy, and climate issues. Dr. Hayden's opinions and conclusions are set forth in his expert report attached as **Exhibit A.** Dr. Hayden's opinions are based on his knowledge and expertise as set forth in his CV, as well as his review of the pleadings and all discovery responses, expert reports, and documents produced so far during discovery in this matter. Dr. Hayden's curriculum vitae is attached as **Exhibit B** and sets forth his qualifications as an expert. Discovery is ongoing in this matter; thus, Dr. Hayden's opinions may be altered or amended based on new testimony and evidence. Accordingly, Defendants reserve the right to supplement this expert disclosure based on any new information.

HYBRID WITNESSES

Defendants note that the below individuals are employees of the Montana Department of Environmental Quality who possess knowledge regarding the facts alleged in this case, as well as specialized training that allows them to formulate opinions regarding those factual allegations. They have not been specially retained for litigation purposes. Rather, they are mixed fact and expert—or "hybrid"—witnesses. *See Norris v. Fritz*, 2012 MT 27, ¶ 22, 364 Mont. 63, 270 P.3d 79. As such, full disclosures, including written reports, are not required. *Id.* at ¶ 32 (citation omitted). Defendants disclose the identity of these mixed fact and expert witnesses and a summary of their proposed testimony so as to prevent unfair surprise or prejudice. *Id.* at ¶ 33 (citation omitted).

2. Chris Dorrington
DEQ Director
1520 E. 6th Avenue
Helena MT, 59601

Chris Dorrington, Director for the Montana Department of Environmental Quality ("DEQ"), will give fact and expert testimony regarding topics raised in Plaintiffs' Complaint at ¶¶ 87–89, 92–93, 118(g)–(i), (k). Director Dorrington's professional CV is attached as **Exhibit C**, and he may testify to any of the experiences or opine on the subjects contained therein. As a result of his positions at and before DEQ, his education, and his professional experience, Director Dorrington may have factual knowledge and expertise in a number of subject areas, including but not limited to public policy, DEQ's internal functioning, permitting generally and past permits issued, air, energy, mining, past legislation, some of the panels/councils/studies discussed by Plaintiffs, fossil fuels, DEQ's authority to regulate or analyze climate change, what climate change analysis would require for DEQ, DEQ's budget and staff. Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

3. Sonja Nowakowski
DEQ Division Administrator: Air, Energy, and Mining
1520 E. 6th Avenue
Helena MT, 59601

Sonja Nowakowski, Division Administrator Air Energy and Mining for the Montana DEQ, will testify regarding topics raised in Plaintiffs' Complaint at ¶¶ 87–90, 92–93, 118(g)–(m), 192, 194. Ms. Nowakoski's professional CV is attached as **Exhibit D**, and she may testify to any of the experiences or opine on the subjects

contained therein. As a result of her positions at DEQ and formerly at the Legislature, her education, and her professional experience, Ms. Nowakoski may have factual knowledge and expertise in a number of subject areas, including but not limited to public policy, DEQ's internal functioning, permitting generally and past permits issued, air, energy, mining, past legislation, some of the panels/councils/studies discussed by Plaintiffs, fossil fuels generally, DEQ's authority to regulate or analyze climate change, what climate change analysis would require for DEQ, DEQ's budget and staff, any of the topics included below for the individuals she supervises, including those in the Air, Energy, and Mining Division. Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

4. Bo Wilkins
DEQ Bureau Chief, Air Quality
1520 E. 6th Avenue
Helena MT, 59601

Bo Wilkins, Air Quality Bureau Chief for the Montana DEQ, will give fact and expert testimony regarding topics raised in Plaintiffs' Complaint at ¶¶ 87–90, 92–93, 118(j)–(m), 192, 194. Mr. Wilkins' professional CV is attached as **Exhibit E**, and he may testify to any of the experiences or opine on the subjects contained therein. As a result of his positions at DEQ and formerly as a private consultant, his education, and his professional experience, Mr. Wilkins may have factual knowledge and expertise in a number of subject areas, including but not limited to public policy regarding air quality, the Air Quality Bureau (AQB) at DEQ and its functioning, air quality permits and past permits issued, permit compliance, air quality generally, past legislation regarding air, some of the panels/councils/studies discussed by

Plaintiffs, DEQ's authority to regulate or analyze climate change, what climate change analysis would require for the AQB, AQB's budget and staff, social cost of carbon and other air quality analysis methods, greenhouse gasses, emissions and pollutants, DEQ's oil and gas well registration program, climate change science, air quality testing, federal and Montana air quality standards and regulations. Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

5. Julie Merkel
DEQ Permitting Services Section Supervisor
1520 E. 6th Avenue
Helena MT, 59601

Julie Merkel, Permitting Services Section Supervisor for the Montana DEQ, will testify regarding topics raised in Plaintiffs' Complaint at ¶¶ 90, 92–93, 118(j)–(k). Ms. Merkel's professional CV is attached as **Exhibit F**, and she may testify to any of the experiences or opine on the subjects contained therein. As a result of her positions at and before DEQ, her education, and her professional experience, Ms. Merkel may have factual knowledge and expertise in a number of subject areas, including but not limited to public policy regarding air quality, the Permitting Section of the AQB, air quality permits and past permits issued, compliance, air quality generally, past legislation regarding air, some of the panels/councils/studies discussed by Plaintiffs, DEQ's authority and ability to regulate or analyze climate change, what climate change analysis would require for the AQB, air quality analysis methods, greenhouse gasses, emissions and pollutants, DEQ's oil and gas well registration program, federal and Montana air quality standards and regulations.

Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

6. Rhonda Payne, Air Quality Planner, DEQ
1520 E. 6th Avenue
Helena MT, 59601

Rhonda Payne, Air Quality Planner for the Montana DEQ, will give fact and expert testimony regarding topics raised in Plaintiffs' Complaint at ¶¶ 90, 92–93, 118(j)–(k). Ms. Payne's professional CV is attached as **Exhibit G**, and she may testify to any of the experiences or opine on the subjects contained therein. As a result of her positions at DEQ, her education, and her professional experience, Ms. Payne may have factual knowledge and expertise in a number of subject areas, including but not limited to public policy regarding air quality, regional haze, wildfire and smoke, air quality planning, air quality permits and past permits issued, compliance, air quality generally, past legislation regarding air, some of the panels/councils/studies discussed by Plaintiffs, DEQ's authority and ability to regulate or analyze climate change, air quality analysis methods, greenhouse gasses, emissions and pollutants, federal and Montana air quality standards and regulations. Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

7. Craig Henrikson
DEA Air Quality Engineering Scientist
1520 E. 6th Avenue
Helena MT, 59601

Craig Henrikson, Air Quality Engineering Scientist for the Montana DEQ, will give fact and expert testimony regarding topics raised in Plaintiffs' Complaint at

¶¶ 90–93, 118(j)–(k). Mr. Henrickson's professional CV is attached as **Exhibit H**, and he may testify to any of the experiences or opine on the subjects contained therein. As a result of his positions at and before DEQ, his education, and his professional experience, Mr. Henrickson may have factual knowledge and expertise in a number of subject areas, including but not limited to public policy regarding air quality, the Air Quality Bureau (AQB) at DEQ and its functioning, air quality permits and past permits issued, permit compliance, air quality generally, past legislation regarding air, some of the panels/councils/studies discussed by Plaintiffs, DEQ's authority and ability to regulate or analyze climate change, what climate change analysis would require for the AQB, social cost of carbon and other air quality analysis methods, greenhouse gasses, emissions and pollutants, climate change science, federal and Montana air quality standards and regulations. Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

8. Ed Warner
DEQ Air Quality Engineering Scientist, DEQ
1520 E. 6th Avenue
Helena MT, 59601

Ed Warner, Air Quality Engineering Scientist for the Montana DEQ, will give fact and expert testimony regarding topics raised in Plaintiffs' Complaint at ¶¶ 90–93, 118(j). Mr. Warner's professional CV is attached as **Exhibit I**, and he may testify to any of the experiences or opine on the subjects contained therein. As a result of his positions at and before DEQ, his education, and his professional experience, Mr. Warner may have factual knowledge and expertise in a number of subject areas, including but not limited to public policy regarding air quality, the Permitting Section

of the AQB, air quality permits and past permits issued, permit compliance, air quality generally, past legislation regarding air, some of the panels/councils/studies discussed by Plaintiffs, DEQ's authority to regulate or analyze climate change, what climate change analysis would require for the AQB, air quality analysis methods, greenhouse gasses, emissions and pollutants, Federal and Montana air quality standards and regulations. Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

9. John Kenning
DEQ Water Protection Bureau Chief
1520 E. 6th Avenue
Helena MT, 59601

John Kenning, Water Protection Bureau Chief for the Montana DEQ, will give fact and expert testimony regarding topics raised in Plaintiffs' Complaint at ¶¶ 87–89, 92–93, 118(j)–(m), 192, 194. Mr. Kenning's professional CV is attached as **Exhibit J**, and he may testify to any of the experiences or opine on the subjects contained therein. As a result of his positions at and before DEQ, his education, and his professional experience, Mr. Kenning may have factual knowledge and expertise in a number of subject areas, including but not limited to public policy regarding water, Montana Pollution Discharge Elimination (MPDES) permits and other water quality permits issued and the permitting process, compliance, water quality standards, the Water Quality Bureau at DEQ and its functioning, DEQ's authority with respect to water. Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

10. Keenan Storrar
DEQ Water Quality Permit Writer
1520 E. 6th Avenue
Helena MT, 59601

Keenan Storrar, Water Quality Permit Writer for the Montana DEQ, will give fact and expert testimony regarding topics raised in Plaintiffs' Complaint at ¶¶ 91–92, 118(i)–(m). Mr. Storrar's professional CV is attached as **Exhibit K**, and he may testify to any of the experiences or opine on the subjects contained therein. As a result of his positions at and before DEQ, his education, and his professional experience, Mr. Storrar may have factual knowledge and expertise in a number of subject areas, including but not limited to DEQ's authority to regulate pipelines, federal and state regulations regarding pipelines, and pipeline permitting generally. Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

11. Dan Lloyd
DEQ Energy Bureau Chief
1520 E. 6th Avenue
Helena MT, 59601

Dan Lloyd, Energy Bureau Chief for the Montana DEQ, will give fact and expert testimony regarding topics raised in Plaintiffs' Complaint at ¶¶ 87–88, 90–93, 118(j), (l)–(m), 192, 194. Mr. Lloyd's professional CV is attached as **Exhibit L**, and he may testify to any of the experiences or opine on the subjects contained therein. As a result of his positions at and before DEQ, his education, and his professional experience, Mr. Lloyd may have factual knowledge and expertise in a number of subject areas, including but not limited to public policy, planning, and development

regarding energy, the Montana State Energy Office and Energy Bureau (EB) at DEQ and its functioning, energy project permits and past permits issued, compliance, energy generally, past legislation regarding energy, some of the panels/councils/studies discussed by Plaintiffs, DEQ's authority to regulate or analyze climate change, what climate change analysis would require for the EB, EB's budget and staff, programs managed by the EB, climate change science, federal and Montana energy regulation, "clean/alternative/renewable" energy in Montana generally, requirements for such sources, history of energy projects/policy/regulation in Montana. Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

12. Bob Smith
DEQ Coal Mining Section Supervisor
1520 E. 6th Avenue
Helena MT, 59601

Bob Smith, Coal Mining Section Supervisor for the Montana DEQ, will give fact and expert testimony regarding topics raised in Plaintiffs' Complaint at ¶¶ 87–89, 93, 118(g)–(i), (k). Mr. Smith's professional CV is attached as **Exhibit M**, and he may testify to any of the experiences or opine on the subjects contained therein. As a result of his positions at and before DEQ, his education, and his professional experience, Mr. Smith may have factual knowledge and expertise in a number of subject areas, including but not limited to public policy, planning, and development regarding coal mining, the Coal Section at DEQ and its functioning, coal mining permits and past permits issued, compliance, coal mining generally, past legislation regarding coal, some of the panels/councils/studies discussed by Plaintiffs, DEQ's

authority to regulate or analyze climate change, what climate change analysis would require for the Coal Section, the Coal Section's budget and staff, federal and Montana coal regulation, history of coal mining and coal policy/regulation in Montana. Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

13. Dan Walsh
DEQ Mining Bureau Chief
1520 E. 6th Avenue
Helena MT, 59601

Dan Walsh, Mining Bureau Chief for the Montana DEQ, will give fact and expert testimony regarding topics raised in Plaintiffs' Complaint at ¶¶ 87–89, 93, 118(g)-(i), (k). Mr. Walsh's professional CV is attached as **Exhibit N**, and he may testify to any of the experiences or opine on the subjects contained therein. As a result of his positions at and before DEQ, his education, and his professional experience, Mr. Walsh may have factual knowledge and expertise in a number of subject areas, including but not limited to public policy, planning, and development regarding mining and air compliance, the Mining Bureau at DEQ and its functioning, mining and air permits and past permits issued, air compliance generally, past legislation regarding mining and air, some of the panels/councils/studies discussed by Plaintiffs, DEQ's authority to regulate or analyze climate change, what climate change analysis would require for the Mining Bureau, the Mining Bureau's budget and staff, Federal and Montana mining and air regulation, history of mining and air policy/regulation in Montana, mining for minerals required for "clean/alternative/renewable" energy."

Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

14. Rebecca Harbage
DEQ Public Policy Director
1520 E. 6th Avenue
Helena MT, 59601

Rebecca Harbage, Public Policy Director for the Montana DEQ, will give fact and expert testimony regarding topics raised in Plaintiffs' Complaint at ¶¶ 90–91, 93, 118(g), (i)–(k), (m). Ms. Harbage's professional CV is attached as **Exhibit O**, and she may testify to any of the experiences or opine on the subjects contained therein. As a result of his positions at and before DEQ, her education, and her professional experience, Ms. Harbage may have factual knowledge and expertise in a number of subject areas, including but not limited to environmental public policy, planning, and development, past legislation involving DEQ, the Major Facilities Citing Act (MFSA) and the Montana Environmental Policy Act (MEPA), permits and projects related to MFSA and MEPA, compliance, MFSA and MEPA budget, staff, policies and procedures, Environmental Impact Statements (EISs) and Environmental Assessments (EAs), DEQ's authority to regulate and/or consider climate change, the history of MFSA and MEPA. Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

15. Craig Jones
DEQ MEPA-MFSA Coordinator
1520 E. 6th Avenue
Helena MT, 59601

Craig Jones, MEPA-MFSA Coordinator for the Montana DEQ, will give fact and expert testimony regarding topics raised in Plaintiffs' Complaint at ¶¶ 90–91, 93, 118(g), (i)–(k), (m). Mr. Jones's professional CV is attached as **Exhibit P**, and he may testify to any of the experiences or opine on the subjects contained therein. As a result of his positions at and before DEQ, his education, and his professional experience, Mr. Jones may have factual knowledge and expertise in a number of subject areas, including but not limited to environmental public policy, planning, and development, past legislation involving MFSA and MEPA, MFSA and MEPA generally, specific permits and projects related to MFSA and MEPA, compliance, MFSA and MEPA budget, staff, policies and procedures, some of the specific permits and EA/EIS's listed by Plaintiffs in their Complaint and discovery requests, Environmental Impact Statements (EISs) and Environmental Assessments (EAs), DEQ's authority to regulate and/or consider climate change, the history of MFSA and MEPA. Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

16. Martin VanOort
DEQ Mining Environmental Scientist
1520 E. 6th Avenue
Helena MT, 59601

Martin VanOort, Mining Environmental Scientist for the Montana DEQ, will give fact and expert testimony regarding topics raised in Plaintiffs' Complaint at ¶¶

87–89, 93, 118(g)–(i), (k). Mr. VanOort's professional CV is attached as **Exhibit Q**, and he may testify to any of the experiences or opine on the subjects contained therein. As a result of his positions at and before DEQ, his education, and his professional experience, Mr. VanOort may have factual knowledge and expertise in a number of subject areas, including but not limited to public policy, planning, and development regarding mining and air compliance, the Mining Bureau at DEQ and its functioning, mining and air permits and past permits issued, air compliance generally, past legislation regarding mining and air, some of the panels/councils/studies discussed by Plaintiffs, DEQ's authority to regulate or analyze climate change, what climate change analysis would require for the Mining Bureau, the Mining Bureau's budget and staff, federal and Montana mining and air regulation, history of mining and air policy/regulation in Montana, mining for minerals required for "clean/alternative/renewable" energy." Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

17. Will Roquist, Regulatory Division Administrator, PSC
1701 Prospect Ave.,
Helena MT, 59601

Will Roquist, Regulatory Division Administrator for the Montana Public Service Commission ("PSC"), will give fact and expert testimony regarding Plaintiffs' claims that the PSC's actions in effectuating the statutes being challenged either promote or lead to a use of resources and a collection of economic activities that are harmful to Montana's economy at large. Mr. Roquist's professional CV is attached as **Exhibit R**, and he may testify to any of the experiences or opine on the subjects

contained therein. Because discovery is ongoing in this matter, Defendants reserve the right to amend or update this list of subjects.

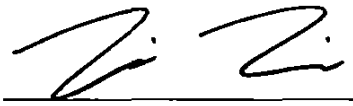
18. Defendants reserve the right to supplement this expert witness disclosure as additional information is discovered and to call any expert named by any other party in this litigation, including Plaintiffs.

19. Defendants reserve the right to disclose and call any expert needed for foundation, impeachment or rebuttal necessary to refute the testimony of experts disclosed by any other party.

DATED this 1st day of June, 2022.

AUSTIN KNUDSEN
Montana Attorney General

DAVID M.S. DEWHIRST
Solicitor General



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Attorneys for Defendants

CERTIFICATE OF SERVICE

I certify a true and correct copy of the foregoing was delivered by email to the following:

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Date: June 1, 2022

Dia C. Lang

Howard C. Hayden
Prof. Emeritus of Physics, UConn
785 S. McCoy Drive
Pueblo West, CO 81007

June 1, 2022

Re: *Held et al v. State of Montana, et al.*;
Montana First Judicial District Cause No. CDV 2020-307

Introduction

Plaintiffs are children and youth in Montana between the ages of two and 18. According to Plaintiffs' Complaint, they bring this suit to invalidate portions of Montana's State Energy Policy, and the Montana limitation of the Montana Environmental Policy Act (MEPA). The Complaint Plaintiffs filed asserts the State's "aggregate acts" allow individuals and businesses to emit greenhouse gases (GHGs), which contribute to harmful global climate change. The alleged "aggregate acts" include various decisions from the Governor, the Montana Department of Transportation (DOT), the Montana Department of Environmental Quality (DEQ), the Montana Department of Natural Resources and Conservation (DNRC), and the Montana Public Service Commission (PSC), all of whom are Defendants in this case. The Montana Legislature is not a party to this case. Plaintiffs allege various "harms" resulting from the alleged "aggregate acts."

I have been retained by the Defendants as a testifying expert in this case to address certain claims and allegations made by Plaintiffs. My opinions are based on my background, qualifications, and technical expertise as outlined in my CV, as well as the pleadings in this case, discovery exchanged by all parties, and outside sources listed in the attached **Exhibit A.**

Background and Qualifications

My background and qualifications are listed in my CV, included with this expert report. I am a Professor Emeritus of Physics from the University of Connecticut. I did my college and graduate work in Physics at the University of Denver (B.S. 1962; M.S. 1964; Ph.D. 1967). My experimental work there was in measuring cross-sections for some atomic-collision processes, little realizing the relevance of the work to my later interest in climate. For my Ph.D. work I began work in a room that did not have so much as a screwdriver and succeeded in building an accelerator and taking the data for my dissertation in a period of 15 months. After my Ph.D., I went to the University of Connecticut. At UConn, I was involved in measuring inelastic energy losses and relating them to spectroscopic energy deficits. At DU, high energy was 1 keV; at UConn, low energy was 6 keV and high energy was 200 keV. I did research in ion implantation, electrical insulation, Rutherford backscattering, energy loss in low-energy molecular collisions, x-ray emission from medium-energy collisions, with many papers in each of these diverse fields. I worked on the experimental foundations of relativity theory, and performed a Trouton-Noble experiment in which I bettered the sensitivity of the original by a factor of 100,000. My opinions are based on my physics education, background, and experience and historical data about temperatures and carbon dioxide (CO2) levels. They also rely heavily on Assessment Reports produced by the Intergovernmental Panel on Climate Change (IPCC).

EXHIBIT A

Summary of Issues

I have been asked to provide opinions on the following issues:

1. Whether the science is unequivocal that anthropogenic GHG emissions are causing or will cause global, catastrophic, or otherwise harmful environmental effects.
2. Whether the science is unequivocal that anthropogenic GHG emissions are causing or will cause catastrophic or otherwise harmful environmental effects in Montana.
3. Whether Montana's carbon and GHG emissions are causing are causing or will cause global, catastrophic, or otherwise harmful, environmental effects.
4. Whether Montana's carbon and GHG emissions are causing are causing or will cause catastrophic or otherwise harmful environmental effects in Montana.
5. Whether anthropogenic GHG emissions are causing "increased risk" of floods, hurricanes, wildfires, and other adverse weather conditions.
6. Whether, if Montana were to reduce all GHG emissions to zero, it could reduce any environmental harm to the globe or Montana.
7. Whether the "climate change" hypothesis—the theory that anthropogenic greenhouse gas emissions are causing dangerous climate change—is a reasonable conclusion drawn from application of the scientific method and based on real data.
8. Whether, even if Plaintiffs' climate change hypothesis is true, Montana could take any action whatsoever that would stop the alleged harms resulting from climate change.
9. Whether non-scientific cultural, social, and political factors account for emergence of Plaintiffs' climate change hypothesis.
10. Is the human toll from storms getting higher?

Summary of Opinions

1. Carbon dioxide (CO2) is a greenhouse gas that is presently responsible for about 20% of the greenhouse effect. Doubling the CO2 concentration, as may happen late in the century, would increase the total greenhouse effect by 2.47%. The entire greenhouse effect has warmed the earth about 34°C. A 2.47% increase would be expected to raise the temperature about 0.8°C. That is not a catastrophic amount, nor will it cause catastrophic or otherwise harmful effects.
2. Anthropogenic CO2 emissions from all sources constitute about 4% of the total CO2 emissions; natural emission being the other 96%. The net increase in atmospheric CO2 is equal to half the anthropogenic emissions and amounts to about one part in 400 of the quantity of CO2 in the atmosphere. Not only is it not harmful, but the increase in atmospheric CO2 has played a role in the greening of the earth.
3. Montana's contribution to greenhouse gases, considering both the CO2 produced within the state and that produced by exported fossil fuels, is utterly negligible compared to that of the world. Immediately ceasing all combustion of fossil fuels within the state and ceasing all exports would forestall 0.00017°C of global warming per year.
4. Montana's GHG emissions will have an utterly negligible impact either worldwide or locally.
5. Plaintiffs contend that anthropogenic GHG emissions are causing rising temperatures which are, in turn, causing adverse weather events. Worldwide temperature has risen about 1°C during the last century. If 100 years of a warming of 0.00017°C per year (0.017°C) were to have an adverse effect, then a whole 1°C of warming would be 59 times as bad.

However, during that time, glaciers have largely continued the decline that has been ongoing since the late 1700s, flood damage as a fraction of GDP has declined by a factor of about 4, the number of landfalling hurricanes and the number of major hurricanes have been on the decline. The heatwave index reached its maximum in the Dust-Bowl years. Sea level has risen about 7 inches and is continuing to rise at the same rate. The number of EF3+ tornadoes has been on the decline for at least 50 years, despite their increased detectability by radar. The global average death rate from natural disasters has been on the steady decline for the last century. The planet is greening. To claim that things are getting worse because of that warming is, to put it kindly, bogus. Montana's contribution to "global warming due to CO2 emissions," including all CO2 produced within the state and all CO2 from fossil fuel exports amounts to 0.00017°C per year, or 0.017°C/century. If Montana's contribution of CO2 to the warming were to have an adverse effect, then the 59-times-as-large 1°C would logically be 59 times as bad; yet the climate is getting better, not worse.

6. If Montanans immediately and completely ceased burning all fossil fuels, the effect would be to forestall 32 millionths of a degree of warming per year.
7. Anthropogenic GHG emissions are not causing dangerous climate change. When the terminology changed from *global warming* to *climate change*, the term *climate change* became simultaneously any weather change for the worse anywhere on the planet, and the universal cause of all untoward effects—more rain, less rain, more snow, less snow, Antarctic ice grows, Antarctic ice shrinks, and so on. Climate change causes climate change.
8. Montana's role in GHG emissions is a negligible fraction of the world's GHG emissions. If Montana immediately and completely ceased all activity involving fossil fuels, the increase in China's CO2 emissions in a single year would wipe out the (alleged) benefit. The demands being made by Plaintiffs would be ineffective at reducing CO2 emissions, and have even less effect on world temperature, but the real problem is not the ineffectiveness. The harm of forcing our progeny to live without the benefits of fossil fuels would be tantamount to a major crime against humanity.
9. Because of our myriad uses of energy, mostly from fossil fuels, the world is more amenable to human habitation than it has ever been. Nevertheless, there is considerable anxiety about the future because of "climate change." The science is clear: the anxiety is not due to climate.
10. The human toll from climate-related events is on the strong decline.

OVERVIEW: BASIC CLIMATE PRINCIPLES

I will first provide an overview of basic climate principles and the history of the climate change "movement." Then I will turn to the specific issues I have been asked to address.

Carbon Dioxide

Carbon dioxide (CO2) is a gas, not something that might precipitate out of the air. Once it enters the atmosphere from combustion of fossil fuels, oxidation of detritus on the forest floor, oxidation of atmospheric swamp gas and other air-borne hydrocarbons, outgassing of the oceans or other process, it moves with the winds and becomes distributed throughout the atmosphere.

The measurement of atmospheric CO2 was taken up by Keeling on Hawaii's Mauna Loa in 1957 because previous measurements varied quite a bit. Chemists had measured values varying between 280 parts per million and 470 parts per million at various locations between 1920 and 1950. During the night, oxidation on forest floors releases CO2 which remains trapped under the canopy so that by morning there is a high accumulation. Similarly, in a sunny meadow, the CO2 is taken up by plants, resulting in a lower concentration in the local atmosphere. Mauna Loa was chosen because of its high altitude, distance from plant growth, distance from cities, and plentiful breeze to determine the "true" CO2 concentration. As shown in Figure 1, the atmospheric concentration of CO2 was about 315 parts per million at the beginning of Keeling's project, and has increased to about 415 ppm at the present, with seasonal wiggles (lowest in September, highest in April), as shown in Figure 1.

By various proxies, scientists are able to measure past CO2 concentrations. During the last 800,000 years, CO2 has varied between about 175 ppm during the glacial periods to about 300 ppm during the interglacials (such as the current Holocene). Below about 150 ppm, plants are unable to survive; all life dies. Detectors on submarines are set to sound alarms if the concentration gets above 8,000 ppm, and the state of Minnesota states that exposure to 10,000 ppm should not be tolerated for more than 8 hours. Call that the "danger level": 25 times the present CO2 concentration.

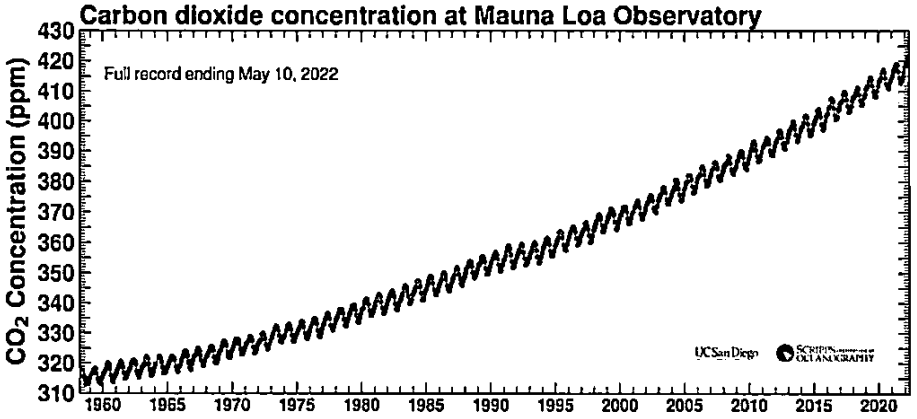


Figure 1: The Keeling curve from https://keelingcurve.ucsd.edu/. Notice that the scale starts at 310 ppm, not at zero.

It is of interest that greenhouses burn natural gas to increase the concentration of CO2, thereby to enhance plant growth. The earth as a whole has seen considerable greening due in large part to the increase in CO2 levels. See Figure 2.

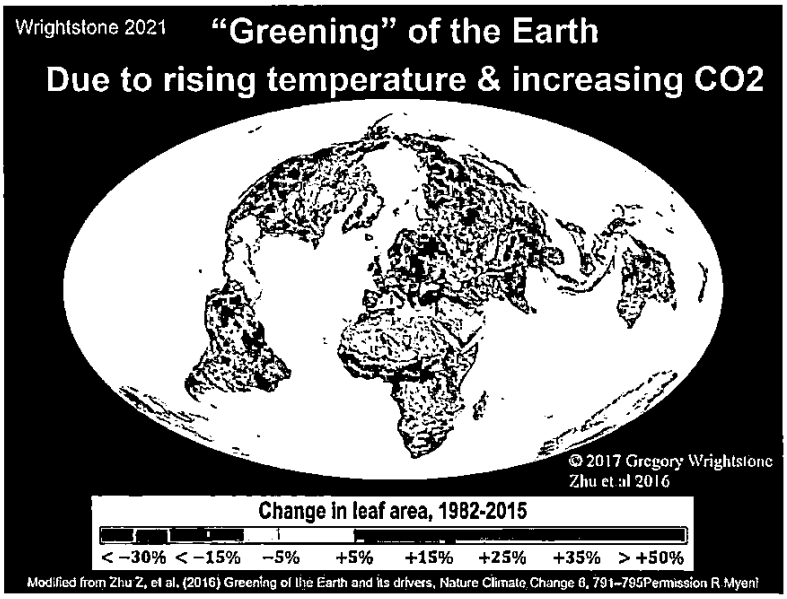


Figure 2: The greening of the earth.

On a longer time scale, CO2 concentration was in the neighborhood of 2,000 ppm during the Jurassic and in the range of 6,000-10,000 ppm a half-billion years ago (see Figure 3). A low concentration equivalent to the present one was reached about 300 million years ago. During the last 140 million years, CO2 has declined from almost 2,500 ppm to less than 300 ppm, reaching lows of about 180 ppm. For purposes of comparison, 400 ppm is equivalent to 4 cents out of 100 dollars.

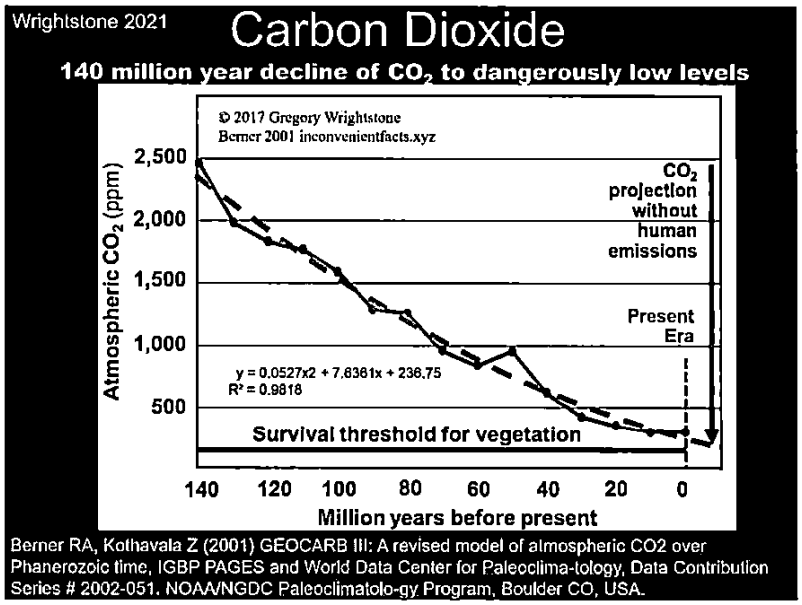


Figure 3: Long-term CO2 levels in parts per million, showing the survival level for photosynthesis to occur.

To keep things somewhat simple, climatologists account for the carbon itself rather than CO2 and/or any other chemical that contains carbon. In the air, we deal with CO2, but also natural gas (mostly methane, CH4). On land and in the oceans, there is carbon in plants (thousands of different chemicals) and carbon in solids such as limestone (CaCO3). A CO2 molecule has a mass of 44/12 times the mass of the carbon atom.

Figure 4 shows carbon quantities in petagrams (PgC; a trillion kilograms of carbon) and fluxes in PgC/year. The atmosphere contains 839 PgC. The land and ocean contain vastly more carbon than the atmosphere. Annually (see vertical arrows), roughly 80 PgC travel from the ocean to the atmosphere and 80 PgC go back to the ocean. The numbers for the land are half again as big at about 120 PgC. The total fluxes into the atmosphere and back to the surface are a bit over 200 PgC, with a net increase of 4 PgC to the atmosphere. Note that the annual flow either into or out of the atmosphere is about one-fourth of the amount in the atmosphere. A cavalier description is that the atmospheric CO2 is replaced every four years.

It is of interest that of the ca. 200 PgC that annually goes into the atmosphere, 8 PgC comes from combustion of fossil fuels, 2 PgC comes from the US, and (according to EIA data) roughly 0.0075 PgC comes from Montana. The annual increase is 4 PgC. Note that carbon dioxide in the atmosphere, while varying seasonally and according to local vegetation, affects all locations on the globe. An increase in CO2 level does not disproportionately increase the CO2 level at any particular farm, town, city, state, or nation.

The IPCC attempts to model the climate. To do so, they must make assumptions about how much CO2 will be in the atmosphere at what time in the future, and that depends on what humans do—throughout the world. For mathematical reasons, they are concerned with doubling CO2 from the "pre-industrial" value of 290 ppm. The most extreme scenario assumes a doubling within about 4 or 5 decades; others assume doubling by 2100 or later.

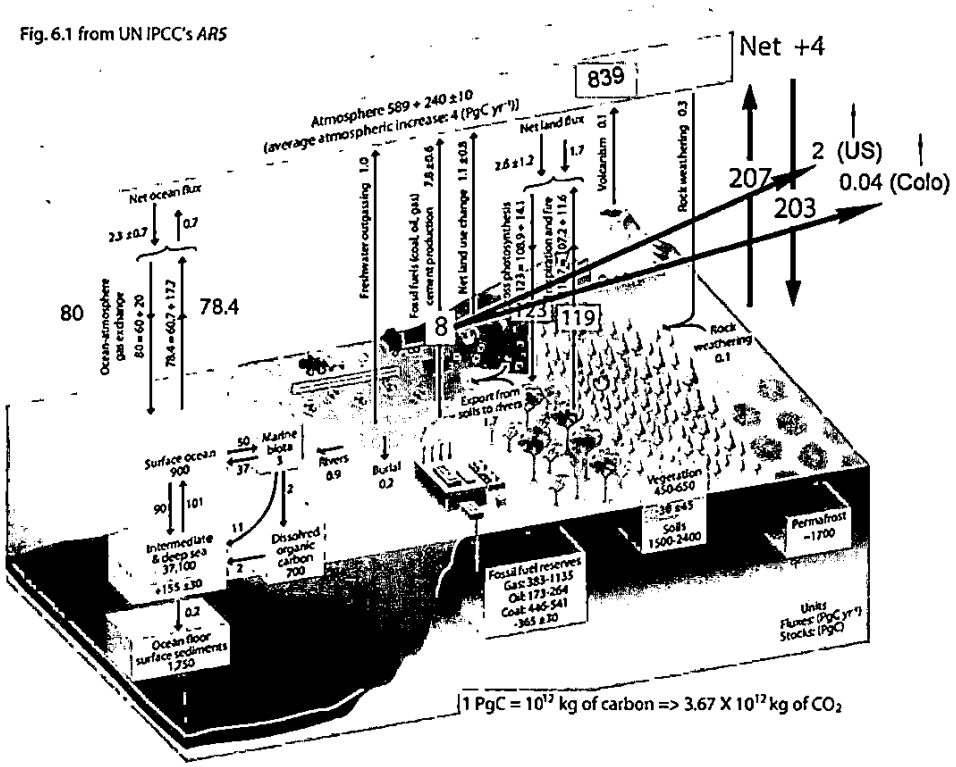


Figure 4. Carbon quantities and fluxes, adapted from IPCC's *Fifth Assessment Report.* Annually, Montana adds roughly 0.0075 PgC to the atmosphere. Note that numbers are in PgC, petagrams of *carbon.* To get the mass of CO2, multiply by 44/12.

The Climate

The convention of climatologists is to regard climate as 30-year averages, but for times far into the past, the interval is necessarily much longer. A 60-year-old person who has lived in one location can claim to have witnessed two climate points in that location. The term *climate* in the present context refers to global averages of local climate. Whether the present climate is warmer or cooler, wetter or drier than at some time in the past depends entirely upon the starting point. Our planet is about 6°C to 8°C warmer now than it was about 20,000 years ago when mile-high glaciers stood over New York. Similarly, we are about 6°C cooler than in the time of T-Rex. Both times are pre-industrial. For about a million years, the earth has gone through glacial periods lasting about 100,000 years with interglacials (like the present one) that last about 10,000-15,000 years.

To a large extent, climate has been determined by the locations, sizes, and separations of tectonic plates. For example, opening a seaway around Antarctica led to a circumpolar ocean current and the isolation of Antarctica from warmer tropical waters, and the uplift of the Isthmus of Panama blocked an ocean current that kept the Arctic warmer than it is today. (See Figure 11.) For the last 2.5 million years, the temperature of the planet seems to have been controlled by the Milankovitch cycles—the precession of the axis of the earth (26,000 years), periodic changes in the tip of the axis

(41,000 years), and the eccentricity of our orbit around the sun (100,000 years). These are, of course, long-term changes that have little bearing on the immediate future.

Until 2001, it was understood by scholars that there was a Medieval Warm Period (MWP) (ca. 900-1300). During this time, the great cathedrals of Europe were built, economies prospered, and the Vikings settled the southern part of Greenland. After that came the Little Ice Age (not to be confused with the last glacial maximum of 20,000 years ago) from about 1450 until about 1850.

However, in the IPCC's *Third Assessment Report*, those periods of history disappeared in favor of Michael Mann's Hockey Stick graph that showed a steadily declining temperature from 1000 until a steep rise during the industrial revolution. Mann's conclusions were based on the widths of tree rings and a dubious statistical procedure that automatically promoted the importance of 13 bristlecone pines so much that they dominated the statistics. One wonders exactly where and in what direction you would extract a tree core such that the widths of the rings are representative of the temperature. For a while, the embarrassment of Mann's statistical approach caused the IPCC to abandon the hockey-stick approach, but *AR6* returns to it in full force.

History of Climate Alarmism

From November 1970 until December 1972, Maurice Strong was Secretary-General of the United Nations Conference on the Human Environment. In 1972, Strong founded and became the first Executive Director of the UN Environment Programme (UNEP). Strong argued that rich Western countries had benefited by exploiting the earth's natural resources and, therefore, the Western countries must fund the poorer countries so their economies could catch up with America. Under Strong's leadership, the 1972 United Nations Stockholm Conference made the environment an international agenda.

In 1978, Professor Bert Bolin of Sweden proposed that human CO2 emissions cause the rise in atmospheric CO2, and more CO2 increases global temperature. Although he lacked scientific evidence, Bolin believed human CO2 emissions could be harmful. The International Council for Science (ICSU) and the UN World Meteorological Organization (WMO) sponsored the first World Climate Conference in Geneva in 1979.

In October 1985, the UNEP and the WMO sponsored the First International Conference on Climate Change in Villach, Austria. Bolin presented his theory with a call to action. The conference concluded that increasing concentrations of carbon dioxide could cause an historic rise in global temperature. Bolin's idea was never tested with the scientific method.

The Brundtland report (1987) issued by the Brundtland Commission warned that human CO2 could increase global temperature enough to harm agriculture, increase sea levels, flood coastal cities, and disrupt national economies. The report called for a major global effort to curb human emissions of CO2 and other GHGs. It promoted the idea of "sustainability" as a possible solution to human-caused environmental problems.

In 1988, UNEP and WMO formed the UN Intergovernmental Panel on Climate Change (IPCC). The IPCC Charter states: "The role of the IPCC is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to

understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation." There is nothing in IPCC's Charter about investigating the cause of climate change. The IPCC rather presupposes human CO2 causes climate change.

In 1990, IPCC's First Assessment Report made global headlines, thanks to UN marketing power. It claimed human CO2 caused global warming and warned that the world must reduce its CO2 emissions by 60 percent immediately to save the planet. There are no data that support those IPCC claims. However, environmentalists quickly adopted IPCC's climate claims because these climate claims supported and amplified their environmental agenda.

In June 1992, Maurice Strong was Secretary General of the U.N. Conference on Environment and Development. He chaired the "Earth Summit" conference in Rio de Janeiro. Strong declared in his Summit speech, "A shift is necessary toward lifestyles less geared to environmentally damaging consumption patterns. We may get to the point, where the only way of saving the world will be for industrialized civilization to collapse. Isn't it our responsibility to bring this about?"

Strong founded and chaired the Earth Council Alliance where he worked with Mikhail Gorbachev to create the Earth Charter which called for a "... sustainable global society founded on the principles of respect for the Earth and life in all its diversity, economic and social justice, and a culture of peace and non-violence." Strong declared, "the real goal of the Earth Charter is that it will in fact become like the Ten Commandments." Strong long supported global governance at the expense of national sovereignty. He said environmental mandates require the eventual dismantling of the power of the nation state: "It is simply not feasible for sovereignty to be exercised unilaterally by individual nation-states, however powerful. It is a principle which will yield only slowly and reluctantly to the imperatives of global environmental cooperation." "We need a system of global governance through which nations can cooperate and deal with issues they cannot deal with alone. The ultimate example is climate change."

In 1992, Al Gore claimed, "Only an insignificant fraction of scientists deny the global warming crisis. The time for debate is over. The science is settled."

In 1997, Strong became Under-Secretary General of the United Nations. Strong was a leading architect of the 1997 Kyoto Protocol that set binding greenhouse gas reduction targets for 37 industrialized countries.

Today's climate alarmism did not begin in the normal scientific process. It began in Strong's incubator that protected IPCC's climate theory from scientific critique. It flourished when environmental organizations adopted it into their programs. Environmentalism's moral assumption is embedded in Strong's remarks on behalf of the UN and in IPCC reports. "Environmentalism" has a moral component. It alleges humanity is destructive, evil, and guilty of destroying the environment on this planet. Its basic premise is nature is good and humanity is bad. IPCC reports assume the same moral view. By contrast, physics—and more generally, science—is amoral. Physics tries to understand nature. Physics will get different answers to climate questions than environmentalism.

Scientific Basis of Plaintiffs' Claims

All Plaintiffs' scientific and damage claims are based on **IPCC** reports. The 2013 IPCC (2013, p. 467, Executive Summary) states:

> "With a very high level of confidence, the increase in CO2 emissions from fossil fuel burning and those arising from land use change are the dominant cause of the observed increase in atmospheric CO2 concentration."

Other IPCC statements from this Executive Summary include:

1. The Human-Caused Perturbation in the Industrial Era CO2 increased by 40% from 278 ppm about 1750 to 390.5 ppm in 2011.
2. It is unequivocal that the current concentrations of atmospheric CO2, CH4 and N2O exceed any level measured for at least the past 800,000 years, the period covered by ice cores.
3. Furthermore, the average rate of increase of these three gases observed over the past century exceeds any observed rate of change over the previous 20,000 years.
4. About half of the emissions remained in the atmosphere (240 ± 10 PgC) since 1750.
5. During the last 7000 years prior to 1750, atmospheric CO2 from ice cores shows only very slow changes (increase) from 260 ppm to 280 ppm, in contrast to the human-caused increase of CO2 since pre-industrial times.
6. The contribution of CO2 emissions from early anthropogenic land use is *unlikely* sufficient to explain the CO2 increase prior to 1750.
7. Further back in time, during the past 800,000 years prior to 1750, atmospheric CO2 varied from 180 ppm during glacial (cold) up to 300 ppm during interglacial (warm) periods. This is well established from multiple ice core measurements.
8. The removal of human-emitted CO2 from the atmosphere by natural processes will take a few hundred thousand years (*high confidence*).
9. Depending on the RCP scenario considered, about 15 to 40% of emitted CO2 will remain in the atmosphere longer than 1,000 years.
10. This very long time required by sinks to remove anthropogenic CO2 makes climate change caused by elevated CO2 irreversible on human time scale. {Box 6.1}
11. Atmospheric CO2 represents the main atmospheric phase of the global carbon cycle. The global carbon cycle can be viewed as a series of reservoirs of carbon in the Earth System, which are connected by exchange fluxes of carbon.
12. Conceptually, one can distinguish two domains in the global carbon cycle. The first is a fast domain with large exchange fluxes and relatively 'rapid' reservoir turnovers, which consists of carbon in the atmosphere, the ocean, surface ocean sediments and on land in vegetation, soils and freshwaters.
13. Reservoir turnover times, defined as reservoir mass of carbon divided by the exchange flux, range from a few years for the atmosphere to decades to millennia for the major carbon reservoirs of the land vegetation and soil and the various domains in the ocean.
14. During the Holocene (beginning 11,700 years ago) prior to the Industrial Era the fast domain was close to a steady state, as evidenced by the relatively small variations of atmospheric CO2 recorded in ice cores (see Section 6.2),

15. By contrast, since the beginning of the Industrial Era, fossil fuel extraction from geological reservoirs, and their combustion, has resulted in the transfer of significant amount of fossil carbon from the slow domain into the fast domain, thus causing an unprecedented, major human-induced perturbation in the carbon cycle.
16. A schematic of the global carbon cycle with focus on the fast domain is shown in Figure 6.1. The numbers represent the estimated current pool sizes in PgC and the magnitude of the different exchange fluxes in PgC/yr averaged over the time period 2000–2009 (see Section 6.3).

The level or concentration of atmospheric CO2 is in units of ppmv (parts per million by volume in dry air). However, it is customary to omit the "v" and write ppm. To convert CO2 in ppmv into the mass of carbon in PgC (petagrams), multiply the ppmv by 2.12. GtC (Gigatons of carbon) is numerically equivalent to 1.0 PgC.

Plaintiffs bear the burden of proof to show that human CO2 emissions are the cause of their claimed damages. Plaintiffs use IPCC reports as the basis for their claims that (1) human CO2 causes all increase in atmospheric CO2 above 280 ppm; and (2) the CO2 increase above 280 ppm has caused all the global warming.

The IPCC (2013, pp. 470-471) assumes the natural CO2 level remained at 280 ppm after 1750 and, therefore, human CO2 caused all the CO2 increase since 1750. The IPCC defines two carbon cycle domains, the *slow* carbon cycle and the *fast* carbon cycle. IPCC (2013, p. 470) explains:

> "The first is a fast domain with large exchange fluxes and relatively 'rapid' reservoir turnovers, which consists of carbon in the atmosphere, the ocean, surface ocean sediments and on land in vegetation, soils and freshwaters."
>
> "A second, slow domain consists of the huge carbon stores in rocks and sediments which exchange carbon with the fast domain through volcanic emissions of CO2, chemical weathering, erosion and sediment formation on the sea floor."

The IPCC, its supporting papers and climate models, assume that human CO2 causes all or most CO2 increase above 280 ppmv. This assumption is the basis of worldwide climate laws and treaties. Human carbon moves carbon from the slow carbon cycle to the fast carbon cycle. Land carbon moves carbon from the land to the atmosphere, all within the fast carbon cycle. Further, the IPCC assumes that human carbon transferred to the fast carbon cycle stays in the fast carbon cycle forever.

Flaws in IPCC Science

Figure 1 (IPCC, 2013, p. 471, Figure 6.1) shows IPCC's natural carbon cycle (in black) and IPCC's human carbon cycle (in red). The title bar shows 589 PgC (278 ppmv) of *natural* carbon and 240 PgC (113 ppmv) of *human* carbon is in the atmosphere as of about 2005. So, according to the IPCC, human CO2 had caused 29% (= 240 / (589 + 240)) of the CO2 in the atmosphere as of about 2010. The IPCC arrives at this conclusion by assuming that human CO2 does not flow out of the atmosphere as natural CO2 flows out of the atmosphere.

Figure 5 below also shows annual *human* carbon emissions in 2005 are 8.8 PgC per year (7.8 PgC per year of human carbon and 1.1 PgC per year of land carbon) while *natural* carbon emissions are 168 PgC per year (107.2 PgC per year from land and 60.7 PgC from surface ocean), making human-caused carbon inflow to be 5.0% (= 8.8 / (168 + 8.8)) of the total inflow.

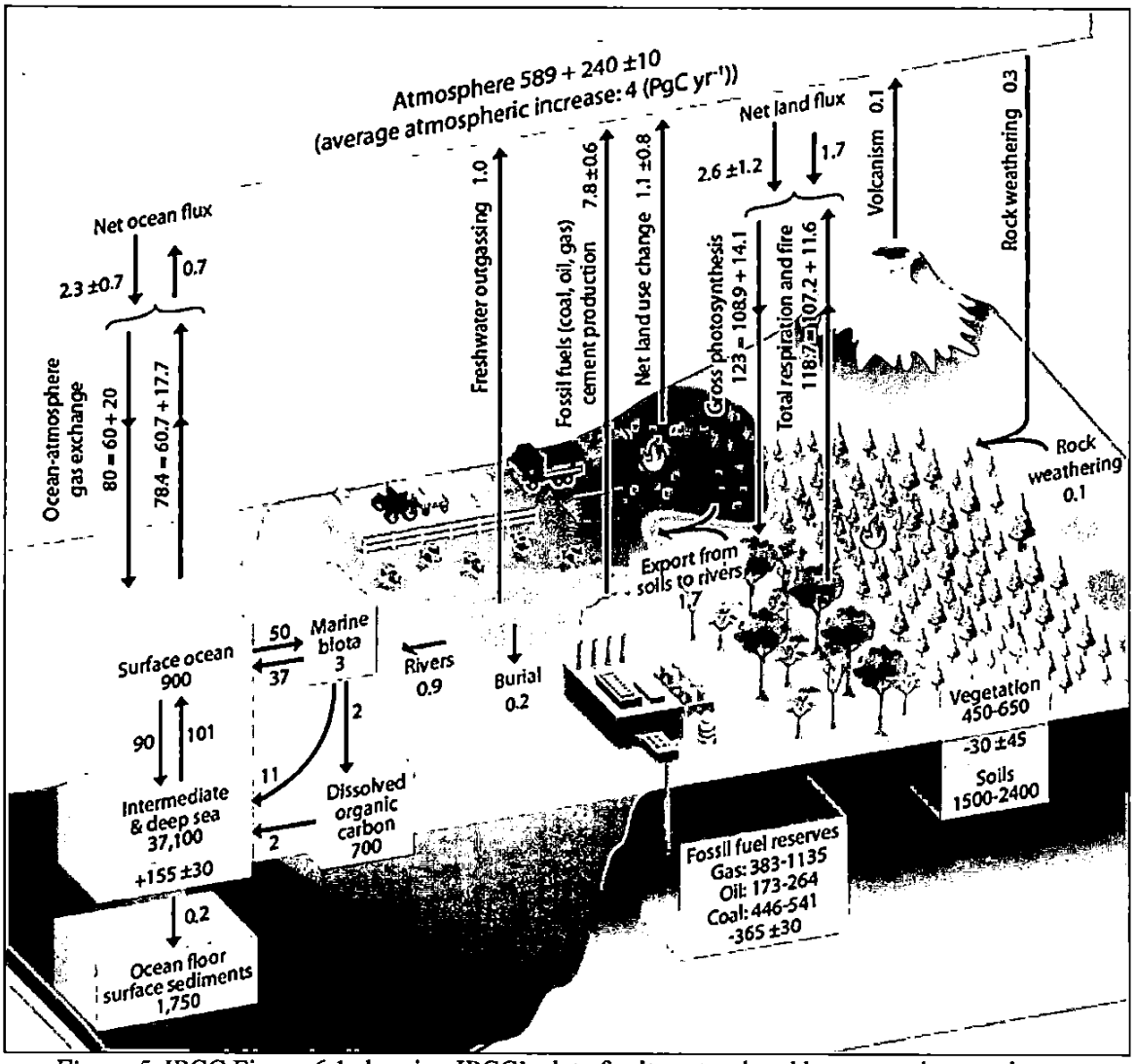


Figure 5. IPCC Figure 6.1 showing IPCC's data for its natural and human carbon cycles.

The IPCC assumes annual *human* emissions, which are only 5% of the total CO2 inflow, becomes 29% of the CO2 in the atmosphere. But 5% of the inflow cannot become 29% of the total. Figure 6 illustrates this problem. The 5% human CO2 inflow will produce 5% of the CO2 in the atmosphere **if human and natural CO2 flow through the atmosphere equally.**

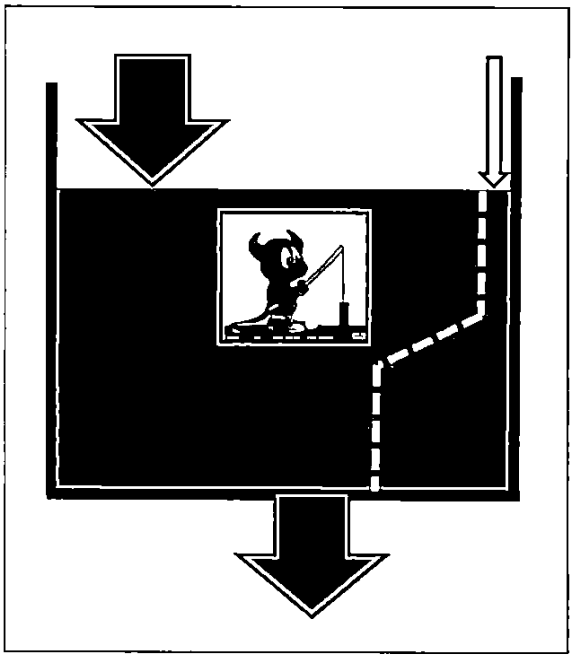


Figure 6. Inflow into a bucket is 95% water and 5% wine. Let the 95% water simulate natural CO2 inflow and the 5% wine simulate human CO2 inflow. The mixture flows out through a hole in the bottom of the bucket. The IPCC says the 5% human CO2 inflow magically turns into 29% human CO2 in the bucket.

The IPCC says the 5% human CO2 becomes 29% of the CO2 in the atmosphere. This is clearly impossible, and it shows how the IPCC exaggerates the true impact of human CO2 on atmospheric CO2. IPCC's climate models include this exaggeration. The IPCC understands this 5% to 29% is a problem. So how does the IPPC get around this issue? The IPCC (2013, p. 469) says *human* CO2 stays in the atmosphere longer than *natural* CO2:

> "The removal of human-emitted CO2 from the atmosphere by natural processes will take a few hundred thousand years (high confidence). Depending on the RCP scenario considered, about 15 to 40% of emitted CO2 will remain in the atmosphere longer than 1,000 years. This long time required by sinks to remove anthropogenic CO2 makes climate change caused by elevated CO2 irreversible on human time scale. {Box 6.1}"

"Turnover time" is the proper way to measure how long CO2 stays in the atmosphere. IPCC (2007, p. 948) says the turnover time (T) for natural CO2 is about 4 years.

> "*Carbon dioxide* (CO2) is an extreme example. Its turnover time is only about four years because of the rapid exchange between the atmosphere and the ocean and terrestrial biota."

So, The IPCC says the turnover time of natural CO2 is about 4 years but the turnover time for human CO2 is over 1,000 years. However, human and natural CO2 molecules are identical.

Therefore, human and natural CO2 molecules must have the same turnover times. The IPCC violates a basic principle of physics, the *climate equivalence principle*. Physics says if molecules are identical, they react the same. This principle shows that human CO2 *cannot* stay in the atmosphere longer than natural CO2.

The level of CO2 in the atmosphere behaves like the level of water in a lake where water flows into the lake and then out over a dam. Figure 3 shows a lake where water flows in from a river and flows out over a dam. Inflow raises the lake level. The higher the lake level, the faster the water flows over the dam. This lake is analogous to the CO2 level in the atmosphere where CO2 flows in and CO2 flows out. The higher the CO2 level, the faster CO2 flows out of the atmosphere. If the inflow is constant inflow, the lake level will either rise or fall until the outflow equals the inflow. The inflow sets the balance level where outflow equals inflow. The lake level and the atmospheric CO2 level always cause an outflow that equals the inflow. When inflow is constant, the lake or CO2 level will remain constant because outflow equals inflow. No water "accumulates" in the lake. No CO2 accumulates in the atmosphere. The level rises until outflow equals inflow and thereafter remains constant.

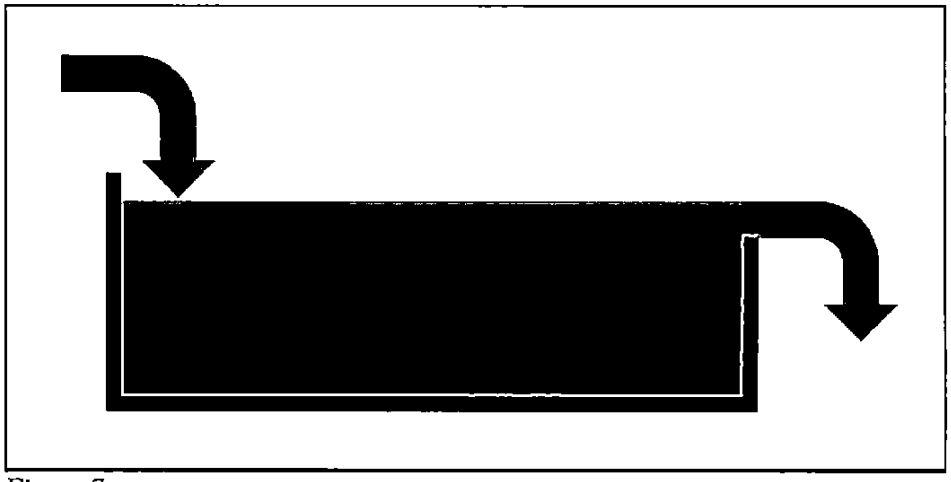


Figure 7.

The IPCC's Box 6 merely assumes the natural CO2 level has remained at 280 ppmv while human CO2 caused all the CO2 increase. There are no data to prove this is the case. IPCC merely assumes its theory is true.

CO2 does not "accumulate" in the atmosphere. The atmosphere is not a garbage dump for CO2. The higher the CO2 level, the faster the CO2 outflow. It is impossible for a constant inflow of human or natural CO2 to cause a continuing increase in atmospheric CO2. Even the IPCC recognizes this when it assumes the natural level stayed constant even as natural CO2 continued to flow into the atmosphere.

If natural CO2 inflow sets a balance level of 280 ppm, then at 280 ppm the CO2 outflow equals the CO2 inflow. The IPCC says the natural CO2 level was 280 ppm in 1750 and that this natural level has remained constant through today, even though the temperature has increased, thereby

releasing more CO_2 from the oceans. IPCC's definition of "turnover time" says outflow is directly proportional to level. If the level doubles, the outflow doubles. This IPCC definition has a unique property. It means natural and human CO2 flow through the atmosphere independently and do not interfere with each other. Therefore, we can envision and model the effects of natural and human CO2 separately. Then, we can add the effects to calculate the overall effect of both sources of CO2. According to IPCC data, human CO2 inflow is 5% and natural CO2 is 95% of the total CO2 inflow into the atmosphere. These inflows act independently. Therefore, to the first approximation, human CO2 causes 5% of the CO2 level and natural CO2 causes 95% of the CO2 level. If the natural CO2 level remained at 280 ppm, as the IPCC assumes, then the 5% human inflow will add 15 ppm to bring the total CO2 in the atmosphere to 295 ppm.

So, how did the level of CO2 in the atmosphere get to 410 ppm? Answer: Human CO2 did not cause all the increase. Natural CO2 had to increase to raise the CO2 level above 295 ppm. IPCC's theory (1) says human CO2 added 130 ppm to the atmosphere to increase the level from 280 ppm to 410 ppm. But we have just proved this is impossible using IPCC's own data.

I used the phrase "to the first approximation" above because there is a more accurate way to calculate the effect of human CO2 on atmospheric CO2. This calculation modifies the first approximation values but does not change the conclusion that IPCC's theory is false. This calculation will use IPCC's carbon cycle data and will account for the flow of human carbon back into the atmosphere that the first approximation did not include. Figure 8 shows IPCC's natural carbon cycle using IPCC's data shown in Figure 5.

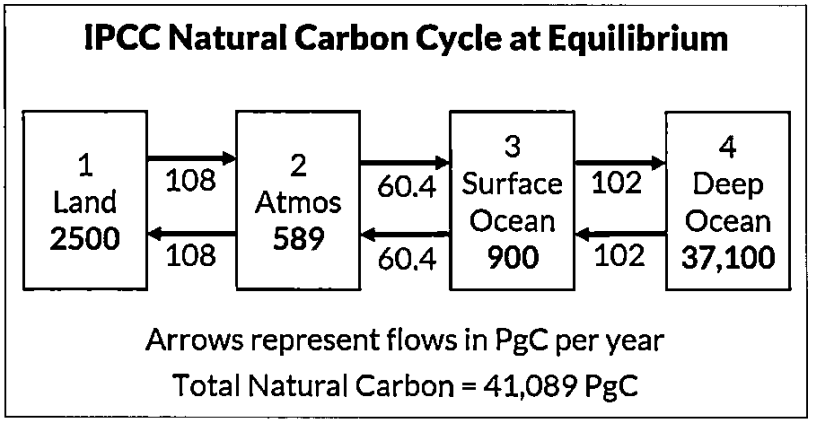


Figure 8.

The boxes show reservoirs, and the arrows show flows between the reservoirs. The origins of the arrows are "nodes." Figure 9 shows the percent of natural carbon in each reservoir from Figure 4. Only 1.43% of natural carbon is in the atmosphere and 90% is in the deep ocean.

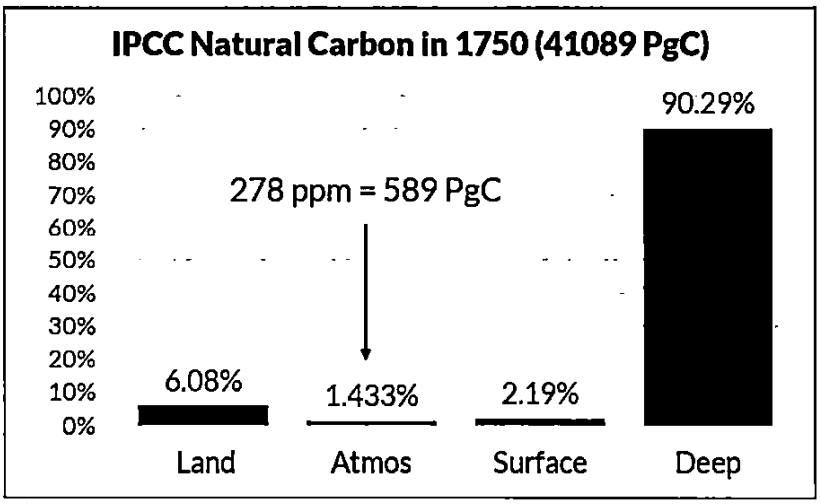


Figure 9.

The Figure 9 reservoir percentages are a fingerprint of the IPCC's natural carbon cycle at equilibrium.

IPCC's true human carbon cycle will have this same equilibrium fingerprint as its natural carbon cycle. If all human carbon emissions were to stop, the human carbon percentages would move toward the natural carbon percentages shown in Figure 9. Only 1.4% of all human carbon would remain in the atmosphere at equilibrium.

IPCC (2007, p. 948) defines turnover time equal to level divided by outflow:

> "Turnover time (T) is the ratio of the mass M of a reservoir (e.g., a gaseous compound in the atmosphere) and the total rate of removal S from the reservoir: T = M / S. For each removal process, separate turnover times can be defined."

IPCC's turnover time, that we call "e-time," measures how fast CO2 flows out of the atmosphere. Each node in Figure 8 has an e-time. To find the e-times for each node, we simply divide the reservoir level by the outflow. Simple physics requires IPCC's human carbon cycle to have the same e-times as IPCC's natural carbon cycle. So, we can use IPCC's natural carbon e-times to calculate IPCC's true human carbon cycle. With a simple physics carbon cycle model, we can replicate IPCC's natural carbon cycle and calculate IPCC's true human carbon cycle that IPCC did not do.

Figure 10 shows IPCC's false human carbon cycle values in Figure 1 for the 2000-2009 time-period.

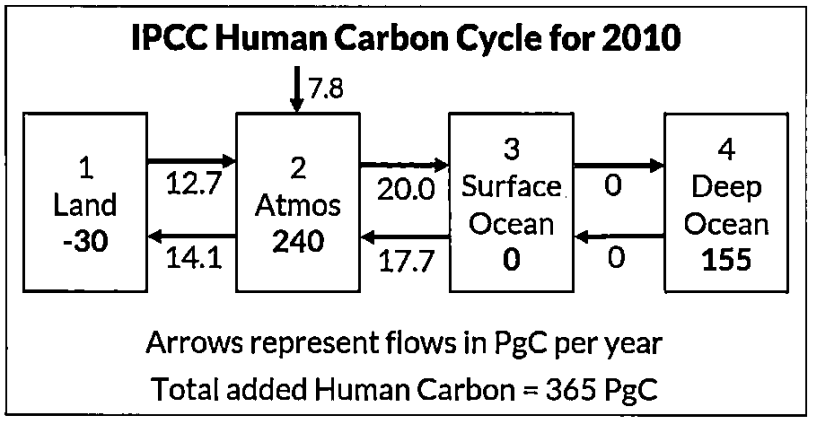


Figure 10.

Figure 11 shows the percent of the 365 PgC of human carbon in each reservoir for IPCC's human carbon cycle shown in Figure 8. These percentages show 8% of 365 has moved from the land to the atmosphere to the deep ocean, 66% is in the atmosphere, and 42% is in the ocean.

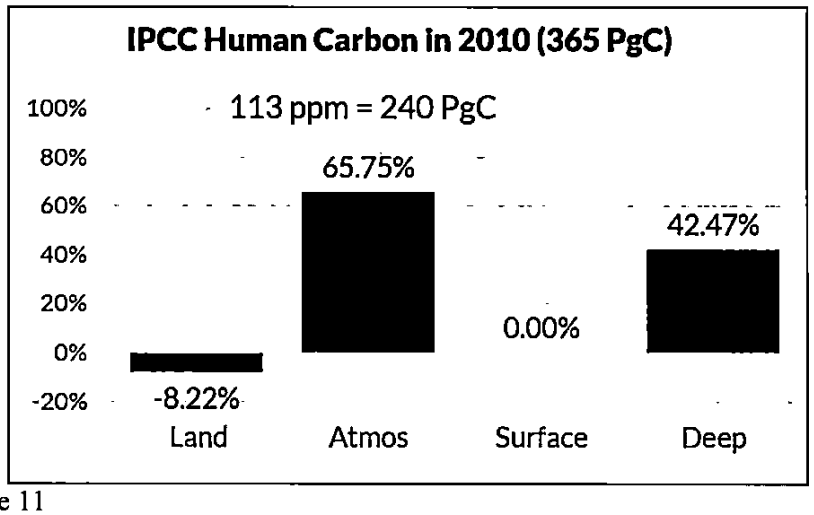


Figure 11

IPCC's human percentages in Figure 11 are purely imaginary. The 66% in the atmosphere is simply the amount necessary to agree with IPCC's theory (1).

Figure 12 shows the percentages of human carbon in each reservoir in 2010 calculated using the IPCC's e-times for its natural carbon cycle.

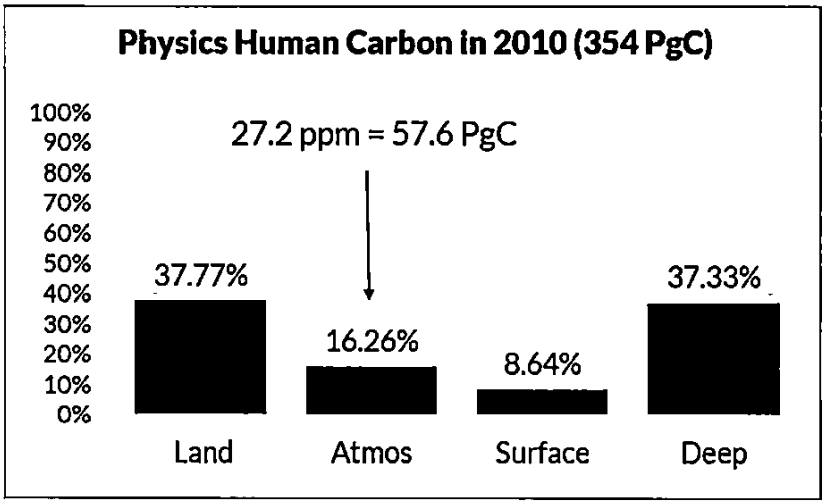


Figure 12.

Figure 13 shows how fast human carbon in the atmosphere would flow to the deep ocean if all human emissions were to stop in 2020. The level percentages move toward IPCC's natural carbon cycle percentages shown in Figure 9.

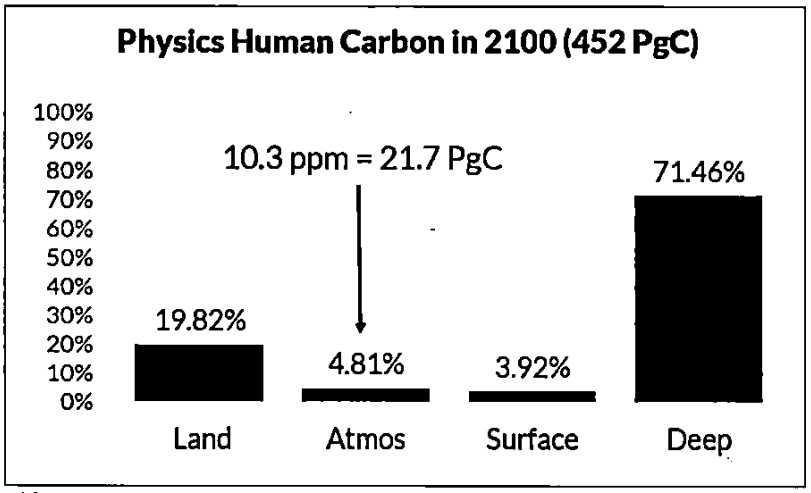


Figure 13.

Comparing the total human carbon of 452 PgC (shown in Figure 13) with the total natural carbon of 41089 PgC (shown in Figure 9), we find that human carbon emissions have increased the carbon in the carbon cycle by 1.10%. This is hardly enough to throw the natural carbon cycle "out of balance." In fact, IPCC's own data show the level of natural carbon in the carbon cycle varies with time more than the human addition to the carbon cycle. Ballantyne et al. (2012) found "there is no empirical evidence" that the ability of the land and oceans to absorb atmospheric CO2 "has started to diminish on the global scale." This means human CO2 has not changed the turnover times found in IPCC's natural carbon cycle.

Figure 14 plots CO2 levels in PgG above 594 PgC (280 ppm).

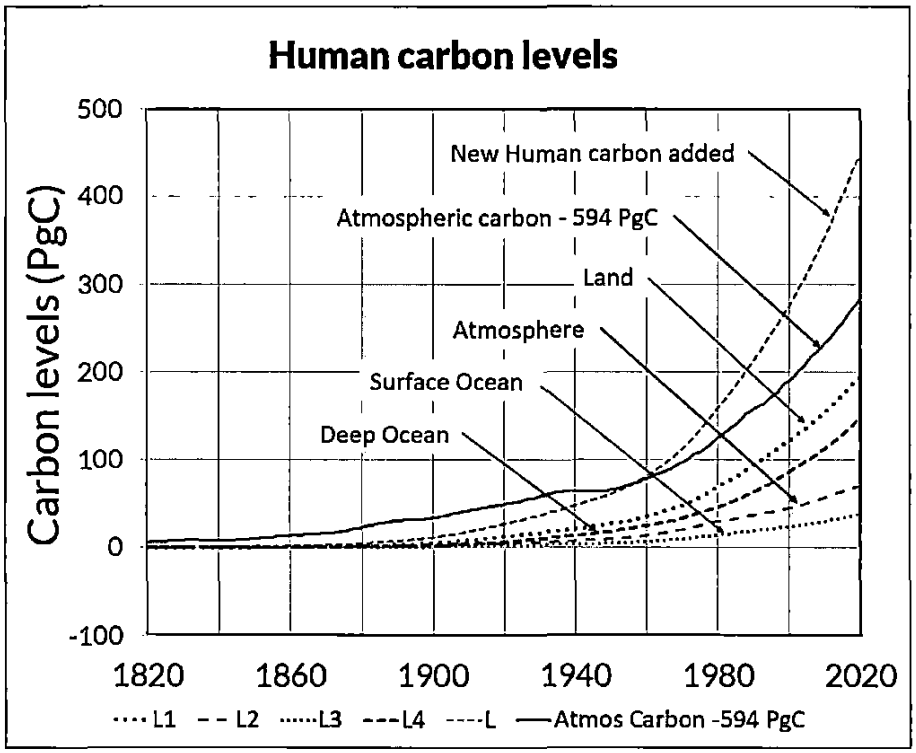


Figure 14.

Observe that atmospheric carbon before 1950 is greater than the total of all human carbon emissions since 1750. This proves, using IPCC-approved data, that the natural CO2 level HAD to increase above 594 PgC (280 ppm), with contradicts IPCC theory. The other lines in Figure 14 show the calculated increase in the deep ocean, surface ocean, atmosphere, and land caused by human CO2 emissions. These calculations use IPCC's natural carbon cycle data. Notice that the human CO2 that remains in the atmosphere (red dashed line) is well below both the total human CO2 emitted and well below the measured CO2 level in the atmosphere.

Carbon-14 (aka radiocarbon, aka 14C) is a very rare isotope. For ever 14C atom, there are about one million-million (one trillion) normal 12C atoms. It is created more or less steadily by cosmic rays, but undergoes radioactive decay with a half-life of 5,730 ± 40 years. Carbon-dating is based on that half-life, and are mildly complicated because of variations in cosmic ray flux, and must be cross-checked against tree-ring data. Of course, there is no 14C in fossil fuels since they are ancient.

Scientists who do age dating with 14C use a value δ14C that is a bit complicated. For arithmetic simplicity, assume that we presently have one atom of 14C for every trillion atoms of 12C. Suppose that some skeleton from a long time ago has one atom of 14C for every 4 trillion atoms of 12C. To compare them we compare the ratios with the present ratio: we get 1 and ¼ respectively. Then we subtract in the non-obvious way: ¼ minus 1 equals minus ¾.

Multiply that by 1000 to get δ14C = –750. (If there is no 14C in the sample, its δ14C value is -1000.)

The above-ground atomic bomb tests in the 1950s and 1960s nearly doubled the amount of 14C in the atmosphere, but also provided an unintended method of determining how long it takes a perturbation to return to normalcy. Figure 15 shows the value of δ14C versus time. Notice that the value (black line) dropped from about 650 to half (325) in about 12 years, and again by half in about 12 years.

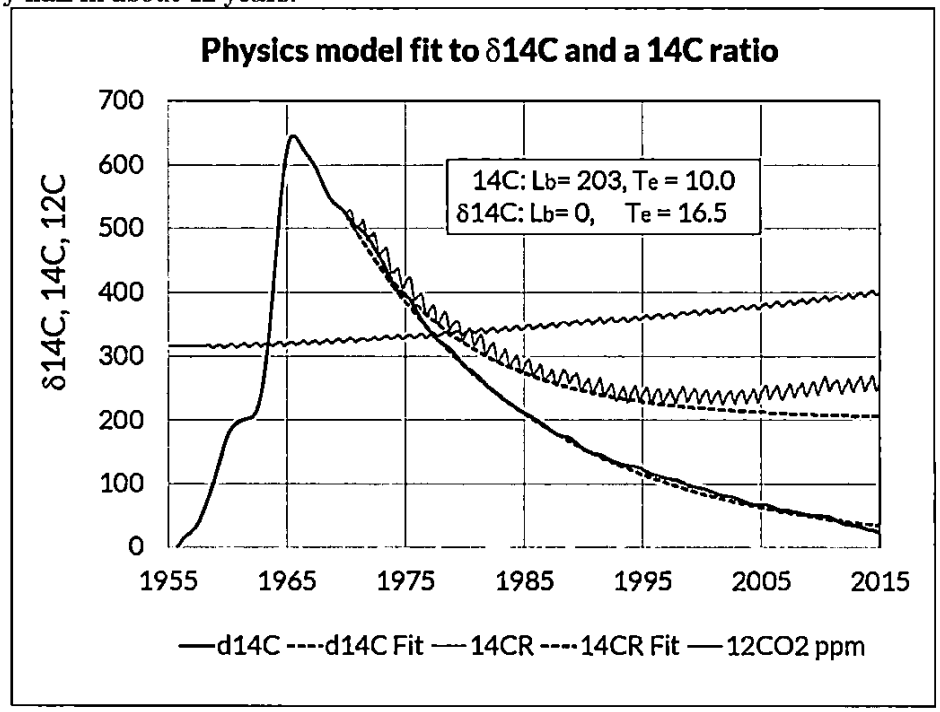


Figure 15. δ14C data (black line), the physics model fit to δ14C (black dashed line), 14CR (blue sawtooth line), physics model curve fit to 14CR (black dashed line), and 12CO2 ppmv (red line).

From 1970 to 2014, δ14C returned to its original balance level of zero with an e-time of 16.5 years. What does this mean? Because fossil fuels contain no carbon-14, human CO2 emissions have zero 14C, making their δ14C equal to -1000.

Natural CO2 emissions have their δ14C equal to zero. If human CO2 emissions caused 30% of atmospheric CO2 and natural emissions 70%, as IPCC's theory (1) claims, this would have reduced the balance level of δ14C to about -300. If human CO2 emissions caused 5% and natural emissions 95% of atmospheric CO2, this would have reduced the balance level of δ14C to about -50. But Figure 15 shows the balance level of has remained close to zero and is certainly not anywhere near -300. This indicates the dominant CO2 inflow is from natural sources and not from human sources.

The blue jagged line in Figure 15 shows the e-time of 14CO2 is 10 years. This e-time is an upper limit for the 12CO2 e-time because the 14CO2 isotope is heavier and slower. This is an important

fact because some scientists argue that the 12CO2 e-time is much longer than 10 years and, therefore, the human contribution to atmospheric CO2 is much larger than 10%. This fact derived from the bomb data proves the IPCC data for its natural carbon cycle is quite accurate. Quirk (2009) examined 13C data and seasonal and hemispherical variations of CO2, to find:

> "The constancy of seasonal variations in *CO2* and the lack of time delays between the hemispheres suggest that fossil fuel derived *CO2* is almost totally absorbed locally in the year it is emitted. This implies that natural variability of the climate is the prime cause of increasing *CO2*, not the emissions of *CO2* from the use of fossil fuels."

Skrable et al. (2022) used 13C and 14C data to conclude the CO2 increase after 1750 is due primarily to increasing natural CO2 inflow.

Jamal Munshi (2015a) shows the "detrended correlation of annual emissions with annual changes in atmospheric CO2" is zero. This proves human emissions are not the primary cause of the increase in the CO2 level. This is basic, fundamental science. If there is no correlation, there is no cause and effect. If there is no correlation between a presumed cause and a presumed effect, then there is no cause and effect.

The COVID-19 pandemic caused a 20% reduction in worldwide human CO2 emissions for over a year. The Global Monitoring Laboratory (2020) data show this decrease in human CO2 emissions did not slow the annual CO2 increase. The physics carbon cycle model calculates that reducing human CO2 emissions by 20% in 2020 would reduce the CO2 level from 33.5 ppmv in 2020 to 33.1 ppmv, which is unmeasurable. However, if human carbon caused all the 133-ppmv CO2 increase, as the IPCC theory (1) claims, then reducing human CO2 emissions by 20% would have reduced the CO2 level from 414.0 ppmv in 2020 to 412.4 ppmv in 2021, which would have been measurable. This did not happen, further proving IPCC's theory is false.

Munshi (2015b) found there is no statistically significant correlation between the rate of human carbon emissions and the rate of change of global surface temperature even using time lags up to 20 years. Therefore, human CO2 emissions are NOT the cause of the temperature increase that is a basis of the plaintiffs' claim. Nature causes the temperature increase. The effect cannot precede its cause. The plaintiffs must prove CO2 changes precede temperature changes.

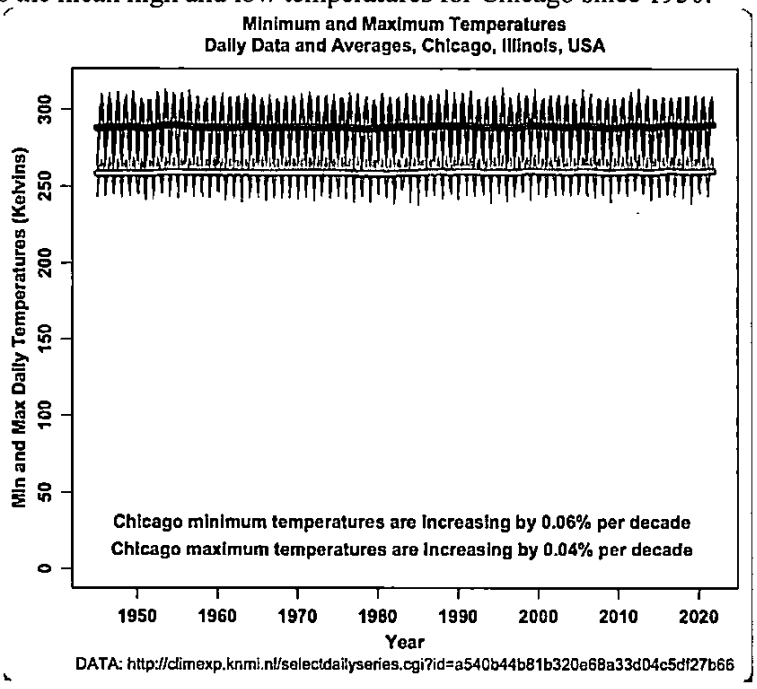
The following is only some of the evidence that proves the plaintiffs are wrong:

- Kuo et al. (1990) used time-series analysis to confirm that temperature and atmospheric carbon dioxide are significantly correlated and found that changes in atmospheric CO2 lag temperature changes by five months.
- Fischer et al. (1999) show the CO2 increase in Antarctic ice cores increased occurred 600 ± 400 years after the warming of the last three deglaciations.
- Caillon et al. (2003) show the CO2 increase during the Antarctic Termination III occurred 800 ± 200 years after the Northern Hemisphere deglaciation.
- Kouwenberg (2004) shows evidence that temperature controls the CO2 level: "temperature-driven changes in CO2 flux between ocean surface waters and atmosphere

may be invoked as a plausible mechanism to explain at least a substantial part of the reconstructed CO2 variations over the last Millennium."

- MacRae (2008) found the rate of change of the CO2 level (dL2/dt) correlates with the surface temperature and thus atmospheric CO2 changes lag atmospheric temperature changes by about nine months.
- Humlum et al. (2013) show CO2 increases do not correlate with human CO2 emissions but consistently follow temperature increases by about 9 to 12 months. A correlation of zero between cause-effect data proves there is no observable cause-effect.
- Salby (2013) shows how CO2 follows changes in the integral of surface temperature.

Figure 16 shows the mean high and low temperatures for Chicago since 1950.



Since energy is related to absolute zero rather than our daily temperatures, this plot gives the proper perspective for energy balance.

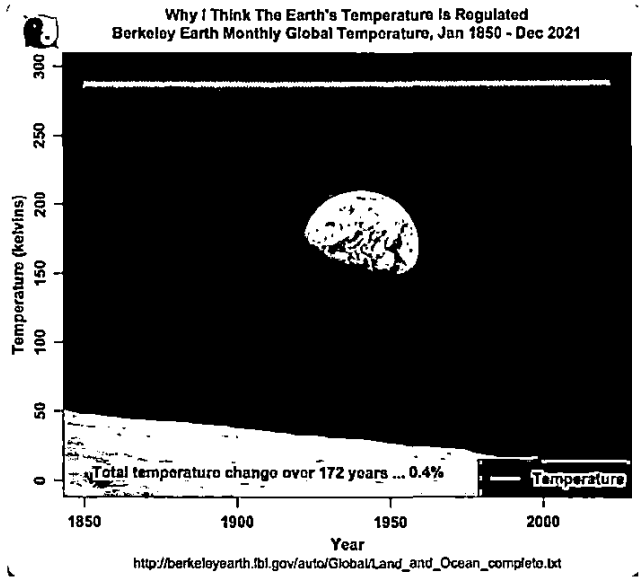


Figure 17 is a similar plot for the Earth.

The point is nature is stable. Climate is stable except when nature causes it to be unstable. Claims that human emissions cause dangerous climate change are an illusion.

APPLICATION TO ISSUES IN THIS CASE

Having set forth the above climate fundamentals, I now turn to providing my opinions on specific issues I have been asked to address in this case.

I. The Greenhouse Effect

CO2 is a greenhouse gas that constitutes a mere 0.04% of our atmosphere, yet that tiny amount is what all life depends on—not because of the greenhouse effect, but because it is what makes photosynthesis possible. Below about 0.015% concentration, all life dies. Above 1%, CO2 becomes hazardous to human health. Carbon dioxide ("CO2") is a greenhouse gas that is presently responsible for about 20% of the greenhouse effect. The greenhouse effect amounts to 159 watts per square meter (W/m2), according to the IPCC in its *Sixth Assessment Report*. CO2 is responsible for about 30 W/m2 of that total. Doubling the amount of CO2 would add 3.93 W/m2. Detailed calculations by van Wijngaarden and Happer would put the figure at 2.97 W/m2, but either figure is a very small fraction of the greenhouse effect of 159 W/m2.

The greenhouse effect of 159 W/m2 keeps the earth 34°C warmer than it would be (all other things remaining equal) without the greenhouse effect. Doubling the CO2 concentration, as may happen late in the century, would increase the total greenhouse effect by 2.47%., warming the earth by about 0.8°C. That is not a catastrophic amount, nor will it cause catastrophic or otherwise harmful effects. Contrarily, the IPCC says that doubling CO2 concentration would increase the temperature by 3°C (their "most probable" value), with the range 2°C to 5°C being considered "very likely."

Importantly, the surface of the earth radiates heat, the more so as the surface warms. Closely, every 1°C rise in temperature causes an increase of 5.47 W/m^2 in heat radiation. If, as IPCC claims as most probable, doubling of CO_2 would raise the temperature by 3°C, the surface would increase its radiation by 16.4 W/m^2. How this can happen with only 3 or 4 W/m^2 of additional greenhouse effect ("radiative forcing") is a question that IPCC has never asked, let alone answered.

II. The Relationship Between CO2 Emissions and the Greenhouse Effect

Combustion of fossil fuels produces CO2 that goes into the atmosphere. Once in the atmosphere, the CO2 quickly spreads throughout the world, affect no farm, town, city, county, state or country disproportionately. Anthropogenic CO2 emissions from all sources constitute about 4% of the total CO2 emissions; natural emission being the other 96%. The net increase in atmospheric CO2 is equal to half the anthropogenic emissions and amounts to about one part in 400 of the quantity of CO2 in the atmosphere. Not only is it not harmful, but the increase in atmospheric CO2 has played a role in the greening of the earth.

III. Anthropogenic GHG Emissions Are Not Causing Dangerous Climate Change

When the terminology changed from *global warming* to *climate change*, the term *climate change* became simultaneously any weather change for the worse anywhere on the planet, and the universal cause of all untoward effects—more rain, less rain, more snow, less snow, Antarctic ice grows, Antarctic ice shrinks, and so on. Climate change causes climate change.

Much has been written about what the worldwide weather would be if human CO2 emissions were changing the climate. Francis and Vavrus (2012) introduced a big misconception. They claimed that as CO2 warms the arctic, this would cause the jet stream waves to amplify and stall. This, in turn, would increase the frequency of severe weather around the globe. Wiese (2016) shows if atmospheric CO2 changed the climate as Francis and Vavrus claim, then severe weather would decrease around the globe, not increase. Today, atmospheric CO2 continues to rise, and yet, there are no discernable changes in our weather patterns even though global temperatures are slightly warmer than they were 130 years ago. This suggests the warmer temperatures are entirely natural and this natural warming trend is the dominant cause of the increase in CO2.

IV. Anthropogenic GHG Emissions are Not Causing Adverse Weather Events

Worldwide temperature has risen about 1°C during the last century. If 100 years of a warming of 0.00017°C per year (0.017°C) due to Montana's activities were to have an adverse effect, then a whole 1°C of warming would be 59 times as bad. However, adverse weather events have not gotten 59 times worse in the last 100 years. Climatologists reckon climate in 30-year spans; geologists use much longer spans. Nevertheless, climate alarmists attribute every weather event that is different this year than last to "climate change." Those hundreds of "climate change" happenings seem to occur in 3 percent of one climate data point.

Worldwide temperature has risen about 1°C during the last century. During that time, glaciers have largely continued the decline that has been ongoing since the late 1700s, flood damage as a fraction of GDP has declined by a factor of about 4, the number of landfalling hurricanes and the number of major hurricanes have been on the decline. The heatwave index reached its maximum in the Dust-Bowl years. Sea level has risen about 7 inches and is continuing to rise at the same rate. The number of EF3+ tornadoes has been on the decline for at least 50 years, despite their increased

detectability by radar. The global average death rate from natural disasters has been on the steady decline for the last century. The planet is greening. To claim that things are getting worse because of that warming is, to put it kindly, bogus.

Montana's contribution to "global warming due to CO_2 emissions," including all CO_2 produced within the state and all CO_2 from fossil fuel exports amounts to 0.00017°C per year, or 0.017°C/century. If Montana's contribution of CO_2 to the warming were to have an adverse effect, then the 59-times-as-large 1°C would logically be 59 times as bad; yet the climate is getting better, not worse.

Because of our myriad uses of energy, mostly from fossil fuels, the world is more amenable to human habitation than it has ever been. Nevertheless, there is considerable anxiety about the future because of "climate change." The science is clear: the anxiety is not due to climate change.

The human toll from climate-related events is on the strong decline.

V. Even accepting Plaintiffs' assumptions, Montana's contribution to global GHG emissions is utterly negligible.

However, even if we accept—*for the sake of argument*—Plaintiffs' scientific premises, their scientific conclusions in this case fail. Let's assume for the sake of argument that Plaintiffs' expert Peter Erickson is correct that the total CO2 produced either in Montana or by combustion of fossils exported from Montana is 166×10^6 tonnes per year. To compare with the IPCC data, we shall consider the carbon in that CO2, namely 45.2×10^6 tonnes ($= 4.5 \times 10^9$ kg). As shown in Figure 1, humanity puts 8×10^{15} grams ($= 8 \times 10^{12}$ kg) of carbon into the atmosphere annually. Montana's fraction of humanity's annual global carbon emissions is, according to Plaintiffs' own experts, **0.0056,** or roughly one-half of one percent.

On the data presented by Plaintiffs' own experts—assuming that Montana's state government is responsible for 100% of Montana's contribution to global greenhouse gas emissions—Montana's contribution is utterly negligible compared to that of the world. Immediately ceasing all combustion of fossil fuels within the state and ceasing all exports would (in the highly unlikely event that the shortfall was not immediately met by other fossil sources) forestall **0.00017°C** of global warming per year. This means Montana's GHG emissions have an utterly negligible impact either worldwide or locally.

VI. The Result if Montana Reduced All GHG Emissions to Zero

IPCC expects CO2 concentration to double by the end of the century, and the temperature to rise by 3°C (most probable value). It is a big overestimate, but we will use the figure for the sake of argument. That's a rise of 0.03°C per year. If Montana were to immediately cease all mining and all combustion of fossil fuels (for automobiles, trucks, trains, airplanes, power plants, home heating, manufacturing, electrical production and so forth), the state would forestall an annual temperature rise of **0.00017°C.** Cessation of all fossil combustion in Montana—assuming no corresponding increase in other parts of the world—would forestall **32 millionths of a degree per year.**

This conclusions bears repeating: If all Montanans immediately and completely ceased burning all fossil fuels, the effect would be to forestall **32 millionths of a degree of warming per year**. Also, realistically, even if Montana immediately and completely ceased all activity involving fossil fuels, the corresponding increase in China's CO2 emissions in a single year would wipe out the alleged benefit of a complete cessation of all fossil-fuel exports and all combustion due to Montana's activities.

The demands being made by Plaintiffs would be ineffective at reducing CO2 emissions and have even less effect on world temperature. Even if Plaintiffs were right, Montana could not stop the alleged harms resulting from climate change.

But there's more. Not only would Plaintiffs' demands do nothing to alleviate their alleged harms, but in fact they would actively cause further harm: the harm of forcing our progeny to live without the myriad benefits of fossil fuels. Energy drives everything. It takes energy to farm food, to produce fertilizer, to cook food, to can food, to refrigerate food, and to deliver food. It takes energy to heat our homes, to provide light, and to air-condition living spaces. It takes energy to mine ores of iron, aluminum, cobalt, molybdenum, gold, silver, lithium, copper, zinc, and all other necessities, and energy to process the ores into useful materials. At present, about 80% of our energy comes from fossil fuels (closer to 85% worldwide), the combustion of which releases CO2 into the atmosphere. To say that humanity benefits from fossil fuels is a vast understatement.

Until about 1850, the main source of energy in the US was combustion of wood. With the advent of railroads, coal began to play a role and wood began to wane. (In England the forests were being rapidly depleted earlier because of steel production.) In the 1800s, the preferred light source was whale-oil lamps, and as the end of the century approached, the whale population was severely depleted. What saved the whales was the advent of kerosene lamps and coal-gas lamps. Winston Churchill, as head of the Admiralty in WWI, decreed that the British navy would run on petroleum rather than coal because it is much easier to use. By about 1925, natural gas supplied about ten percent of our energy; by now, it's about one- third. All things considered, our combustion of petroleum, natural gas, and coal adds about 2 PgC to the atmosphere annually, of which 1 PgC remains.

If you combine data from the Energy Information Administration (www.eia.gov) with population statistics (https://en.wikipedia.org/wiki/Demographic_history_of_the_United_States, for example), you find that the *per-capita* consumption of energy in the US is a mere 3.5 times as high as it was in Ben Franklin's time. This striking fact is the result of efficiency improvements being made on a continuous basis.

Converting heat to work involves rejection of waste heat to the environment, according the Second Law of Thermodynamics.

Again, about 80% of the energy that provides us with food, materials, heat, sanitation, communication, transportation, medicines and all other things that have improved life expectancy from 47 years in 1900 to about 80 years at present comes from fossil fuels. Ammonia (NH3) fertilizer, without which agricultural production would drop severely, is made from natural gas (mostly CH4). Arbitrarily removing the energy sources that have provided us with these wonders

would be the very worst thing we could do to our progeny. The benefit from abundant available energy far outweighs all else. *In short, the consumption of energy has made the earth the most hospitable place for habitation that is has ever been.* Energy drives *everything*, and 80% of our energy comes from fossil fuels. The benefits are to be found everywhere: heat, light, transportation, agriculture, manufacturing, the Internet, television, telephones, refrigeration of foods, freezing of foods, sanitation, clean drinking water, and so forth. Ammonia fertilizer is made from natural gas, and requires a lot of energy besides. Our smooth roads are paved with asphalt (derived from petroleum) and/or concrete whose cement is made by baking CO2 out of limestone. Without fossil-fuel products, medicine goes back to the dark ages. The list is endless.

All opinions given in this report are made to a reasonable degree of scientific certainty. I reserve the right to amend or supplement my opinions if additional information becomes available to me.

Howard "Cork" Hayden

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Department of Physics, UConn

REVISED MAY 2022

BIRTHDATE:	6/20/40	**BIRTHPLACE:** Pueblo, Colorado
EDUCATION:	B.S.	1962 University of Denver
	M.S.	1964 University of Denver
	Ph.D.	1967 University of Denver
EXPERIENCE:	1961–67	Laboratory Instructor, Student Laboratories, University of Denver; Teaching Assistant, Laboratory Technician, 1962; Graduate Research Assistant, 1963–67
	1967–68	Research Assistant IV, University of Connecticut
	1968–75	Assistant Professor, University of Connecticut
	1975–76	Visiting Assistant Professor, University of Tennessee; Guest Appointee, Oak Ridge National Laboratory (Summer, 1975 and Spring semester, 1976)
	1975–89	Associate Professor, University of Connecticut
	1990–1999	Professor, University of Connecticut; Retired 1999
PROFESSIONAL SOCIETIES:		American Association of Physics Teachers; American Institute of Physics; Sigma Xi; American Physical Society; Sigma Pi Sigma American Nuclear Society
FIELD OF SPECIALIZATION:		Molecular and Atomic Scattering, Ion Implantation, "Relativity" Experiments
RESEARCH INTERESTS:		Ionization; Charge Transfer; Inelastic Energy Losses; Coincidence Techniques; Beam-foil Spectroscopy; Collision-induced X-ray Spectra, Ion Implantation, Energy Issues, Relativity Theory and Experiments, Climate

EXHIBIT B

PUBLICATIONS:

BOOKS AND MONOGRAPHS

Hayden, H. C. 1964. The Ionization of Helium, Neon and Nitrogen by Helium Atoms. Master's Thesis, University of Denver. (Published in: Hayden, H. C. and N. G. Utterback 1964. Phys. Rev. 135A:1575).

Hayden, H. C. 1967. Vibrational Excitation Effects on Charge-transfer Processes Involving H_2^+ and D_2^+ Between 70 and 1000 eV. Doct. Diss., University of Denver. (Published in: Phys. Rev. 172:104, with R. C. Amme).

Hayden, H. C. 1975. Laboratory Physics for the Life Sciences. W. B. Saunders Company, Philadelphia. 223 pp. + graph paper.

Hayden, H. C. 1982. Elementary Physics (text). U.Conn. Co-op. 276 pp.

Hayden, H. C. 2008. A Primer on CO_2 and Climate.

Hayden, H.C. 2009. A Primer on Renewable Energy.

Hayden, H.C. 2011. Bass Ackwards: How Climate Alarmists Confuse Cause with Effect.

Hayden, H. C. 2015. Energy: A Textbook.

JOURNAL ARTICLES

Hayden, H. C. and N. G. Utterback. 1964. The Ionization of Helium, Neon and Nitrogen by Helium Atoms. Phys. Rev. 135A:1575.

Amme, R. C. and H. C. Hayden. 1965. Ion-beam Excitation Effects on the Single Charge Transfer Between Argon and Nitrogen. J. Chem. Phys. 42:2011.

Hayden, H. C. and R. C. Amme. 1966. Low-energy Ionization of Argon Atoms by Argon Atoms. Phys. Rev. 141:30.

Amme, R. C and H. C. Hayden. 1966. Ionization Cross Sections for Neutral-neutral Collisions Utilizing Asymmetric Charge Transfer. J. Chem. Phys. 44:2828.

Hayden, H. C. and R. C. Amme. 1967. Vibrational Excitation Effects on Charge-transfer Processes Involving H_2^+ and D_2^+ Between 70 and 1000 eV. Phys. Rev. 172:104.

McCaughey, M. P., E. J. Knystautas, H. C. Hayden and E. Everhart. 1968. Q-structure and K-shell Vacancies in Neon-neon and Krypton-krypton Collisions. Phys. Rev. Letts. 21:65.

Knystautas, E. J., Q. C. Kessel, R. Del Boca and H. C. Hayden. 1970. Measurements of Q-values for N^+ -Ar and O^+ - Kr Collisions by the Coincidence Technique. Phys. Rev. A1:835-33.

Hayden, H. C. and E. J. Knystautas. 1971. Analysis of the N^+ - Ar and O^+ - Kr Collisions. Phys. Rev. A1:206-16.

Del Boca, R., H. C. Hayden and G. M. Thomson. 1971. Promotion of L-shell Electrons to Higher Bound States in Ar^+ - Ar Collisions. Phys. Rev. Letts. 26:1417.

Del Boca, R., J. W. Montgomery and H. C. Hayden. 1973. Coincidence Measurements of Ar^+ - Kr Collisions at KeV Energies. Phys. Rev. A7:1994-2002. (Also, unpublished supplemental tables). Laubert, R., R. S. Peterson, J. P. Forester, K-H. Liao, P. M. Griffin, H. C. Hayden, S. B. Elston, D. J. Pegg, R. S. Thoe and I. A. Sellin. 1976. Differences in the production of non-characteristic radiation in solid and gas targets. Phys. Rev. Letts. 36:1574-76.

Pegg, D. J., S. B. Elston, P. M. Griffin, H. C. Hayden, J. P. Forester, R. S. Thoe, R. S. Peterson and I. A. Sellin. 1976. Dipole Oscillator Strengths for n=0 Transitions in Highly Ionized Sulfur. Phys. Letts. 58A:349-51.

Pegg, D. J., S. B. Elston, P. M. Griffin, H. C. Hayden, J. P. Forester, R. S. Thoe, R. S. Peterson and I. A. Sellin. 1976. Radiative Lifetimes and Transition Probabilities for Electric Dipole n=0 Transitions in Highly Stripped Sulfur Ions. Phys. Rev. A14:1036-41.

Thoe, R. S., R. S. Peterson, D. J. Pegg, J. P. Forester, H. C. Hayden, P. M. Griffin and I. A. Sellin. 1976. Polarization Measurements of Non-characteristic Radiation Emitted in Energetic Heavy Ion-atom Collisions. Phys. Rev. 56A:89.

Forester, J. P., D. J. Pegg, P. M. Griffin, G. D. Alton, S. B. Elston, H. C. Hayden, R. S. Thoe, C. R. Vane and J. J. Wright. 1978. Radiative Lifetimes and Oscillator Strengths for Allowed Intra L-shell Transitions in Multiply Charged Chlorine Ions. Phys. Rev. A18:1476-80.

Budnick, J. I., H. C. Hayden, P. A. Saunders, A. A. Antar, Q. C. Kessel, A. J. Shuskus, F. A. Otter, B. L. Laube, G. McCarthy and C. O. Hulse. 1979. Ion Beam Modified Materials and Their Properties. J. Metals 31 (12):58.

Forester, J. P., P. M. Griffin, G. D. Alton, S. B. Elston, H. C. Hayden, R. S. Thoe, C. R. Vane, J. J. Wright. 1979. Systematic Study of $2s^2 2p^k$ - $2s2p^{k+1}$ - $2p^{k+2}$ Transitions in Multiply-charged Cl Ions. J. Physique 40:1208.

Otter, F. A., J. I. Budnick, H. C. Hayden, A. A. Antar, Q. C. Kessel. 1979. Ion Recoil Plating of Ultra-thin Films. J. El. Chem. Se. 126:C345.

Vedder, M., H. Hayden and E. Pollack. 1981. Study of the D^++H_2 Collision in the Small-angle, Low keV Energy Range. Phys. Rev. A23:2933-40.

Peterson, R. S., W. W. Smith, H. C. Hayden and M. Furst. 1981. Comparison of L X-ray Spectra From Multi-stripped Ions in P^++Ar and S^++Ar Gas Collisions at 100 keV. Proceedings of the 6th Conf. on the Applications of Accelerators in Research and Industry, Denton, TX, Nov. 1980. IEEE Transaction on Nuclear Science NS-28, 1114-1116.

Hayden, H. C. 1981. Solar Energy: How Bright the Prospect? The Science Teacher 48:17-22.

Hayden, H. C. 1981. Rosetta Stones For Energy Problems. The Physics Teacher 19:374-383.

Namavar, F., J. I. Budnick, H. C. Hayden, F. A. Otter and V. Patarini. 1983. Study of Near Surface Structure and Composition for High-dose Implantations of Cr^+ into Si. Mat. Res. Soc. Symp. Proc. Vol. 27:391.

Peterson, R.S., W.W. Smith, M. Furst, and H.C. Hayden. 1983. High Resolution Measurement of L X-rays From S^+ - Ar and P^+ - Ar Collisions.

Namavar, F., J. I. Budnick, A. Fasihuddin, H. C. Hayden, F. A. Otter and V. Patarini. 1983. The Influence of Implantation Conditions and Target Orientation on High Dose Implantation of Al^+ into Si. Mat. Res. Soc. Symp. Proc. Vol. 27:347.

Musket, R. G., D. W. Brown and H. C. Hayden. Formation of Subsurface Al_2O_3 Layers in Aluminum by Oxygen Ion Implantation. 1984. Ion Beam Modification of Materials, Proceedings of Fourth International Conference on Ion Beam Modification of Materials (North Holland Publishing Co., Amsterdam, 1985) p. 31.

Namavar, F., J.I. Budnick, A. Fasihuddin, H.C. Hayden, D.M. Pease, F.A. Otter and V. Patarini. 1984. The Influence of Implantation Conditions and Target Orientation in High Dose Implantation of Al^+ Into Si. Mat. Res. Soc. Symp. Proc. Vol. 27:347.

Namavar, F., J.I. Budnick, H.C. Hayden, F.A. Otter and V. Patarini. 1984. Study of Near Surface Structure and Composition For High Dose Implantation of Cr^+ into Si. Mat. Res. Soc. Symp. Vol. 27:341.

Namavar, F., J.I. Budnick, F.H. Sanchez, and H.C. Hayden. 1985. On The Formation of Si Oxide by Ion Implantation. Conf. Proc., MRS Meeting, April 1985.

Namavar, F., F.H. Sanchez, J.I. Budnick, A. Fasihuddin, and H.C. Hayden. 1986. Systematics of Silicide Formation by High Dose Implantation of Transition Metals Into Si. MRS Boston. To be published in Mat. Res. Soc. Symp. Proc.

Albert, M.K., and H.C. Hayden. 1986. Electronic Integrator for Physics Experiments. Am. J. Phys. 54:720.

Pease, D.M., J.I. Budnick, M.H. Choi, Z. Tan, G.H. Hayes, F. Namavar and H.C. Hayden. 1986. Krypton XANES Studies in Implanted Systems. Journal de Physique, Colloque C8, EXAFS and near edge structure IV, Vol. 2, 1053-1056.

Hayden, H. 1987. Data Smoothing Routine. Computers in Physics, 1, 74.

Schaible, M., H. Hayden, and J. Tanaka. 1987. Chemical Changes Created by High Energy Ions in Polyethylene. IEEE Trans. on Elec. Insul. EI-22, 699.

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Tan, Z., J.I. Budnick, F.H. Sanchez, G. Tourillon, F. Namavar and H.C. Hayden. 1989. Silicide Structural Evolution in High-dose Cobalt-implanted Si(100) Crystals. (Accepted for publication in Phys. Rev. B.).

Hayden, H.C. 1990. Light Speed as a Function of Gravitational Potential. Galilean Electrodynamics 1, 15.

Moring, J., W.J. Shoemaker, H.C. Hayden, R.M. Saloman, and L.G. Herbette. 1990. Characterization of Rat Cerebral Cortical Synaptoneurosome Membranes by X-ray Diffraction. To be published in Biophysical Journal, August 1990.

Hayden, H.C. 1990. Possible Explanation for the Edwards Effect. Galilean Electrodynamics 1, 33.

Hayden, H.C. and C.K. Whitney. 1990. If Sagnac and Michelson-Gale, Why Not Michelson-Morley? Galilean Electrodynamics 1, 71 (1990).

Moring, J., W. Shoemaker, V. Skita, P. Mason, H. Hayden, R. Salomon and L. Herbette. 1990. Rat Cortical Synaptoneurosomal Membranes: Structure and Interactions with Imidiazobenzodiazepine and 1,4 Dihydropyridine Drugs. Accepted for publication in August 1990 issue.

Hayden, H. 1991. Is the Speed of Light Isotropic in the Frame of the Rotating Earth? Phys. Essays, 4, 361.

Hayden, H. 1991. On a Recent Misinterpretation of the Sagnac Effect. Galilean Electrodynamics 2, 57 (1991).

Hayden, H. 1991. Yes, Moving Clocks Run Slowly, but is Time Dilated? Galilean Electrodynamics 2, pp. 63-66, July/Aug. 1991.

Hayden, H. 1992. Distinctions Between Galilean and Einsteinian Physics. Galilean Electrodynamics, 3, 23-27.

Hayden, H. 1992. Was Edwards Contradicted Experimentally? Galilean Electrodynamics 3, 76-77.

Hayden, H. 1992. Rotating Mossbauer Experiments and the Speed of Light. Galilean Electrodynamics 3, 114-117.

Hayden, H.C. 1993. Ozone Depletion: What's Hidden Behind the Mask of Science? EGAD Quarterly (Univ. of AZ) 1(3), 92.

Hayden H.C. 1993. Einsteinian and Quantum-mechanical Observers. Galilean Electrodynamics 4, 29-31.

Hayden, H.C. 1993. Was Edwards Contradicted Experimentally? Galilean Electrodynamics 3, 76-77.

Hayden, H.C. 1993. Rotating Mossbauer Experiments and the Speed of Light. Galilean Electrodynamics 3, 114-117.

Hayden, H.C. 1993. Stellar Aberration. Galilean Electrodynamics 4, 89-92.

Hayden, H.C. 1994. High Sensitivity Trouton-Noble Experiment. Rev. Sci. Instr. 65, 788-792.

Hayden, H.C. 1994. Analysis of Trouton-Noble Experiment. Galilean Electrodynamics 5, 83.

Hayden, H.C. 1994. Global Positioning Satellites. Galilean Electrodynamics 5, 92.

Hayden, H.C. 1996. Special Relativity: Problems and Alternatives. Physics Essays 8, pp. 366-375.

Hayden, H.C. 1996. High-Level Radioactive Waste. The Phys. Teach. 33, pp. 450-454.

Hayden, H.C. 1996. The Automotive Ignition System. The Phys. Teach. 34, pp. 90-93.

Hayden, H.C. 2011. A Conspectus on US Energy, The Phys. Teach. 49, pp. 497-501

Hayden, H.C. 2013. Evaluating a Surprising Claim, The Phys. Teach., November.

Hayden, Howard. 1996 to present. *The Energy Advocate*, a monthly newsletter about energy and climate, now in its 26th year of publication

Christopher J. Dorrington

PROFESSIONAL EXPERIENCE

STATE OF MONTANA, DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ)

DIRECTOR — JAN 2021 – PRESENT

- Executive leader responsible of the development, performance, direction, safety and motivation of 400+ environmental science, engineering, financial, business, and IT professionals.
- Maintain and perform cost control, labor/overhead planning, forecasting, budgeting, accounting, engineering and science, capital planning, with extensive resource, program & project planning, and execution on $100M annual budget.
- Lead and direct agency legislative efforts on matters including statewide natural resource and energy policy and fiscal impacts. Managing issues, topics, policies, agendas and developing and maintaining relationships to accomplish this.
- Develop and maintain key stakeholder relationships representing varied interests and backgrounds, beliefs.
- Resolve and solve emergent needs and challenges, using collaborative approaches to reach consensus, but not always.
- Conceive, develop, and implement complex multi-year, multi-stakeholder, fiscally challenging public policy.
- Provide executive agency litigation input, direction and response in partnership with legal leadership
- Metrics-driven customer service approach using clear performance targets, novel to state government

STATE OF MONTANA, DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ)

DIVISION ADMINISTRATOR – AIR, ENERGY, AND MINING — JUNE 2016 – JAN 2021

- Executive leader of ~ 85 science, engineering and business professionals in air quality, energy, and mining disciplines.
- Permit and regulate hard rock, coal and opencut (sand & gravel) mining operations.
- Develop, implement legislation and testify during session on matters including statewide policy and fiscal impacts.
- Develop and maintain key stakeholder relationships representing different interests and backgrounds, beliefs.
- Provide information and support for Montana's energy policy, production, transportation, conservation and efficiency, including renewable energy evaluation, development and deployment.

STATE OF MONTANA, DEPARTMENT OF TRANSPORTATION (MDT) — **JAN 2006 – JUNE 2016**

TRANSPORTATION PLANNING – STATEWIDE MULTIMODAL PLANNING BUREAU CHIEF — NOV 2013 – JUNE 2016
TRANSPORTATION PLANNING – DATA & STATISTICS BUREAU CHIEF — JUN 2012 – NOV 2013
STATEWIDE REST AREA PRIORITIZATION PLAN – AUTHOR, STRATEGIST & COORDINATOR — MAR 2008 – JUNE 2016
RAIL, AIR QUALITY & SPECIAL STUDIES SECTION SUPERVISOR — APR 2011 – NOV 2012, JUNE 2013 – NOV 2013
PLANNING SYSTEMS SECTION SUPERVISOR — NOV 2006 – APR 2011
TRANSPORTATION PLANNER — JAN 2006 – NOV 2006

- For 10.5 years, I led teams of transportation professionals of increasing breadth, depth and complexity moving quickly from transportation planner – section supervisor – bureau chief.
- Thought leader for diverse technical projects and programs for statewide and urban area transportation policy, planning, and program management, data and statistics, and specialty transportation areas to include – air quality, economics, rail, highway, bicycle and pedestrian transportation modes.
- Work disciplines include policy creation, fiscal analysis, planning, economics and modeling.
- Interpret, understand and apply state and federal laws and regulations, policies then generate state business policies, process, and task assignments to implement changes.
- Led the division in supporting leadership for all legislative responses, detailed technical & financial analysis, EPP.
- Establish, maintain and improve relationships with agency leaders and staff, external stakeholders through collaborative discussion, issue identification and proactive problem solving at the lowest level possible.
- Rest area program manager developing a ground-up asset strategy, maintaining partnerships, conducting coordination meetings, research, and some consultant contracts then prioritizing and allocating $5M annual investment strategy. Resulted in 2012 Governor's Excellence award for the creation and management of revolutionary MT rest area asset strategy.

SYNERGY BUILDERS, INC. – HELENA, MT — **NOV 2004 – NOV 2005**

CONSTRUCTION SUPERINTENDENT — Feb 2005 – Nov 2005
CONSTRUCTION LABORER — Nov 2004 – Feb 2005

- Solely responsible for leading day-to-day organization, project management, production and direction of up to 10 direct-reporting staff and up to 15 subcontractors and staff, at up to 3 simultaneously-operating construction sites.
- Extensive project development and planning to include resource needs, allocation and tracking of budgeted material, labor, change order, shipping, handling costs, emerging issues awareness and resolution.

EXHIBIT C

Christopher J. Dorrington

WADDELL & REED – HELENA, MT **APRIL 2003 – NOV 2004**

FINANCIAL ADVISOR, OFFICE LEAD

- Provide detailed and often complex financial planning in the areas of budget development and tracking, debt management and mitigation, asset allocation and analysis, wealth development and management, tax strategies, retirement planning and preparation, risk assessment and management, estate analysis, planning and strategies, and timely plan implementation to meet the specific needs of individuals and businesses.
- Maintain strict office and individual regulatory adherence with State (Office of State Auditor), Federal (Securities Exchange Commission (SEC) & National Association of Securities Dealers (NASD), and corporate standards for licensing, securities, insurance, and fee-based financial services.
- Generate and achieve challenging, attainable office and personal goals. 3 new advisors Q4 2004. First-year advisors on track for incentive bonuses, 2nd year advisors on track for trip reward and first level bonus minimum.
- Perform in public speaking engagements to include Montana Governor's Annual Conference on Aging (2003 & 2004), group presentations to local organizations, state and federal employees, businesses, community events.
- Successfully passed Series 6, 63, 65 tests first try.

ILX LIGHTWAVE CORPORATION – BOZEMAN, MT **JULY 1998 – NOV 2002**

APPLICATION SALES ENGINEER III/ WEST REGIONAL ACCOUNT MANAGER

- Manage and motivate staff to achieve sales forecast and revenue targets and maintain/increase productivity.
- Increased West Regional sales in yr. 2001/2002 by >120% to $7.7M; 2000/2001 by >200% to $6.5M; and delivered only domestic regional revenue increase 2001 Q4/Q3. Travel up to 60% for on-site technical meetings, training, etc.
- Quickly and concisely relay photonic test and measurement solutions (e.g. laser manufacturing parametric testing).
- Demonstrate and explain test equipment application, operation, and technology to assess and close complex sales.
- Conduct technical research, market studies, providing new or enhanced product ideas, identifying emerging markets and points of existing strength or weakness to capitalize on strategic opportunities.
- Review and enhance internal product development processes for continuous improvement, ISO9000.

EDUCATION

MASTER OF ART – TRANSPORTATION POLICY, OPERATIONS & LOGISTICS (TPOL)

GEORGE MASON UNIVERSITY, SCHOOL OF PUBLIC POLICY **ARLINGTON, VA – MAY 2010**

- #1 graduating student in 2010 TPOL class – May 2010. Cumulative GPA – 3.94 : 36 semester credits
- Outstanding Student of the Year, George Mason University – US DOT University Transportation Centers 2011
- George Mason TPOL program – Malcom P. McLean Transportation Award recipient
- Advanced public policy education in transportation planning, regulation, operations and logistics

BACHELORS OF SCIENCE – MECHANICAL ENGINEERING

GONZAGA UNIVERSITY, SCHOOL OF ENGINEERING AND APPLIED SCIENCE **SPOKANE, WA – MAY 1998**

- Graduated from School of Mechanical Engineering in May 1998
- Fully ABET-accredited Mechanical Engineering curriculum with broad liberal arts. Accomplished in 4 years
- State or Federal work-study participant each of 4 college years, averaging 20-30 hrs per week

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Sonja Nowakowski

406-444-0496 | Sonja.Nowakowski@mt.gov

Work History

Montana DEQ – Air, Energy, and Mining Division

04/2021--Present

Division Administrator

- Supervise three bureaus and roughly 90 employees, including scientists, engineers, and policy analysts. DEQ values – leadership, accountability, customer service, communication, efficiency, excellence, and decision making drive our work.
- Member of Senior Leadership Team. Provide overall vision, direction, leadership, and management to the Division.
- Represent the Division in various situations, including internal and external stakeholder groups and legislative activities. Develop and maintain internal and external working relationships, acting on behalf of and representing the division and agency.
- Actively manage resources, including Division budget.
- Direct and plan division strategic plans in alignment with agency goals and objectives. Consider current and future program needs and operations to identify opportunities to make change.

Montana Legislature – Office of Research and Policy Analysis

10/2016—04/2021

Research Director for Legislative Office of Research and Policy Analysis

- Supervise eight researchers covering health and human services, economic affairs, state administration and veterans' affairs, revenue, local government, education, criminal justice, and web design and development.
- Participate in six-member management team to maintain key business functions for the Legislative Services Division.
- Responsible for planning, organizing resources, delegating responsibilities, leading others to efficiently execute plans, and evaluating plan effectiveness.
- Responsible for reviewing research and analysis completed by office and conducting additional research and analysis on issues ranging from transportation to energy.
- Draft legislation and amendments for legislators.
- Assist with staffing of standing, interim, and administrative committees.

EXHIBIT D

Sonja Nowakowski

406-444-0496 | Sonja.Nowakowski@mt.gov

Montana Legislature – Legislative Environmental Policy Office

09/2006 – 10/2016

Research Analyst for Legislative Environmental Policy Office-- Legislative Services

- Draft legislation and amendments for legislators with a focus on energy and environment. Analyze legislation for constitutional compliance, compliance with federal requirements, and legal format.
- Research and analyze energy and environmental issues.
- Staff the Natural Resources and Energy Standing Committees. Track bills assigned to committee, amendments, hearings, and committee action.
- Staff the Energy and Telecommunications Interim Committee and assist with staffing the Montana Environmental Quality Council; plan agendas, develop committee work plans.
- Communicate with stakeholders, legislators, and the general public to help them understand issues, policies, rules, and regulations.
- Complete research and analysis based on the assignments from the Montana Legislature. Write and design research materials for legislative committees.
- Write and design informational publications for the public and citizen-legislators on environmental and energy issues.

Great Falls Tribune

02/2001 - 09/2006

Natural Resources Reporter

- Natural resources reporter responsible for reporting in-depth newspaper stories every month. Completed enterprise reporting covering local, state, and national natural resource stories.
- Planned story outlines and adhered to strict deadlines. Gathered and analyzed information for the public on topics about safeguarding our natural resources and protecting human health.
- Received numerous Montana Newspaper Association Awards and quarterly Gannett awards.

Sonja Nowakowski

406-444-0496 | Sonja.Nowakowski@mt.gov

Education

- B.A. University of Montana
- Journalism with minor in political science

Job Related Training

- Council of State Governments Legislative Management Group – West, 2016-present
- Legislative Web Content Working Group, 2009-2012
- Montana Environmental Policy Act (MEPA), Training 2011, 2013
- Montana Professional Development Center, Basics of Management Training Program 2011
- National Conference of State Legislatures, Research and Training Programs, Professional Development – 2009, 2013, 2016, 2018
- Council on State Governments – West, Analysis and Energy Training 2011

Professional Publications

- **Powering Down: Decommissioning Energy Facilities in Montana – 2020** https://leg.mt.gov/content/Committees/Interim/2019-2020/EQC/Meetings/july-2020/hj38final-report-draft-july2020.pdf
- **SJ 5: Coal in Montana: Changing Times Challenging Times – 2018** https://leg.mt.gov/content/Committees/Interim/2017-2018/EQC/Meetings/Sept-2018/sj5final-report.pdf
- **Net Metering in Montana – 2016** https://leg.mt.gov/content/Committees/Interim/2015-2016/Energy-andTelecommunications/Meetings/Sept-2016/SJ12DraftReport.pdf
- **A Citizen's Guide to Montana Energy Law: An Overview of Laws Related to Energy Generation, Transmission, and Consumption in Montana -- 2014** http://leg.mt.gov/content/Publications/Environmental/2014-citizen's-guide.pdf
- **Understanding Energy in Montana: A Guide to Electricity, Natural Gas, Coal, Petroleum, and Renewable Energy Produced and Consumed in Montana – 2014** (*Established in conjunction with DEQ's Energy Office*) http://leg.mt.gov/content/Publications/Environmental/2014-understanding-energy.pdf
- **Renewables Rewards and Risks: A Look at the Impacts of Montana's Renewable Portfolio Standard – 2014** http://leg.mt.gov/content/Publications/Environmental/2014-sjr6-rps-report-etic.pdf

DEQ Montana Department of Environmental Quality

Bo Wilkins

Air Quality Bureau Chief

Helena, Montana | 406-444-0286 | bo.wilkins@mt.gov

SUMMARY

Air quality professional with experience in state government and the private sector. Professional focus on leadership, program development, and project management. Technical background includes air quality testing, quality control, and resource development.

PROFESSIONAL EXPERIENCE

Air Quality Bureau Chief
Montana Department of Environmental Quality, Helena, Montana
AUGUST 2021 – PRESENT

- Provides overall vision, direction, and management to the Air Bureau and programs within.
- Develops innovative approaches and solutions to challenges faced by Bureau programs.
- Engages with stakeholders to cultivate support for Department initiatives.
- Coordinates Bureau activities with those of other bureaus, divisions, and departments.
- Participates in and directs policy initiatives.
- Implements or directs projects of high priority to the Department.

Source Team Coordinator
Bison Engineering, Inc., Helena, Montana
JANUARY 2020 – JULY 2021

- Directed source testing operations for the Helena, MT branch location.
- Provided leadership in systems and operations development, business development, and market growth.
- Managed large-scale and complex projects.
- Contributed to develop and maintenance of quality assurance/quality control measures to maintain the company's American Association for Laboratory Accreditation.
- Trained employees in advanced project management.

Environmental Consultant
Bison Engineering, Inc., Helena, Montana
DECEMBER 2017 – DECEMBER 2020

- Prepared Title V and preconstruction permit applications, including emission inventory, CAM plan and air program analysis.
- Assisted clients with air regulatory compliance.
- Provided source testing compliance assistance.
- Compiled and reviewed source test data and reports.

Air Quality Scientist
Montana Department of Environmental Quality, Helena, Montana
ARPIL 2015 – NOVEMBER 2017

- Provided senior level compliance oversight necessary to implement air quality regulations in the state.
- Performed on-site evaluations of industrial facilities, off-site evaluations of reports for determination of compliance with rules and permit conditions.

EXHIBIT E

- Oversaw and managed source test approval and review program.
- Lead on Montana Source Test Protocol and Procedures Manual project.

Environmental Scientist, Project Manager
Aspen Consulting and Testing, Helena, Montana
JUNE 2012 – MARCH 2015

- Provided air quality consulting, testing, and analysis for industrial clients throughout Montana and neighboring states.
- Managed testing teams through a variety of complex source testing campaigns.

EDUCATION

B.S. Environmental Chemistry May 2010
Beloit College, Beloit, Wisconsin

PROFESSIONAL AFFILIATIONS AND TRAINING

Mine Safety and Health Administrations (40 hr.)

Julie Merkel

5824 Danas Point Drive Helena, MT 59602 (406)444-3626

Objective

Working at the Montana Department of Environmental Quality has offered me the opportunity to learn, interpret, implement, and communicate state and federal regulations and policy related to the State Air Quality Program. Collaboration with a variety of groups to build and cultivate internal and external alliances and develop an effective and transparent program. Meeting for decision making purposes, speaking about technical issues, and presenting information included groups such as the general public, stakeholders, special interest groups, consultants, industry representatives, upper management, staff, the media, legal advisors, the Board of Environmental Review, and federal and state representatives. Tact, courtesy, alertness, and good judgment in developing messages, facilitating an open exchange of opinions, negotiating, and reaching constructive conclusions.

Work Experience

Montana State DEQ – *Air Permitting Section Supervisor*
October 6, 2012 to Present

- Lead permitting staff to demonstrate an understanding of the Montana Air Quality Program including minor and major source permitting, as well as compliance and enforcement implications
- Guide staff in the decision making process for permitting minor sources, prevention of deterioration permitting, and those sources subject to Title V of the Clean Air Act (CAA)
- Implement air pollution laws, regulations and policy on both the state and federal levels as they pertain to air permitting and compliance
- Present technical issues to a variety of audiences, such as public meetings, Board of Environmental Review, Clean Air Act Advisory Committee, and other public interest group meetings
- Effectively participate in management level decision making for implementation of the Montana Air Program
- Communicate effectively, both orally and written, with professional staff, supervisors, attorneys, facility representatives, special interest groups, and members of the public regarding implementation requirements of new and existing regulations and associated guidance
- Assist attorneys with writing technical aspects of documents including summary judgment responses to appeals, enforcement actions, and rule changes
- Lead permitting staff to clearly understand new and existing regulations and recognize when a Montana state rule change is required
- Assist permitting staff to understand and implement requirements of enforcement actions including administrative orders and consent decrees
- Prepare presentations to educate a variety of audiences on new state and federal regulations, permit appeals, and other topics of interest
- Work with attorneys and staff in the development of strategy to defend permit appeals
- Research legislative issues and determine how the Bureau would be affected

EXHIBIT F

Montana State DEQ - *Air Quality Scientist*
March 1, 2001 to October 5, 2012

- Review proposals, make independent decisions and write technical permits for facilities in power generation, wood products, agricultural, mining, incineration and oil & gas industries
- Conduct technical reviews of permits and associated compliance evaluation reports
- Conduct compliance inspections at a variety of facilities and prepare associated full compliance evaluation reports
- Demonstrate knowledge of air pollution laws, regulations, and policy on both the state and federal levels
- Communicate effectively, both orally and written, with professional staff, supervisors, facility representatives, and members of the public
- Mentor and assist co-workers with permit related issues for implementation of Montana's Air Permitting Program
- Serve as the technical lead on rule-making committees
- Serve as lead on implementing the Open Burning Program which included establishing budgets, determining fees, and working with state and federal agencies
- Communicate extensively with federal land managers, state land managers, industry representatives, and the general public regarding regulations and requirements
- Hire and mentor interns
- Research legislative issues and determine how the Bureau would be affected

Broadwater Athletic Club - *Personal Fitness Trainer*
November 1999 to March 2002

- Design fitness programs for a variety of clients. This included assessment of the client's needs, and assistance in formulating achievable goals, and basic nutrition counseling
- Instruct fitness equipment orientation courses for clients

Bison Engineering, Inc. – *Industrial Hygienist*
October 1992 to June 1993

- Instructed asbestos training courses, performed asbestos site assessment and monitoring
- Precision assessments on opacity monitors
- Conduct audits and calibrations of meteorological stations, and opacity, small particle, and SO2 monitors
- Perform data analysis and assist in writing protocols and technical reports

Cyprus Minerals– *Industrial Hygienist*
Summer 1991

- Revised safety guidelines manual, and established a basis for an industrial hygiene manual
- Assisted with small particle sampling on various Cyprus Minerals properties

Education

Montana College of Mineral Science and Technology (1990 to 1993)
Butte, Montana
MS, Industrial Hygiene

University of Montana (1983 – 1989)
Missoula, Montana
BS, Recreation Management and Forestry

Rhonda Payne

1616 Highland St. Helena, MT 59601 (406) 475-1461 **rhonda.payne@hotmail.com**

Profile

I have over 15 years of professional experience in air quality work for state government, including air quality permitting, compliance, and planning. As a project manager, I am a collaborative leader and learner, guiding my teams with honesty and earnest connection. I demonstrate an excellent capability to conceptualize the big picture, along with precise and consistent attention to detail. I excel at organizing, coordinating and managing projects and initiatives of any type. My greatest skill is my ability to connect with people – always striving to nurture productive work relationships through open dialogue.

Employment

February 2020 – present *Air Quality Planner, Air Quality Bureau, Montana Department of Environmental Quality (MT DEQ)*

- Project Manager of the Montana Regional Haze team, working and communicating with industries, multiple states, planning organizations, Federal Land Managers (FLMs) and the US EPA to improve visibility in Class I areas in Montana and throughout the West
- Represent Montana in meetings, conferences and interagency task groups relating to Regional Haze State Implementation Plan (SIP) development, including reviewing technical analyses, developing control strategies, and documenting Montana's demonstration of compliance with the Regional Haze Rule
- Serve as the Fire and Smoke Work Group co-chair for Montana's regional technical organization, the Western Regional Air Partnership (WRAP)
- Project Manager of the Consolidated Air Emissions Reporting System (CAERS) team, tasked with business process mapping of current and future emissions data systems and integration across DEQ systems, with the ultimate goal to improve data and business processes within AQB.
- Present and communicate air quality topics to a variety of stakeholders that participate in the Clean Air Act Advisory Council (CAAAC).
- Interpret and analyze new legislation, regulations, policy and guidance and its impact on air quality in Montana

October 2013-Feb. 2020 *Environmental Science Specialist, Air Quality Bureau, MT DEQ*

- Author air quality permits of varying complexity on behalf of the State of Montana
- Draft federally-enforceable permit conditions and conduct emission and Best Available Control Technology (BACT) analyses
- Review and assist in interpreting air dispersion modeling results to comply with state and federal regulations
- Prepare Environmental Impact Statements (EIS) and Environmental Assessments (EA)
- Served as the Open Burn Coordinator for the Smoke Management program (2014 – 2017) – worked with FLMs, private industry and minor burners to coordinate prescribed fire ignitions and management to minimize or prevent smoke impacts
- Assumed State Air Quality Meteorologist role in wildfire smoke communications and meteorological assessments on multiple occasions (2015 – 2017)
- Worked with systems analyst to develop data management systems and complete data flows to EPA databases

EXHIBIT G

- Experience in air regulatory compliance issues and enforcement cases

July 2005-Oct. 2013 *Environmental Scientist and Specialist, Air Quality Bureau, New Mexico Environment Department (NMED)*

- Maintained NM Emissions Inventory (EI) program and submitted EI data to US EPA for the National Emissions Inventory (NEI) and the electronic Greenhouse Gas Reporting Tool (e-GGRT)
- Worked to make criteria and greenhouse gas pollutant inventories transparent, complete, and accurate to be readily used in policy making, planning, and as inputs in air quality models
- Initiated, planned, executed and completed the Air Emissions Inventory Reporting system (AEIR) web application for online inventory submission
- Tested and helped develop the Air Quality Bureau to EPA Emission Inventory System (EIS) Data Flow submitted through EPA's Network Node Exchange (CDX)
- Worked with WRAP to develop systems of data exchanging
- Drafted Cross-Media Electronic Reporting Rule (CROMERR) application for air quality data systems for the NMED.
- Worked with project teams to define IT project frameworks, project objectives, resource requirements, timelines, deliverables, budgets, and potential constraints
- Provided Geographic Information Systems (GIS) support for the Bureau
- Authored Title V operating permits of varying levels of complexity for facilities including refineries, natural gas compressor stations, landfills, coal-fired power plants and government laboratories
- Interpreted and implemented federal and New Mexico state air quality regulations in air quality permits

June 2003-July 2005 *Associate, Systems Analysis Group, PB Consult*

- Applied GIS expertise to various travel demand forecasting projects.
- Created GIS data framework for the Ohio Statewide Transportation Modeling Program by creating a comprehensive data dictionary, creating geodatabases, and GIS attribute tables and spatial features
- Geocoded onboard transit surveys for the Albuquerque High Capacity Transit Project and performed further geographical analysis of results

Education and Training

1997-2002 *Bachelor of Science in Physical Geography, University of New Mexico (UNM)*
2002-2012 *Continuing education at Santa Fe Community College, Northern NM College and UNM*

References

Mary Uhl, Executive Director
WESTAR
3 Caliente Road, #8 - Santa Fe, NM 87508
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Liz Ulrich, Analysis and Planning Section Supervisor
Air Quality Bureau, MT DEQ
(406) 444-9741 eulrich2@mt.gov

Julie Merkel, Permitting Services Section Supervisor
Air Quality Bureau, MT DEQ
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Sufi Mustafa, Air Dispersion Modeling Section Manager
Air Quality Bureau, NMED
525 Camino de los Marquez Suite #1 - Santa Fe, NM 87505
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Craig Henrikson

Degrees/Licensure/Professional Certificates

My educational and professional background include a Bachelors Degree in Chemical Engineering from Montana State University (1989); a Masters Degree in Civil Engineering from the University of Minnesota (2005); current registration as a Professional Engineer in Montana and Certified Safety Professional (CSP) (retired status).

Work History

State of Montana – Air Quality Bureau
Senior Environmental Engineer, P.E. 6/11- Present
Permit engineer within the bureau responsible for permit assignments including minor and major sources and both Montana Air Quality Permits and Title V Operating Permits. I have also worked on a project initiative related to permitting compressor engines. This project has been a perfect example of working within a subgroup of CAAC and the stakeholders that would be most affected by any regulatory changes. I have also been a member of DEQ's Clean Power Plan working on understanding the significance of the 111(d) proposed greenhouse gas rule. Helping to draft DEQ's White Paper and continuing to support efforts as EPA continues to evaluate how to move forward with whatever details are finalized. Also staffed Governor Bullocks Climate Solution Council (2020-2021) initiative which produced the equivalent of a Climate Action Plan for Montana.

Morrison-Maierle
Senior Municipal Engineer, P.E. 12/07 – 6/11 3 yr 6 mo
Wrote preliminary engineering reports and technical memorandums for clients. Performed engineering designs for water/wastewater/odor control/emission control projects. In my most recent years at Morrison-Maierle (MMI), I served as a project manager on a number of projects. These included mine water treatment, odor and VOC control, and municipal wastewater treatment. I also supported projects on the Oglala Sioux - Pine Ridge Reservation involving water infrastructure improvements. I was the project manager for the Missoula Odor Control project. This was a project that was an outcome of a compliance order from the Missoula City/County Health Department. The conclusions and recommendations from that study are largely being implemented under a construction project in Missoula.

Morrison-Maierle
Design Engineer, P.E. 07/06 – 12/07 1 yrs 6 mo
During this initial couple of years at MMI, I primarily worked on water and wastewater projects including both municipal and industrial clients. This included specific tasks related to developing scope and fee estimates for various projects. It also included working to track projects for financial performance. Being new to MMI during this period, I worked as a task manager supporting larger projects. I also attempted to stay involved with emission control and odor projects that came along. This included a number of small projects with 3M, working on small consulting projects with their Tonawanda, New York Facility. This included consultation on their emission control processes.

3M Company
Advanced Engineering Specialist 06/02 – 07/06 4 yr 1 mo
Responsible for environmental and safety related to the design and operation of both existing and new emission control equipment. Reviewed thermal oxidizer proposals, and consulted on 3M solvent recovery systems. Provided consultation on 3M engineering standards related to inert gas ovens, flammable solvent handling, gas trains, and wastewater systems. Supported work on a special project related to "wet air oxidation" which involved a new technology for 3M with high pressure and high temperature conditions. During this period, I also helped investigate incidents including fires, explosions and spills. I also helped

EXHIBIT H

document facility action items and worked with business management to agree on corrective action and timing.

3M Company
Senior Engineering Specialist 06/99 – 06/02 3 yr
Responsible for technical review of emission control equipment both in U.S. and international related to modifications of existing and new equipment. This involved consultation for environmental performance and evaluation of safety programs on these processes. Conducted process hazard analyses on numerous processes across 3M. This involved helping facilities develop process safety information data packages prior to conducting site visits. Leading these process safety reviews to demonstrate OSHA compliance.

3M Company
Technical Supervisor 12/96 – 06/99 2 yrs 7 mo
Responsible for directing sixteen technical personnel including engineers and technicians. Directed these activities for compounding, coating, solvent recovery, slitting and converting departments. These departments represented the "wet end" operations because they involved departments handling flammable solvents. Coordinated all technical projects to support the technical needs of the facility. This included developing objectives for engineers, and conducting performance reviews on a semi-annual basis. It also included capital forecasting for each of these departments on an annual basis as well as continuous reporting of department results for each of these departments. During a portion of this period, I also served as the compounding production supervisor responsible for a production staff operating a 4-shift operation with approximately 40 employees total.

3M Company
Solvent Recovery Supervisor 08/94-12/96 2 yr 4 mo
Over this period I was the solvent recovery supervisor. Responsible for a team of production operators, a trainer and day to day operation of the solvent recovery process. Responsible for capital forecasting, production reporting and maintaining cost controls for the process. In this role, I was responsible for all aspects of the solvent recovery option. This included planning for all maintenance activities, scheduling additional resources to accommodate larger project efforts.

3M Company
Engineer to Senior Engineer to Lead Engineer 06/89-08/94 5 yr 3 mo
Over this period I was a coating engineer, magnetic film product engineer, solvent recovery engineer, and a lead engineer with supervisory responsibility. Provided technical support for a large solvent recovery system which basically was a small refinery recovering solvents and purifying them for re-use at the manufacturing plant. Responsible for reporting malfunctions and shutdowns to the Minnesota Pollution Control Agency. This facility operated 24/7 typically with only a week of downtime spread out over the year.

Ed Warner
21 Sweetgrass Road
Clancy, Montana 59634
phone: 406-410-1410
email: ewarnerusa@yahoo.com

Education
Bachelor of Science Degree – Industrial & Management Engineering

Experience

June 2013 – Present
Montana Department of Environmental Quality – Air Quality Bureau – Air, Energy & Mining Division, Helena, Montana
Lead Engineer – Permitting Services Section

- I am the lead resource for the regulated community and general public for navigating the air quality permitting program in Montana. These include air quality pre-construction permits, Title V Operating Permits, and registration programs.
- I provide customer service for the regulated community and general public regarding air quality issues and programs.
- I have participated in the permitting of several mobile data centers, from coordinating pre-application meetings to preparation and review of air quality permits.
- I review all of the air quality permits before they are issued for technical accuracy and consistency.
- I am the permitter for the largest source of emissions in Montana, the Colstrip Steam Electric Station operated by Talen Energy, LLC. I helped review and approve their continuous particulate matter emissions monitoring methodology. Several of my suggestions for improving the quality of the regression analysis and compliance demonstration were implemented by Talen Energy, LLC in their Title V Operating Permit.
- I developed a registration program for portable sources in Montana. This program benefits this sector of the regulated community by providing them with a streamlined regulatory process to operate in Montana while maintaining and even improving the protection of air quality. The program allows these sources to operate within 15 days of registration rather than the 90 days that it took via the conventional permitting program.
- I assist other Bureaus in public meetings to represent the Air Quality Bureau.

January 2009 – June 2013
Montana Department of Environmental Quality – Air Resources Management Bureau – Permitting and Compliance Division, Helena, Montana
Environmental Engineer - Air Permitting Section

- Performed the administrative and professional functions necessary for issuing air quality permits and compliance programs in Montana.
- Established criteria for acceptable air pollution control equipment and practices, also known as Best Available Control Technology (BACT) analysis.
- Developed emission inventories.
- Issued Montana Air Quality Permits (MAQP) and Title V Operating Permits.
- Developed working knowledge of many state and federal environmental statutes, regulations, policies, and guidelines.
- Project Leader for the Compressor Engine Workgroup tasked with developing strategies for addressing continuous compliance issues with natural gas compressor engines.
- I was one of the primary contacts for developing the permitting process within the ARMB Workflow software, a software tool used by the Department for tracking work processes.

April 2002 – December 2008
Aspen Consulting & Testing, Inc., Helena, Montana
Project Engineer – Environmental Testing and Consulting Services

EXHIBIT I

- Performed data analysis, reduction, compilation, and presentation for source testing activities and report production.
- Performed air quality testing on emission sources following established Environmental Protection Agency (EPA) Federal Reference Methods, including tests for particulate matter (PM and PM_{10}), opacity, moisture content, nitrogen oxides (NO_x), carbon monoxide (CO), and formaldehyde.
- Coordinated and managed all laboratory procedures for EPA particulate matter testing.
- Project Manager of numerous emissions testing campaigns.
- Performed field audits for ambient air monitoring instruments for PM_{10} and $PM_{2.5}$.
- Certified by the Certified Mold Inspectors & Contractors Institute to do mold testing, mold problem inspection, and mold investigation.
- Prepared and submitted documents and reports for clients and state regulatory agencies.

July 2001– February 2002
Signal Processing Technologies, Colorado Springs, Colorado
Reliability & Failure Analysis Engineer – Quality Assurance Department

- My job performance as Product Engineer with this company identified me as an ideal candidate for this position and the Quality Assurance Manager actively recruited me for the job.
- Coordinated reliability and accelerated life testing on new products. Researched and implemented equations for determining failure rate (FR), mean time between failures (MTBF), and failure in time (FIT). These equations were then added to the SPT Quality Handbook.
- Responsible for failure analysis of customer returned material. Corresponded with outside resources when external failure analysis was necessary.
- Generated Failure Analysis Reports and Reliability Qualification Reports that are presented to customers.

January 2001 – July 2001
Signal Processing Technologies, Colorado Springs, Colorado
Sustaining Product Engineer

- Managed several product lines. My primary product responsibility was for the largest volume and highest income-producing product in the company.
- Responsible for maintaining and improving test yields with all of my products.

June 2000 – December 2000
SCI – Plant 22, Fountain, Colorado
Process Engineer

- Designed line layouts for assembly operations. Worked with assembly line workers to develop efficient assembly stations for maximizing product throughput.
- Wrote work instructions for assembly line workers.

Education

1995–2000
Montana State University, Bozeman, Montana
B.S., Industrial & Management Engineering

- Graduated with a 3.8 GPA for my department.
- Alpha Pi Mu Industrial Engineering Honor Society member
- Tutored introduction to static mechanics and mechanics of materials engineering courses.
- Tutored introductory Spanish.

Additional Skills

Microsoft Office programs such as Excel and Word.
I can speak basic Spanish. I learned the language through five years of formal education, as well as having travelled in Spain and Mexico.

Interests

I am an avid cyclist, snowboarder, and outdoor enthusiast. I also enjoy cooking and traveling for recreation.

Resume

Jon M. Kenning, PhD
Water Protection Bureau Chief
Montana Department of Environmental Quality
Phone: 406-444-0420
Email: jkenning@mt.gov

Education

University of Minnesota, Twin Cities — 2009
PhD Ecology, Minor Microbial Ecology

Carleton College — 2001
BA Biology

Experience

Water Protection Bureau Chief — April 2014-Present
MT Department of Environmental Quality
Duties:
I oversee many sections within the Department's Water Quality Division by managing the supervisors overseeing staff involved in many of the same water quality regulatory duties as I supervised for the State of Nebraska previously. These staff and supervisors are located in four offices statewide. The primary duties of the Bureau are to provide water quality education, discharge permits, rule development, TMDLs, nonpoint source grant management, source water protection, well evaluation, data management, technical support and inspections. My duties include not only managing these programs, but the business and administrative functions of the Bureau, such as budgets, personnel decisions, policy changes and talent development. I also serve as the Department representative for ACWA and GWPC setting various national environmental agendas and policies. Because regulatory work can sometimes land the Bureau in court, I serve as a strategist and expert to walk the Bureau through appeals and litigation. Through the regulation of water quality, the Bureau works closely with virtually every program in the Department, ranging from mines, superfund sites, and even tax certification of pollution control equipment. Although the Bureau primarily is tasked with the regulatory side of the Water Quality Division, it works closely with other programs including engineering and water quality standards. There are very few programs in the Department that do not have a water quality connection making the Bureau an integral cog in not only the Department, but the State as a whole. This is why I am also charged with promoting the Bureau and maintaining relationships outside the Department, whether they are with the EPA, Montana Legislature, various stakeholders or the public at large.

EXHIBIT J

During my time in the position, the Bureau has undergone a major makeover in an attempt to improve our image both within and outside government, retain talented personnel, and improve workload efficiency, all while not compromising our mission to protect water quality. This involved hiring new staff and breaking down barriers that prevented relationship-building. The staff within each section has exploded its productivity. Many of the inspectors have completed their inspection assignments with months remaining in the fiscal year and toned-down their aggressiveness and instead working with people to understand their business and help them understand how they can comply with regulations. The technical support staff has lost FTEs and have not missed a beat. In fact, they are nearly finished with an initiative to build a database that will cover the entire permitting and inspection programs. The permit writers have almost doubled their output, despite losing FTEs. The TDML program and permitting programs satisfied backlog lawsuits. Staff went from coldly avoiding communication to being almost too talkative and spending time getting to know the regulated community. The public image of the program has improved dramatically, which is best illustrated tin the number of appeals and lawsuits that involve Bureau permits dropping dramatically to only one in the past year. The Bureau suddenly went from rarely approached by the public to now being unable to keep up with the number of invitations to talks, working groups, and seminars. The Bureau has also opened itself up to sister programs and gaining a reputation of consensus-makers, not rivals.

Board Member — April 2015-Present
National Ground Water Research and Education Foundation
Duties:
I was specifically recruited to serve as a board member of this foundation due to my reputation doing research on biogeochemical processes. The Foundation raises funds and provides research grants and scholarships to government agencies, universities and nongovernment agencies interested in doing either research or outreach in attempt to find workable solutions to ground water problems facing the nation.

Board Member — March 2015-Present
Ground Water Protection Council
Duties:
I was specifically recruited to serve as a board member of this foundation due to my reputation as a regulator and researcher of groundwater issues. The Council works on a variety of topics related to groundwater protection, including underground injection control, source water protection and hydraulic fracturing. The council was the first to develop a database to track underground injection and its FracFocus continues to be the worldwide leader in data on oil and gas wells. By being on the front of the issues, the Council is regularly asked to testify at the federal level and consult in the development of rules and policy with the EPA.

Water Quality Assessment Supervisor — August 2013-April 2014
Nebraska Department of Environmental Quality
Duties:

This was an expansion of my duties by moving the Permits and Compliance Unit and the Engineering Unit in the Water Quality Division under my supervision. With this expansion of my duties, I oversaw 45 staff, including inspectors, engineers, geologists, permit-writers, lab technicians, and administrative assistants. I signed, stamped or initialed all letters and permits generated by the group. I formulated and managed a $10 million budget and negotiated for additional funds. I signed off on all inter-agency agreements and worked directly with the EPA on their plans, from funding to inspection targets to enforcement. I worked on strategic planning. I testified as needed during litigation. I also presented or testified during city, county or state meetings. I recognized opportunities to collaborate within NDEQ's divisions and between government agencies, universities, businesses, trade groups and the public. I continued the duties described below as a section supervisor and oversaw the duties of the Permit and Compliance Unit Supervisor, which was my position until January 2013. By overseeing the Engineering Unit, double checked the engineering calculations for wastewater infrastructure, stamped plan when needed, made regulatory determinations, and mediated professional disagreements. The engineering unit also placed me in direct oversight of NDEQ's secondary containment, load-out and chemigation programs. I trained all new staff from inspectors and permit writers to supervisors. I was involved in the development of eReporting for NDEQ. After resolving permitting bottlenecks and issues with problematic staff and a supervisor, my team eliminated the section's NPDES permit backlog and addressed the program issues requiring resolution by EPA.

Chairman — April 2013-May 2014
Nebraska Ground Water Monitoring Advisory Committee
Duties:
I chaired the committee designed to address groundwater quality and quantity issues. Nebraska is fortunate to be home to one of the world's largest aquifers, which allows for its famous corn crop to exist. However, because of that corn crop, Nebraska's aquifers are heavily impacted by agrichemicals, affecting the drinking water of nearly 85% of Nebraskans. Agrichemicals in groundwater also taint surface water through natural seepage or the new practice of pumping groundwater into rivers to meet surface water rights and testy interstate river compacts. This committee serves to bring together stakeholders to educate one another on each stakeholder's perspective, activities taking place, and new data with the hope of working through issues. My job as chair was to keep an open dialogue, ask the difficult questions, and keep everyone focused on the task at hand.

Water Quality Assessment Section Supervisor — Dec 2012-April 2014
Nebraska Department of Environmental Quality
Duties:
I oversaw many programs within NDEQ by managing the supervisors and staff, managing the multimillion dollar budget, updating regulations, and ensuring a healthy relationship between the public, businesses, state agencies, the federal government, nonprofits and lobbyists. The staff within each unit covers a variety of different programs. We worked on mining and mineral exploration regulations, which in Nebraska primarily deal with in-situ uranium mining. We also determined the need for monitoring wells and tracked possible pollutants emanating from new

or established industries. We also worked on emergency response and remediation of contaminated sites, whether they are superfund sites, leaky underground storage tanks, military installations or agrichemicals. We evaluated multiple classes of UIC wells, whether they were for septic systems, heat pumps, waste disposal or even fracking. We ran a comprehensive drinking water program under the Safe Drinking Water Act, including setting drinking water standards, evaluating sole source aquifer applications, and establishing Wellhead Protection Areas and Groundwater Management Areas. We worked with the state revolving fund staff on infrastructure projects. We provided a variety of GIS and ground water modeling services for Nebraska's regulated communities. We frequently collaborated with NDEQ's Hazardous and Integrated Waste Section on emergency response, waste determination and proper disposal of waste. We worked on pipeline citing and environmental impact statements. I renegotiated our performance partnership grant with EPA to spend $2,500,000 on test holes and a statewide monitoring well network to better understand the underlying geology of Nebraska and expand its monitoring well network into gaps in coverage.

I also oversaw all surface water programs, including the NDEQ's field, laboratory, and office staff. These programs take a variety of field measurements and gather water, algae, invertebrate and fish samples, running them through a battery of tests to determine water quality impairments and advisories. We ran a comprehensive fish tissue program and issue health alerts. We performed emergency responses to spills and fish kills. We updated Nebraska's 303(d) lists and work on TMDLs. We updated the regulations and set water quality criteria. We administered a variety of grant programs, such as 319 grants, to help improve water quality. I worked closely with US Army Corps of Engineers on wetland rehabilitation, wetland mitigation, and 401 certifications. We contracted for work to be done by third parties, such as remediation, carry out investigations, and administer research projects in collaboration with USGS, USDA and academic institutions. We also developed education programs for everyone from children to adults. We utilized my computer experience developing databases for my graduate research to manage our massive datasets that go into STORET, as wells as handled the large load of projects, inspections and investigation being performed by staff. I worked directly with the supervisors of the other divisions within NDEQ and other agencies to address cross-jurisdiction issues. I worked directly with IT staff to streamline our work, become more electronically-based, and have our permit application materials and public records online. I also made the critical decisions determining the severity of violations discovered by NDEQ investors and how we will proceed, whether continue to proactively work with the violator to help return things to compliance or pursue legal action. I served on many committees, such as the Platte River Recovery Implementation Plan Committee, that are typically interagency, interstate, and have many stakeholders. Lastly, I was involved in the daily personnel management from hiring to promotions to discipline to training to keeping moral high around the office. I oversaw all employee performance management. I spent much of my day in meetings, having to rapidly think on my toes as I moved from one high priority item to the next, often addressing multiple issues at once. I am very skilled at multi-tasking and learning on the fly with limited information. Overall, my job was to set the agenda for the section to maximize the staff's exceptional talents and best use our resources to serve Nebraska.

Permits and Compliance Unit Supervisor June 2010-Dec. 2012
Nebraska Department of Environmental Quality
Duties:
I oversaw the permitting of state and federally-delegated water programs that focus on conservation, land-use and agriculture (livestock and crop production). I also reviewed all NPDES and pretreatment permits generated by the NDEQ, from CAFOs to stormwater to publicly-owned treatment works to mining operations. I edited regulations based on new laws, court rulings, technology and emerging issues. I wrote guidance documents, holding public meetings, giving presentations, and ultimately signing off on any permit after a thorough review of the application for proper engineering, best management practices, endangered species determinations, environmental impact, and life cycle analysis of the sustainability and closure of operations. Furthermore, I teamed with federal (EPA, Army Corps of Engineers, Fish and Wildlife Service, Department of Agriculture including Natural Resources Conservation Service and Forest Service), state, nonprofit, industrial, and academic experts to establish the proper engineering or conservation-based approaches to resolve water quality issues. I worked with stakeholder groups to educate them and compromise on issues. I responded to phone calls and emails, often simultaneously, all day long from staff, the media, politicians, advocacy groups, academia and the public.

I oversaw investigations and inspections performed by state personnel in multiple offices throughout Nebraska. These investigations and inspections searched for possible violations of state water laws. I determine when corrective action is necessary, which typically involves working with the individual or operation to come into compliance, or in some cases necessitated referral to the Nebraska Attorney General and giving testimony at legal proceedings. I daily negotiated and resolved conflicts between scientists, land owners, the public and government agencies.

I served on NRCS's State Technical Committee evaluating publications, protocols, budgets, and research. I used my research background to serve as a liaison between the NDEQ and researchers with the USDA and Nebraska's universities and colleges. I translated research findings into policy recommendations and mediated between scientists and the NDEQ when their findings did not completely agree with policy. I represented the NDEQ at national and regional meetings, symposia, workshops, and conferences on agriculture, land-use and climate change. I held training sessions for the public and my staff. I gave public presentations and developed collaborations for possible research that right lead to policy changes. I performed all major supervisory duties including hiring and firing of staff, completing performance evaluations, training, resolving worker conflicts, rewarding staff, day-to-day management, team building, and budget formulation and execution. I reduced paper by moving towards a more electronically-based system and improved the overall efficiency of the unit so that we met deadlines with time to spare. I monitored greenhouse gas regulations that pertain to land-use and agriculture.

Program Specialist August 2009-May 2010
Nebraska Department of Environmental Quality
Duties:
I analyzed engineering specifications and emissions data from a variety of combustion sources, including generators, coal and biomass-fueled power plants, incinerators, Portland cement kilns,

gravel pits, biogas operations, and biofuel operations. I performed prevention of significant deterioration determinations and wrote Title V permits. I reviewed greenhouse gas regulations, determined applicable regulatory thresholds, and extrapolate from available data the possible impact of greenhouse gas regulations on industrial and agricultural sectors through various regulatory scenarios, including the use of offsets and best available control technology. I served as a staff statistician and computer modeler of emissions plumes.

Visiting Assistant Professor — August 2006-July 2009
Creighton University
Duties:

I developed and taught lectures and/or labs in Biostatistics, Terrestrial Ecology, Marine and Freshwater Ecology, Environmental Science, Current Topics and Emerging Issues in Ecology, General Biology, Animal Behavior, and Microbiology. I ordered lab supplies, devised methods, and repaired laboratory equipment. I handled hazardous waste disposal. I ran field courses on geology, geography and ecology in National Parks, Grasslands, and Forests from the mountains of Colorado and Wyoming to the iron ore mines and lakes of Minnesota. I taught students to investigate and prepare environmental impact statements. I taught many of the principles of forestry, forest health, conservation, and preservation, including covering the mission, regulation, and management of a variety of types of federal lands, from Waterfowl Production Areas to National Forests and Grasslands. I taught about the distribution, life cycle, diseases and ecological adaptations of organisms as well as the impact of anthropogenic forces on those organisms. I taught natural resource management of forests, grasslands, and lakes for recreational, commercial and conservation purposes. I taught some of the treatment techniques to restore disturbed and degraded ecosystems. I taught stewardship-based and active management approaches to maintaining ecosystems and satisfying stakeholders. I taught a variety of mining processes, including biomining, and regulations that govern such activities. I taught waste management life cycle analysis, RCRA and CERCLA. I taught the economics and regulatory framework of managing ecosystems to account for public and commercial interests in the goods extracted from an ecosystem, services that ecosystem provides, and values of stakeholders.

I served on curriculum, budget, grant and scholarship review committees. I wrote grant proposals, reviewed book chapters, and published and peer-reviewed research. I formulated, presented, analyzed and executed budgets. I supervised undergraduate research, staff, the University greenhouses, and the Department's computer lab. I ran a variety of paleoecological research studies utilizing sediment cores. I held public workshops for the young and old. I served as an expert for the local media, and provided assistance to a local forest preserve in identifying beetle and moth biodiversity and possible invasive species. I was an insect, amphibian, and plant taxonomist on bioblitzes, or rapid biodiversity surveys of Nebraskan and Iowan forest and prairie preserves. I also worked with the Henry Doody Zoo in developing germination and propagation techniques for endangered plants.

Prescribed Burn Consultant — Springs 2005-2009
Duties:

I managed prescribe burns where wind, humidity, fuel load, and fuel moisture were used as predictors for the burn efficiency and spread. Before and after each burn, the sites were monitored to assess the resulting fuel load, plant diversity, invasive species, and change in woody plant biomass. I volunteered all my time and expertise.

Principle Investigator January 2006-June 2008
University of Minnesota, Twin Cities
Duties:
I analyzed ecosystem changes and carbon burial rates in Minnesota in the past over multiple wet-dry periods using sediment cores. I collected the cores, dated sediment layers using ^{210}Pb and ^{14}C dating, and analyzed the changes in the carbon, nitrogen, and phosphorus. in relation to the climate and ecosystem present at the time the sediment layer was deposited.

PhD Dissertation Research May 2002-July 2006
University of Minnesota, Twin Cities
Duties:
I biomanipulated predator populations to create alternative stable states in wetlands to understand stable states and determine how the introduction of predators affects ecosystem properties. I chose wetlands in brush lands and prairies in Minnesota to study because they have closed watersheds so I did not have to account for animals or nutrients leaving the ecosystem. With collaborators from the US Fish and Wildlife Service, MN Department of Natural Resources, and various universities, I pieced together the entire food web and trophic cascade from the top predators down to the bacteria. Separately, I focused on the terrestrial and wetland plant, bacterial, and algal diversity, stoichiometry and productivity to determine net ecosystem productivity and the cycling of nutrients in the wetland and its watershed. Stable isotopes were used to help track the movement of carbon, nitrogen and phosphorous through the watershed and wetland. I used various statistical, theoretical, and engineering calculations and models to arrive at my conclusions. I devised the methodology for the research, determined budgets, hired assistants, coordinated field activities, ordered supplies, and repaired lab equipment. I obtained all the necessary permits, wrote grant proposals, and received funding from the National Science Foundation and state programs to relieve my dissertation adviser and collaborators of funding all my work. Altogether, my specific research brought in over $475,000 in funds in addition to the funds acquired for other aspects of the project. I wrote all the progress reports that were required by the funding sources. I also aided my adviser on his research into the biomagnification of PCBs in food webs.

PhD Dissertation Research January 2005-July 2006
University of Minnesota, Twin Cities
Duties:
I worked for the University of Minnesota President as the sole student on a committee of faculty and administrators trying to identify barriers that are limiting collaborative research between disciplines and developing a framework for breaking down those barriers.

Keenan A Storrar

keenanstorrar@gmail.com, 406-579-8556
1741 Stuart Street, Helena, Montana 59601

EDUCATION

The University of Montana — Missoula, MT
- Master of Science, Resource Conservation, Post-fire erosion control — May, 2013
- Published; *Science of the Total Environment,* August 2019, Volume 676

The University of Montana — Missoula, MT
- Bachelor of Science, Environmental Geology — May, 2008

WORK EXPERIENCE

Water Quality Specialist — **2019 – Present**
Water Protection Bureau, Montana Department of Environmental Quality

- DEQ's lead stream permitting coordinator:
  - Ensure stream alterations within Montana's streams, rivers, and wetlands comply with the Clean Water Act and Montana's water quality standards
  - Review applications of proposed in-stream projects for proper implementation of Best Management Practices and provide input on softer stabilization/restoration techniques to reduce impacts and protect beneficial uses of state waters
  - Effectively communicate with permit applicants through in-person and remote meetings, emails, and phone calls regarding deficiencies, permit status, and conditional approvals
- I make CWA Section 401 Water Quality Certification determinations (MCA 75-5-401 through 75-5-403; ARM 17.30.101 – 17.30.108) for projects permitted by the US Army Corps of Engineers (USACE)
  - This includes reviewing federal Section 404 permits for potential water quality impacts to state waters. I occasionally review pipeline maintenance and new construction projects permitted by the USACE under the Nationwide Permits 3 for Maintenance and 12 for Oil or Natural Pipeline Activities. These reviews consist of assessing potential water quality impacts due to pipeline construction activities at waterbody crossings and conditioning work to better protect water quality.
- Issue 318 Authorizations waiving the numeric turbidity and suspended sediment standard during in-stream project work
- Collaborate and engage on a daily basis with federal, state, and county agencies and private stakeholders including the US Army Corps of Engineers, US EPA Region 8, Montana Fish, Wildlife, and Parks, DNRC conservation districts, Floodplain Administrators, US Fish and Wildlife Service, NorthWestern Energy, and Avista

Hydrogeologist, Project Manager — **2014 – 2019**
Coal Program, Utah Division of Oil, Gas and Mining
Salt Lake City, UT

- Determined hydrologic impacts from coal mining operations by:
  - conducting field investigations to determine surface and groundwater system inputs and outputs
  - reviewing hydrogeologic reports produced by coal mine operators, affected water uses, and third party independent consultants
- Authored and awarded grant in partnership with Utah State University to study the effectiveness of pocking or surface roughening to prevent sediment erosion from reclaimed hillslopes
- Presented analyses and findings on water resource impacts from coal mining to federal and state agencies and affected water users including ranchers and municipalities
- Permitted coal mining and reclamation operations
  - Wrote technical findings on the probable hydrologic consequences of coal mining

EXHIBIT K

- Documented site inspections with detailed written and photo log reports
- Verified vegetation establishment and surface stability of reclaimed areas for bond releases

- Project Manager overseeing final reclamation of abandoned Horizon coal mine near Price, Utah
  - Managed $450,000 budget to reclaim a bond-forfeiture coal mine site
- Developed relationships with agencies and stakeholders including coal mine representatives, US Office of Surface Mining Reclamation and Enforcement, US Forest Service, US BLM, US MSHA, Utah Division of Water Rights, Utah Division of Water Quality, Water Conservancy Districts

Hydrologist, Graduate Research Assistant 2010 – 2014
The College of Forestry and Conservation, The University of Montana
Missoula, Montana, in partnership with
Rocky Mountain Research Station, USDA Forest Service
Moscow, ID

- Co-authored paper published in *Science of the Total Environment*, August 2019, Volume 676
  - "Effectiveness of straw bale check dams at reducing post-fire sediment yields from steep ephemeral channels"
- Project manager studying the effectiveness of an erosion control barrier at reducing post-fire sediment yields in small watersheds
- Installed and operated a suite of monitoring and measuring equipment:
  - Crest gauges, HOBO rain gauges/data loggers, total stations, optical levels, stadia rods, pygmy current meters, acoustic doppler velocimeters
  - Campbell Scientific CR-10X weather stations connected to ultrasonic depth sensors, rain gauges, anemometers, soil moisture sensors, ISCO samplers
- Compiled and statistically analyzed multi-year data sets using the software R

Hydrologic/Biologic Technician **Field season 2007**
USDA Forest Service, Madison Ranger District
Ennis, Montana

- Installed in-stream structures to reduce channel incision and sediment transport rates to restore floodplain connectivity
- Conducted cross-section and longitudinal profile surveys to analyze stream health

ADDITIONAL EXPERIENCE

Farm Apprentice, Big Fork, MT **Field seasons 2008 - 2009**

- Co-managed the operations of planting, irrigating, harvesting, and marketing produce
- Operated tractors and power take offs, MIG/TIG welded, small engine repair

Field Geology Mapping Course, Dillon, MT **Field season 2007**

- Conducted geologic mapping of surficial and cross-sectional features across thirty square miles on 1 : 24,000 scale topographic maps

Student Researcher - Juneau Icefield Research Program **Field season 2006**

- Traversed the Juneau Icefield conducting glacier health mass balance research

COMPUTER EXPERIENCE

- MS Office Suite
- Global Mapper, Trimble Geomatics Office
- Modflow Modeling Software
- HEC-RAS Modeling Software, WinXSPRO
- MapSource, All Topo Maps, Google Earth
- R Statistical Software

REFERENCES

Cheryl Parker, P.E. Utah Division of Drinking Water	801-866-2667 cherylparkerpe@gmail.com
Warren Kellogg NRCS Watershed Specialist, Retired	406-437-3028
Peter Robichaud, PhD, P.E. USDA Forest Service	208-883-2349 probichaud@fs.fed.us

Keenan A Storrar

Graduate Research Advisor

Daniel Lloyd

36 S. Alta St. | Helena, MT 59601 | lloydaniel@gmail.com | (319) 331-5699

PROFESSIONAL EXPERIENCE

Bureau Chief
2020-Current Montana Department of Environmental Quality Helena, MT

- Manager of the Montana State Energy Office at the Department of Environmental Quality.
- Responsible for management of state, federal and private funds to support access to reliable, affordable, and clean energy in Montana.
- Coordinated and collaborated with state and regional stakeholders including utilities, non-governmental organizations, elected officials, and federal officials to represent Montana's interests.

Project Manager
2019-2020 Absaroka Energy Bozeman, MT

- Led development of a proposed pumped storage hydro development including landowner negotiations, consultant selection/management, and off-take discussions.
- Developed project timelines, communication strategy, and state/federal regulatory protocols.
- Responded to utility request for proposals, analyzed potential acquisition of renewable projects, and provided regulatory guidance.

Section Supervisor
2017- 2019 Montana Department of Environmental Quality Helena, MT

- Managed the Energy Planning and Renewables section of the Montana Energy Office.
- Participated in utility, state, and regional energy planning, policy, and development processes.
- Developed policies and administrative rules to implement energy policies related to wind decommissioning and bonding, energy grant and loan programs, and energy emergency planning.

Business Development Specialist/Policy Advisor
2013-2017 Montana Governor's Office Helena, MT

- Coordinated statewide business retention, expansion, and recruitment efforts.
- Provided technical assistance to private businesses and communities on financing, infrastructure, and workforce development.
- Provided policy and technical recommendations to the governor on economic development issues, especially related to energy and technology.

Energy Development Specialist
2010-2013 Montana Department of Commerce Helena, MT

- Provided financial, workforce development, and regulatory assistance to developers of energy projects in Montana.
- Promoted Montana's energy resources through creation of marketing materials and face-to-face meetings.

EXHIBIT L

EDUCATION

2006 **University of Notre Dame** Notre Dame, IN
Bachelor of Business Administration, *Cum Laude*
Minor: Science, Technology, & Values

CERTIFICATIONS & ASSOCIATIONS

2020-Current **Western Green Hydrogen Initiative**
Co-chair

2020-Current **National Association of State Energy Officials**
Board Member and Central Region representative

2018-2019 **Western Interstate Energy Board Member**
Appointed by Governor Bullock to represent Montana

2016 **Leadership Montana Participant**

2013 **National Development Corporation**
Certified Economic Development Finance Professional

Robert D. Smith

Experience

January 2021 to present Montana Department of Environmental Quality Helena, MT

Coal Section Supervisor

- Manage a diverse staff of engineers, hydrologists, biologist, soils scientist, and vegetation ecologist.
- Coordinate all permitting activities within the Coal Program.
- Oversee, assign, and reviewing the work of engineers, hydrologists, biologist, soils scientist, and vegetation ecologist.
- Presenting rules changes to the Board of Environmental Review.
- Developing letters, EAs, and general correspondence to be sent to operators, the public and upper management.
- Conduct and review environmental inspections for compliance of state of Montana regulations within the coal mines throughout Montana.
- Provide compliance assistance to the coal mine operators as well as coal prospecting operations in Montana.
- Present at public meetings.

March 2011 to January 2021 Montana Department of Environmental Quality Helena, MT

Coal Section Permit Coordinator

- Coordinate all permitting activities within the Coal Program.
- Oversee, assign, and reviewing the work of engineers, hydrologists, biologist, soils scientist, and vegetation ecologist.
- Presenting rules changes to the Board of Environmental Review.
- Developing letters, EAs, and general correspondence to be sent to operators, the public and upper management.
- Conduct and review environmental inspections for compliance of state of Montana regulations within the coal mines throughout Montana.
- Conduct the review for archaeology studies and mitigations associated with coal mining activities as well as general review of all permitting applications.
- Provide compliance assistance to the coal mine operators as well as coal prospecting operations in Montana.
- Present at public meetings.

January 2007- March 2011 – January 2007 Montana Department of Environmental Quality Helena, MT

Environmental Enforcement Specialist

- Provided formal enforcement for solid waste, hazardous waste, junk vehicles and open cut violations (gravel pits).
- Provided expert testimony for solid waste, hazardous waste and junk vehicle cases.

EXHIBIT M

406-439-2848•robesmit343@hotmail.com

Robert D. Smith

- Conducted inspections for citizen complaints involving unpermitted entities.
- Provided DEQ oversight for spills from mobile sources, including determination of sampling protocols and final clean-up criteria.

June 2001 – June 2003 ATC Associates, Inc. Tempe, AZ

Staff Scientist

- Conducted numerous Phase I ESAs throughout Arizona and New Mexico.
- Conducted mold inspections, indoor air quality studies, lead based paint surveys, soil sampling, ground water sampling and many other studies as assigned.
- Provided safety and health expertise for the office including preparing and reviewing all site specific health and safety plans for many project sites.

January 2000 – June 2001 LEGEND Technical Services, Inc.

Fargo, ND

Industrial Hygienist

- Conducted safety and health oversight of the reconstruction of the Grand Forks Air Force Base runway project. Duties included daily safety audits, conducting site specific safety training, and new employee safety training.
- Conduct asbestos abatement oversight, inspections, clearances, and project designs.
- Conducted mold inspections, indoor air quality studies, lead based paint surveys, soil sampling, ground water sampling and many other studies as assigned.
- Provided safety and health expertise for the office including preparing and reviewing all site specific health and safety plans for many projects.

June 1998 – August 1998 and June 1999-August 1999 Columbia Falls Aluminum Company Columbia Falls, MT

Safety and Health Intern

- Conducted accident investigations as well as near miss investigations.
- Conducted heat stress monitoring for all tasks within the aluminum plant and wrote a heat stress program for Columbia Falls Aluminum Company.
- Surveyed the facility for all confined spaces and determined which spaces were permit required confined spaces.
- Conducted personal exposure monitoring for numerous contaminates including dust, coal tar pitch, fluoride, and noise.

Education

September 1995 - December 1999 University of North Dakota Grand Forks, ND

BS Occupational Safety and Environmental Health

- Emphasis in Industrial Hygiene, Safety, and Waste Management

406-439-2848•robesmit343@hotmail.com

Robert D. Smith

Certifications/Trainings

Inexperienced Minor MSHA 20 hour

Hazardous Waste Operations and Emergency Response (HAZWOPER)

NIOSH 582

Basics of Management

References

References are available on request.

Dan Walsh

1520 East Sixth Avenue, Helena, MT 59620 ● (406) 444-6791 ● dwalsht@mt.gov

Education

BS Environmental Engineering
Montana Tech of the University of Montana
December 1995

Licenses/Certifications

Licensed Engineer-in-Training, State of Montana, October 1995

Major Accomplishments

- Development/Coordination/Implementation of DEQ's Mining Bureau
- Successfully lead the Hard Rock Mining Bureau
- Coordination and co-development of Hard Rock Mining Guidance Manual
- Coordination and co-development of Air Compliance Guidance Manual
- Successfully lead the Air Compliance Section
- Provided technical review of air permitting documents, air compliance documents, and mining documents

Work History

July 2021 to Present
Montana Department of Environmental Quality, Helena, Montana
Mining Bureau Chief

April 2017 to July 2021
Montana Department of Environmental Quality, Helena, Montana
Hard Rock Mining Bureau Chief

September 2004 to April 2017
Montana Department of Environmental Quality, Helena, Montana
Air Compliance Section Supervisor

March 2000 – September 2004
Montana Department of Environmental Quality, Helena, Montana
Lead Preconstruction Permit Engineer – Air Permitting Section

December 1997 – March 2000
Montana Department of Environmental Quality, Helena, Montana
Environmental Engineer Specialist – Air Permitting Section

EXHIBIT N

August 1996 – December 1997
Bison Engineering, Inc., Helena, Montana
Staff Engineer

Significant Mining Permits Issued and Issues Addressed:

- Golden Sunlight Mine Permit (No. 00065) Amendment No. 017
- Tintina Montana Inc. Permit No. 00188
- Montana Resources Permit (No. 00030) Amendment No. 010
- Stillwater Mining Co. – East Boulder Permit (No. 00149) Amendment No. 003
- Comprehensive 5-Year Bond Review/Approvals

Significant Air Quality Permits Issued:

- *Roundup Power Project (MAQP #3182-00)* (PSD - New)
- *Roundup Power Project (MAQP #3182-00 (Case-by-case MACT Determination)*
- *Roseburg Forest Products,* MAQP #2303-08 (PSD – Lookback)
- *Plum Creek Timber Company – Columbia Falls,* MAQP #2667-09 (PSD – Major Modification)
- Numerous major/minor permit actions *reviewed*
- *Roseburg Forest Products Title V Operating Permit No.* OP2303-00 (Initial Issuance)

Significant Compliance/Enforcement Activity:

- Montana Tunnels Mining, Inc. Consent Order MB-MM-22-01
- Westmoreland Resources Inc. – Absaloka Coal Mine (C1985005) Cessation Order and Corresponding Termination of Cessation Order
- Involvement in numerous violation determinations and corresponding resolution
- Involvement in numerous enforcement actions and corresponding resolution

Professional Training Courses:

- Mine Design, Operations, & Closure Conference 2017-2022
- Society for Mining, Metallurgy and Exploration Annual Conference, February 2020
- Lean Green Belt, November 2019
- OSHA HAZWOPER, Thru April 2021
- Monitoring Compliance Test and Source Test Observations, April 2016
- Environmental Law for First Responders, October 2014
- Joint Engineers Conference, November 2015
- Joint Engineers Conference, November 2014
- Effective Permit Writing, October 2013
- Advanced NSR/PSD, October 2013
- Basic NSR/PSD, October 2013
- Advanced Inspector Training, July 2013
- ICS for Single Resource and Initial Action Incident, April 2013

- Introduction to Incident Command, November 2012
- ETA Visible Emissions Evaluator, October 2012 (most recent)
- Ability to Pay Training, May 2012
- Hydrogen Sulfide Training, March 2012
- GasFindIR Infrared Camera Training Course, April 2008
- NSR Reform Workshop, May 2005
- BACT Determination Workshop, June 2004
- BACT Determination Workshop, April 2003
- CARB Industrial Boilers, June 2002
- CARB Observing Source Tests, June 2002
- CARB Continuous Emission Monitoring, June 2002
- CARB Volatile Organic Compound Control Devices, June 2002
- Advanced NSR Workshop, February 2001
- Smoke Management Techniques, January 2000
- Smoke Modeling, March 1999
- PERMITS Air Dispersion Modeling, September 1998
- CARB Baghouses, June 1998
- CARB Stationary Internal Combustion Engines, June 1998
- CARB Electro Static Precipitators, June 1998
- CARB Hot Mix Asphalt Facilities, June 1998
- The Fundamentals of Ambient Air Monitoring, March 1997
- ETA Visible Emissions, October 1996 (Classroom)
- 40-Hour HAZWOPER Training, February 1995
- Air Pollution Control Orientation Course, February 1995
- Introduction to Ambient Air Monitoring, February 1995
- Basic Air Pollution Meteorology, April 1994

Rebecca A Harbage

CONTACT

1-406-461-6183

rharbage@mt.gov

Helena, MT

linkedin.com/in/rharbage

EDUCATION

Master of Community and Regional Planning, 2013

University of Oregon

Bachelor of Arts, History, 2007

Barnard College, Columbia University

SKILLS

Strategic Planning

Project Management

Communication & Outreach

Public Speaking

Leadership

RECENT EXPERIENCE

PUBLIC POLICY DIRECTOR

Montana Dept. of Environmental Quality | Helena, MT | Aug. 2019 – Present

- Member of senior leadership team and directly involved in communications and public relations on all high-profile issues across the agency.
- Supervise six direct reports working in the areas of communications, public outreach, tribal and cultural resources, public records, and the Montana Environmental Policy Act.
- Regularly interface with the press, stakeholders, legislators, tribes, and local government.
- Developed and maintained web presence for Governor Bullock's Climate Solutions Council. Participated in Council and work group meetings and oversaw the public comment process as well as final editing of the Climate Solutions Plan.

AIR QUALITY PLANNER IV

Montana Dept. of Environmental Quality | Helena, MT | Sep. 2013 – Aug. 2019

- Led efforts to engage stakeholders through the Montana Clean Air Act Advisory Committee. Organized, facilitated, and presented at quarterly meetings.
- Led the team developing a permit-by-rule program for sand and gravel equipment. Gained stakeholder buy-in and successfully got rules adopted through the Montana Board of Environmental Review.
- Led the team developing a state plan under the regional haze requirements of the federal Clean Air Act. Established project timelines and milestones, organized outreach efforts, prioritized daily tasks, and provided updates to management and stakeholders.
- Co-chaired the Western Regional Air Partnership Regional Haze Planning Work Group.
- Lead planner on the multi-disciplinary team assigned to develop a state plan under the federal Clean Power Plan. Analyzed federal policy, developed implementation options, and presented on potential compliance pathways.

PROJECT COORDINATOR

Community Planning Workshop, University of Oregon | Eugene, OR | Sep. 2012 – Jun. 2013

- Managed a team of graduate students providing technical assistance to four small Oregon cities working to meet federal Clean Water Act requirements.
- Developed strategies for implementing best practices related to surface water runoff in coordination with local steering committees, including development code amendments, a riparian ordinance, and an outreach and education plan.

COMMUNITY LEADERSHIP

City of Helena Zoning Commission	**Chair, Mar. 2019 – Present** Vice Chair, Jun. 2017 – Mar. 2019 Commissioner, Apr. 2015 – Jun. 2017
Montana Commission on Community Service	**Chair, Oct. 2021 – Present** Vice Chair, Oct. 2017 – Oct. 2021 Commissioner, Aug. 2016 – Oct. 2017

EXHIBIT O

CRAIG JONES

2625 Cody Dr, East Helena, Montana · (406) 459-5769
Crajones1@gmail.com

Analytical, organized and detail-oriented accountant with GAAP expertise and experience in the full spectrum of public accounting. Collaborative team player with ownership mentality and a track record of delivering the highest quality strategic solutions to resolve challenges, propel business growth.

EXPERIENCE

2014 TO PRESENT

SENIOR MONTANA ENVIRONMENTAL POLICY ACT (MEPA)/MAJOR FACILITY SITING ACT (MFSA) COORDINATOR

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY, HELENA, MONTANA

My essential functions are implementing the requirements of the Major Facility Siting Act (MFSA) and ensuring the Department follows the Montana Environmental Policy Act (MEPA). The MFSA portion of my job is to be the lead worker in assisting applicants and stakeholders in a complex and controversial permitting process of linear facilities. The MEPA duties are to be the project manager in leading the Environmental Impact Statement (EIS) process with Department staff, the applicant, other State or Federal agencies, and contract officer managing third-party contractors. I'm expected to be an expert in the implementation of MEPA and a resource for other staff when conducting MEPA documents. A component of conducting the MEPA activities is interpreting complex and technical scientific information can be presented in a MEPA document. The goal of these MEPA documents is to present potential impacts as required under MEPA in a transparent and understandable manner for all stakeholder groups.

2012-2014

LEAD MAJOR FACILITY SITING ACT COORDINATOR

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY, HELENA, MONTANA

My duties included implementing the requirements of the Major Facility Siting Act (MFSA) for the Department. The duties included being a project manager for highly controversial linear facilities such as transmission lines and pipelines. I was the lead worker for the MFSA program with stakeholders, the applicant, and contractors for all MFSA projects. I was tasked with managing interdisciplinary environmental resource teams to meet the requirements of MFSA for project.

2007-2012

ENVIRONMENTAL SCIENCE SPECIALIST IN THE MAJOR FACILITY SITING ACT PROGRAM

MONTANA DEPARTMENT OF ENVIRONMETAL QUALITY, HELENA, MONTANA

I was part of interdisciplinary team in permitting linear projects under the Major Facility Siting Act (MFSA) for the Department. These linear projects were transmission lines and pipelines in the State of Montana. I was charged with engaging with concerned stakeholders in projects and gathering current land use data for the MFSA process.

EXHIBIT P

EDUCATION

JUNE 2007
BACHELOR OF ARTS, POLITICAL SCIENCE, CARROLL COLLEGE
HELENA, MT

Martin Van Oort

2210 East Sixth Avenue, Helena, MT 59601 ● (406) 459-2754 ● mdvanoort@yahoo.com

Hydrologist

My interest in geology, hydrology, and hydrogeology in particular, is based in my curiosity. Beneath our feet lies a mystery, of which we can only catch small glimpses. The location, arrangement, and composition of geologic materials made clear only at surface outcrops, or by limited borings or excavations. The physical and chemical properties of rocks and sediments interacting in a multitude of ways with the water they contain. The groundwater moving, although often nearly imperceptibly slowly, from recharge to discharge. Groundwater and surface water interacting at and shaping the surface of the earth. The activities of man leaving footprints in the water, some subtle, others blatant.

An intuitive thinker I am adept at recognizing trends and patterns. I view each project as a puzzle, which I enjoy solving. I am organized and methodical, with a tendency for perfectionism. I approach problems by breaking them down to fine details, then assembling those details to form a complete picture. I have a reserved and quiet personality, but I am confident to offer my technical expertise in any forum.

CORE COMPETENCIES

- ***Data Management, Analysis, and Presentation***

I have managed and analyzed numerous environmental datasets for facility investigations, modeling projects, and landfill and coal mine monitoring. I am an expert at compiling data and ensuring quality control in large databases. Organizing data and displaying it in graphs and maps to facilitate analysis has been a part of nearly every project I have worked on. I believe that a picture truly is worth a thousand words, and well-conceived, creatively designed, and professionally presented illustrations are essential to communicate the story each dataset has to tell. I am proficient with MS Excel, MS Powerpoint, and ArcGIS, and have working knowledge of MS Access and EQuIS. I have also used Tecplot and MVS.

- ***Technical Writing***

I have prepared many technical reports both alone and in collaboration with colleagues. These have ranged from my Master's thesis, to groundwater modeling reports, field investigation reports, and hydrologic assessments for landfill and mine permitting. I also have written sections for EA's and worked on EIS's. As a regulator I have written and contributed to many review letters in response to submittals from the regulated community and also responses to public comments. I have also written and contributed to both internal and external guidance documents. I am proficient with MS Word and OpenOffice Writer.

- ***Groundwater Modeling***

I am experienced with both steady-state and transient flow and transport models. I have completed entire modeling projects from conceptualization to reporting, worked on modeling

projects begun or completed by others, and adapted existing models for additional applications. I have also reviewed many groundwater models as a peer and as a regulator. I am most experienced with MODFLOW, MODPATH, and MT3D/RT3D, but also have experience with PEST and Feflow. I have experience with both GWVistas and GMS.

- ***Field Geology***

I have experience with many geologic and environmental field procedures. I have conducted low-flow and traditional purge groundwater sampling, collected surface water samples, and collected both surface and subsurface soil samples. I have measured groundwater levels using electric tape, sonic meters, and dataloggers, and performed stream flow measurements. I have performed both slug- and pump-tests utilizing pressure transducers and analyzed the data using Aqtesolv. I have overseen drilling and installation of monitoring wells using both hollow-stem auger and air-rotary techniques, and described lithology from split-spoons, cores, and drill cuttings. I have supervised Geoprobe investigations utilizing membrane interface probes, electrical conductivity logging, soil coring, and groundwater grab sampling; test pit excavations for describing soils and locating contaminant source areas; and geophysical investigations for utility clearance including EM, RF, and GPR.

- ***Regulatory Compliance***

I am experienced in reading and interpreting laws and rules. I have reviewed many license and permit applications for compliance with regulations. I have met frequently with applicants and their consultants to provide guidance on meeting the requirements necessary to obtain a license or permit. I also have performed many compliance inspections at landfills and coal mines. I have interacted with employees of regulated entities, from equipment operators and laborers, to scientists and engineers, to foremen, managers, and company executives, providing them information on how best to comply with laws and rules. I have worked with enforcement specialists and legal staff in resolving violations and assisted lawyers with responding to legal challenges. I have served as an expert witness and offered expert testimony in depositions and hearings. I also interact with citizens' groups and local landowners to provide information and investigate complaints.

- ***Leadership***

As the senior hydrologist in the Coal Section I have worked in a mentorship role for new hydrologists. I also provide advice and reviews for other section hydrologists, engineers, and ecologists on regulatory and technical subjects. As the Inspection Coordinator for the Coal Section I facilitate scheduling of monthly field inspections of mine permits by 11 staff to ensure inspections meet statutory and rule requirements. In this coordinator role I determine and assign inspection priorities so that inspections are consistent and comprehensive. I review and approve inspection reports by staff, determine appropriate compliance measures and timelines, and make recommendations to the Section Supervisor on formal enforcement actions when required.

PROFESSIONAL EXPERIENCE

Montana Department of Environmental Quality, Mining Bureau, Coal Section
May 2013 - Present
Hydrologist

- Review coal mine permit applications, amendments, and revisions; including Probable Hydrologic Consequences determinations and groundwater model reports, and provide deficiency comments for permittees.
- Prepare Cumulative Hydrologic Impact Assessments (a detailed and comprehensive analysis of hydrologic impacts of mining) for coal mine permit written findings.
- Assist in preparation of Environmental Assessments and review and edit Environmental Impact Statements prepared by third party contractors.
- Review, suggest alterations, and approve mine Monitoring and Quality Assurance Plans for hydrologic monitoring, and review annual and semi-annual hydrology data reports.
- Review bond release applications, and conduct on site evaluations of reclamation for compliance with bond release requirements.
- Conduct coal mine inspections for compliance with the laws and rules.
- Investigate and prepare findings for complaints related to potential mining impacts.
- Serve as an expert witness in appeals of permit decisions.

September 2019 - Present
Inspection Coordinator

- Coordinate scheduling of monthly mine inspections by 11 Coal Section staff.
- Conduct pre-inspection meetings with staff outlining priorities for inspection
- Conduct post-inspection meetings with staff to determine necessary steps for compliance and review and approve inspection reports.
- Make recommendations to Section Supervisor for referral of violations to Enforcement.

Montana Department of Environmental Quality, Waste and Underground Tank Management Bureau, Solid Waste Section
September 2008 – May 2013
Groundwater Hydrologist

- Reviewed solid waste facility license applications and provided comments for licensees.
- Assisted in preparation of Environmental Assessments.
- Reviewed landfill groundwater sampling and analysis plans, routine monitoring results and statistical analyses, and corrective action plans.
- Reviewed landfill methane monitoring plans and results.
- Conducted solid waste facility inspections for compliance with the laws and rules.
- Wrote a sampling and analysis plan for an abandoned landfill, conducted routine groundwater and methane monitoring, preformed statistical analyses of groundwater monitoring data, and prepared groundwater monitoring reports.
- Contracted a well driller to install new monitoring wells at an abandoned landfill and supervised drilling and well installation.
- Performed hydrologic evaluations of septic tank pumper land application sites.

GeoTrans, Inc., Sterling, VA
October 2005 – September 2008
Project Hydrogeologist

- Field manager and site safety officer for RCRA investigation to characterize soil and groundwater contamination at active chemical plant. Responsible for preforming and/or supervising all work done on site by GeoTrans and subcontractors. Field work included

utility clearance, GeoProbe® investigations, soil borings, monitoring well installation and development, slug testing, groundwater and soil sampling, and trench excavation, and was performed over a period of two years.

- Performed 8-hour aquifer tests for residential water wells and participated in 72-hour aquifer tests for municipal water supply wells. Assisted with aquifer test data collection using pressure loggers and analysis of aquifer test results using Aqtesolv.
- Reviewed sampling reports and statistical analyses of sampling results for closure of a facility with radioactive contamination.
- Designed, constructed, and/or calibrated groundwater flow and transport models and prepared or assisted in preparing modeling reports for several projects. Primarily used MODFLOW, MODPATH, MT3D/RT3D with Groundwater Vistas for pre- and post-processing, also used PEST, Feflow, and Bio1D. Projects included:
  - Uranium transport model using kinetic sorption package to estimate plume cleanup times
  - Transient model for a highly variable aquifer in hydraulic contact with the Mississippi River including particle tracking to estimate contaminant travel time to potential receptors
  - Four species reactive transport model for evaluation of potential for offsite contaminant migration following contaminant recovery system shutdown
  - Stochastic steady state model using multiple kriged hydraulic conductivity distributions and particle tracking to estimate advective travel times for contaminants
  - Finite element model to evaluate potential pumping scenarios for optimizing contaminant plume capture

The Ohio State University, Columbus, OH
September 2001 – August 2005
Research Assistant

- Performed research for thesis project: designed, constructed, and calibrated a transient flow model of quarry dewatering to demonstrate the potential for impacts on private wells in area in support of an Ohio Department of Natural Resources (ODNR), Division of Mineral Resource Management investigation. Accompanied ODNR personnel on site visits to quarry and assisted with water level measurements in private wells.
- Designed and created graphics and animations from transient transport model results; wrote macros to batch process model results to create animation videos in TecPlot visualization software.

Teaching Assistant

- Instructor for introductory geology labs, prepared and presented short introductions to exercises, assisted students during work, graded complete exercises, assisted with field trips, and proctored exams.

Macatawa Area Coordinating Council, Holland, MI
November 2000 – May 2001
GIS Internship

- Operated the Geographical Information System for a small metropolitan planning organization.
- Created maps to support transportation and environmental planning.

- Used Avenue scripting language for ArcView to create a custom aerial photo viewing system.

Hope College, Holland, MI
June 1998 – April 2001
Research Assistant

- Surveyed Lake Michigan barrier sand dunes using plane table and alidade; located, mapped, and described paleo-soils; collected paleo-soil samples for carbon dating; and presented results of research at scientific symposia and conferences.

Teaching Assistant

- Assisted students during geology labs, graded lab and classroom exercises, and proctored exams.

EDUCATIONAL BACKGROUND

The Ohio State University, Columbus, OH
August 2005

- Master of Science in Geological Sciences, *summa cum laude*
- Emphasis in Hydrogeology
- Thesis: "Numerical Modeling of the Effects of Dewatering at Seaway Quarry, Lucas County, Ohio"

Hope College, Holland, MI
May 2001

- Bachelor of Science in Geology, *magna cum laude*
- Minor in Environmental Science

Training

- HAZWOPER 40hr General Site Worker
- MSHA Certified: Surface, Coal, Metal, and Non-metal mines

WILLIAM ROSQUIST

426 Monroe Ave. Helena, MT 59601 | (406) 437-8070 | warosquist@gmail.com

Education – Economics / University of Montana / June 1990

Graduated with honors

Graduate studies in microeconomics and advanced econometrics

Professional Experience

Montana Public Service Commission

Regulatory Division Administrator / January 2016 – Present

- Manage team of fourteen analysts, pipeline safety engineers, and railroad safety inspectors
- Manage Division workload, make staff assignments, and evaluate performance
- Set Division goals and objectives and monitor performance
- Work with staff to analyze utility rate applications and other regulatory matters
- Recruit and train Division staff
- Member of agency coordinating team responsible for day-to-day operation of the agency

Montana Public Service Commission

Economics and Rate Design Bureau Chief / July 2010 – January 2016

- Manage team of three economic analysts
- Supervise Bureau productivity, set standards for work products, and evaluate performance
- Coordinate Bureau activities with other bureaus and divisions within the agency
- Work with Bureau staff to analyze utility rate applications, long range resource plans, and other regulatory matters
- Oversee preparation of economic analyses requested by the Public Service Commission

Montana Public Service Commission

Utility Rates and Economic Analyst / January 1991 – July 2010

- Analyze rate applications from electric natural gas and telecommunications utilities
- Evaluate methods of cost analysis and pricing using economic theory and agency policies
- Provide advice to the Public Service Commission from economic and public interest perspectives
- Develop and implement policies and rules for integrated least-cost resource planning for electric utilities
- Evaluate methods and policies to implement the federal Public Utility Regulatory Policies Act
- Collaborate with staff from other bureaus and divisions within the agency
- Represent the Public Service Commission before the Montana Legislature as needed

U.S.D.A Forest Service

Intern / January 1990 – June 1990

- Assist forest economist with economic studies
- Analyze benefits and costs of alternative timber sale methods
- Analyze cost-effectiveness of post timber sale treatment methods
- Apply linear regression and other econometric and statistical tools
- Prepare written reports and present study results to forest managers

EXHIBIT R

Professional Education

- Rutgers University Center for Research in Regulated Industries, Advanced Workshop in Regulation and Competition (2007)
- National Association of Regulatory Utility Commissioners, Portfolio Management Workshop, Washington, D.C. (2000)
- Wisconsin Public Utility Institute, Antitrust in Energy Markets, University of Wisconsin Law School (2000)
- Lawrence Berkeley Laboratory, Advanced Integrated Resource Planning seminar, University of California, Berkeley (1994)
- Public Utility Research and Training Institute, Advanced Course on Externalities and Public Utilities, University of Wyoming (1992)
- National Association of Regulatory Utility Commissioners, Annual Regulatory Studies Program, Michigan State University (1991)