Nos. 21-15313, 21-15318

United States Court of Appeals for the Ninth Circuit

CITY AND COUNTY OF HONOLULU et al.,

Plaintiffs – Appellees,

v.

SUNOCO LP, et al.,

Defendants – Appellants,

COUNTY OF MAUI,

Plaintiff – Appellee,

v.

SUNOCO LP, et al.,

Defendants – Appellants,

Appeal from the United States District Court
for the District of Hawaii
Nos. 20-cv-00163, 20-cv-00470 (The Honorable Derrick K. Watson)

AMICUS BRIEF OF CHARLES FLETCHER IN SUPPORT OF APPELLEES AND REMAND

William A. Rossbach
ROSSBACH LAW, P.C.
401 N. Washington Street
P. O. Box 8988
Missoula, MT 59807
Phone: (406) 543-5156
Fax: (406) 728-8878
bill@rossbachlaw.com

Attorney for Amicus Curiae

CORPORATE DISCLOSURE STATEMENT

Pursuant to Fed. R. App. P. 26.1, *amicus curiae* Dr. Charles Fletcher certifies that he is an individual, not a corporation.

TABLE OF CONTENTS

Page

TABLE OF AUTHORITIES

Other Authorities **Page**

AMICUS CURIAE'S IDENTITY, INTEREST AND AUTHORITY TO FILE

Amicus curiae, Dr. Charles Fletcher, as a scientist and scholar, has devoted much of his professional life to research, studying, writing, and teaching climate science, particularly climate science of the Hawaiian Islands and its communities. He is the Associate Dean for Academic Affairs at the School of Ocean and Earth Science and Technology (SOEST), University of Hawaii at Mānoa. He serves as Chairperson of the Honolulu Climate Change Commission. His research and teaching focus on Climate Change, Coastal Community Resiliency, and Natural Coastal Systems.

The results of his work are used by government agencies for administering coastal policy, establishing construction guidelines, and planning resilient infrastructure projects. Data produced by his research team is used by Kauaʻi and Maui counties in their setback ordinance, and is considered in permit decisions by the City of Honolulu and the Hawaii Department of Land and Natural Resources.

With his students, Dr. Fletcher has published over 100 peer-reviewed articles as well as three textbooks.

- *Living on the Shores of Hawaii: Natural Hazards, the Environment, and Our Communities*, (2011, University of Hawaii Press);
- *Climate Change: What the Science Tells Us 2nd Edition* (2019, J. Wiley & Sons);
- *Physical Geology: The Science of Earth 3rd Edition* (2017, J. Wiley & Sons).

Fletcher's team has modeled the impacts of sea level rise (coastal erosion, seasonal [non-storm] wave overtopping, and hydrostatic flooding) for years 2030, 2050, 2075, & 2100, as set forth in Intergovernmental Panel on Climate Change, Fifth Assessment Report, RCP8.5. Modeling of urban flooding depicts risk from groundwater inundation, storm drain back-flow, and direct marine flooding. The widespread practice of shoreline hardening in Hawaii and globally, leads to beach loss as shown in these publications: beach loss, failure to protect, and his original paper in 1997.

As courts address cases involving the damage to coastal communities caused by climate change and ongoing sea-level rise, it is essential for judicial decisions to be based on an understanding of the

relevant science and the unavoidable adaptation expenses these communities are facing. Dr. Fletcher submits this *amicus* brief to assist the Court in that regard.

All parties have consented to the filing of this brief. No party's counsel authored the brief in whole or in part, no party or party's counsel contributed money that was intended to fund preparing or submitting the brief, and no person other than counsel for amici contributed money that was intended to fund preparing or submitting the brief.

SUMMARY OF ARGUMENT

There is broad consensus among climate scientists that the impacts of global warming, including rising seas, changes in precipitation regimes, expanding drought, increased risk of extreme weather events, environmental loss in the ocean and on land, threats to fundamental indigenous identity, and food and water impacts are accelerating. Carbon dioxide (CO_2) from combustion of fossil fuels—of which the Appellants' products are a primary source—is the largest single contributor to this warming. The island communities that brought this case face the daunting and expensive challenge of protecting their citizens and infrastructure—roads, bridges, airports, rail lines, port facilities, sewage treatment systems, drinking water supply systems, storm drainage systems, and public utilities—from the impacts of the climate change and providing for the impact on the human communities of the Appellee governments.

Despite the recent United Nations Paris Agreement, by which 195 governments agreed to reduce global emissions in order to keep global warming from progressing to dangerous levels, global CO_2 emissions grew to record levels in 2017 (1.6 percent increase) and increased again

in 2018 (2.7 percent increase).[1] Continued production, marketing, and combustion of fossil fuels on this high emission path will likely result in at least 2 feet of mean global sea-level rise by 2100[2]. There is a small, but very real possibility, that collapse of parts of the Antarctic ice sheet could result in over 6 feet of global sea-level rise by 2100[3]. Even the most aggressive emissions reduction scenarios would likely result in at least one foot of mean global sea-level rise by 2100[4,5] and these scenarios are generally recognized as unachievable with current policies.

These predictions mean that the damage already caused by coastal flooding will inevitably increase as global warming causes sea levels to rise further. This will compel coastal communities to take

---

[1] Le Quéré, C., et al., "Global Carbon Budget 2018," 10 *Earth System Science Data* (2018).
[2] About 85% probability according to Kopp, R. E., et al., "Probabilistic 21st and 22nd Century Sea-Level Projections at a Global Network of Tide-Gauge Sites," 2 *Earth's Future* 383 (2014).
[3] Bamber, J. L., et al., "Ice Sheet Contributions to Future Sea Level Rise From Structured Expert Judgement," 116 (23) *Proceedings of the National Academy of Sciences, 11195* (2019).
[4] About 92% probability according to Kopp, R. E., et al., "Probabilistic 21st and 22nd Century Sea-Level Projections at a Global Network of Tide-Gauge Sites," 2 *Earth's Future* 383 (2014).
[5] Sweet, W.V., et al., "Global and Regional Sea Level Rise Scenarios for the United States," *Climate Science Special Report* (2017).

costly remedial steps to harden infrastructure so it can withstand flooding, or people and communities will have to retreat from coastal locations

The City and County of Honolulu and the County of Maui seek to recover from the fossil fuel companies, whose products cause global warming and the climate impacts that threatens their communities, a fair share of the cost of adapting their infrastructure to withstand the impacts of climate change.

Amicus will detail in this brief the scientific evidence showing that Appellants' fossil fuels are a substantial factor in global warming impacts affecting Honolulu and Maui. Amicus will also describe the peer reviewed data showing the relative contribution of each of the top 90 producers of fossil fuels, including almost all the Appellants named herein, to the CO_2 in the atmosphere. Climate scientists have used that data to calculate the relative contribution of each of the top 90 to the increases in CO_2 in the atmosphere, surface temperature, and sea level from 1880 to 2010. These calculations prove that Appellants' fossil fuel products are a substantial factor in the injuries and damages that Honolulu and Maui and their citizens have and will continue to suffer.

ARGUMENT

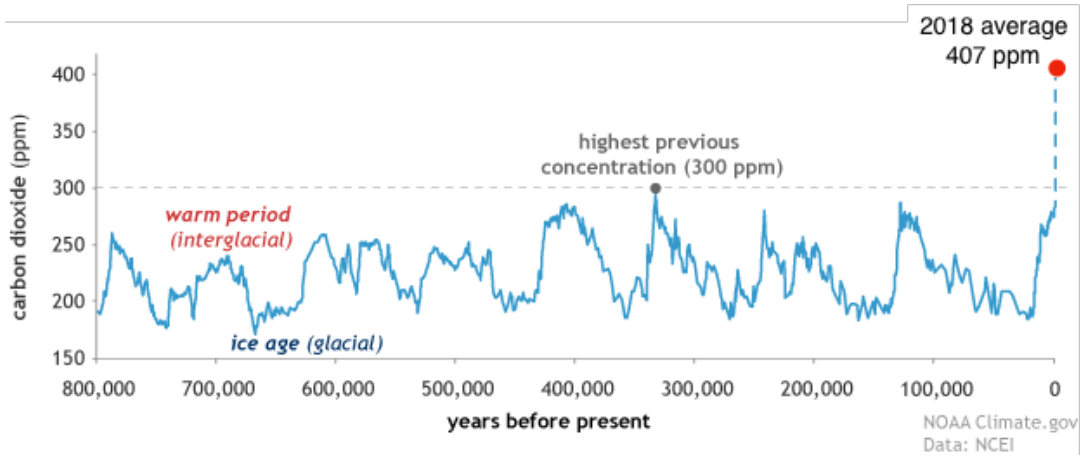
I. With The Commencement of The Industrial Revolution, Previously Stable Atmospheric Carbon Dioxide Levels Began Increasing, Causing Rising Atmospheric and Ocean Temperatures and Sea-Level Rise That Is Unprecedented In The History Of Human Civilization.

For most of the history of human civilization, the amount of CO_2 in the Earth's atmosphere remained in a stable range between 260 to 280 parts per million (ppm).[6] During the past 200 years, commencing with the Industrial Revolution (1720 to 1800 CE), increased combustion of fossil fuels, cement production, and deforestation[7] have raised the average concentration of CO_2 in the atmosphere to greater than 410 ppm[8] – higher than any time in at least 800,000 years (Figure 1).[9] Most critically, however, more than half of all industrial emissions of CO_2 have occurred since 1988.[10]

---

[6] Lourantou, A., et al., "Changes in Atmospheric CO_2 and Its Carbon Isotopic Ratio During the Penultimate Deglaciation," 29 *Quaternary Science Reviews* 1983 (2010).
[7] Le Quéré, C., et al., "Global Carbon Budget 2018," 10 *Earth System Science Data* (2018).
[8] Dlugokencky, E. & Tans, P., "Trends in Atmospheric Carbon Dioxide," NOAA/ESRL, www.esrl.noaa.gov/gmd/ccgg/trends/
[9] Masson-Delmotte, V., et al., "Information from Paleoclimate Archives," *Climate Change 2013*: *The Physical Science Basis,* Chap. 5 (2013).
[10] Frumhoff, P., et al., "The Climate Responsibilities of Industrial Carbon Producers," 132 *Climatic Change* 157 (2015).

Figure 1. Changes in atmospheric CO_2 concentrations over the last 800,000 years. Historic CO_2 levels are from ice core data, and current data are from the Mauna Loa Observatory. Average 2018 concentration indicated by red dot. Figure modified from NOAA.



Due primarily to the increased concentration of anthropogenic CO_2 from fossil fuel combustion, the mean surface temperature[11] of Earth has increased by 1 degree Celsius (1.8 degrees Fahrenheit) since the late nineteenth century.[12,13,14] One way to conceptualize the immense amount of heat that Earth is absorbing is to combine

---

[11] *Global mean surface temperature* is calculated by combining measurements from the air above land and the ocean surface.
[12] Hawkins, E., et al., "Estimating Changes in Global Temperature Since the Preindustrial Period," 98 *Bulletin of the American Meteorological Society* (9) (2017).
[13] Most of the same defendant corporations agreed to these facts at a "tutorial" before Judge William Alsup, in federal district court in the Northern District of California, in March 2018.
[14] Intergovernmental Panel on Climate Change, "Summary for Policymakers," *Global warming of 1.5°C* (2018).

measurements of ocean, land, atmosphere, and ice heating. Based on these data, over the last two decades Earth's climate system has been absorbing the heat equivalent, in joules, of detonating four Hiroshima atomic bombs per second, or nearly 400,000 Hiroshima A-bombs per day.[15,16]

If there is sustained greenhouse gas emissions growth, by the end of the century, global mean surface temperature is projected to increase between 3.6 to 5.8 degrees Celsius above pre-industrial temperature.[17] The last time global mean surface temperature was comparable to today[18,19], global mean sea-level was 20 to 30 feet higher than today.[20] Even under the most ambitious emissions reductions scenario, the

---

[15] Church, J. A., et al., "Revisiting the Earth's Sea-Level and Energy Budgets from 1961 to 2008," *Geophysical Research Letters*, 38(18), L18601 (2011).
[16] Nuccitelli, D., et al., "Comment on Ocean Heat Content and Earth's Radiation Imbalance II, Relation to Climate Shifts," 376 *Physics Letters A*, (45) (2012).
[17] Collins, M., et al., "Long-term Climate Change: Projections, Commitments and Irreversibility," *Climate Change 2013*: *The Physical Science Basis,* Chap. 12 (2013).
[18] The Last Interglacial, 130,000–115,000 years ago.
[19] Hoffman, J., et al., "Regional and Global Sea-Surface Temperatures During the Last Interglaciation," 355 *Science* 276 (2017).
[20] Dutton, A., et al., "Sea Level Rise Due to Polar Ice-Sheet Mass Loss During Past Warm Periods," 349 *Science,* 153 (2015).

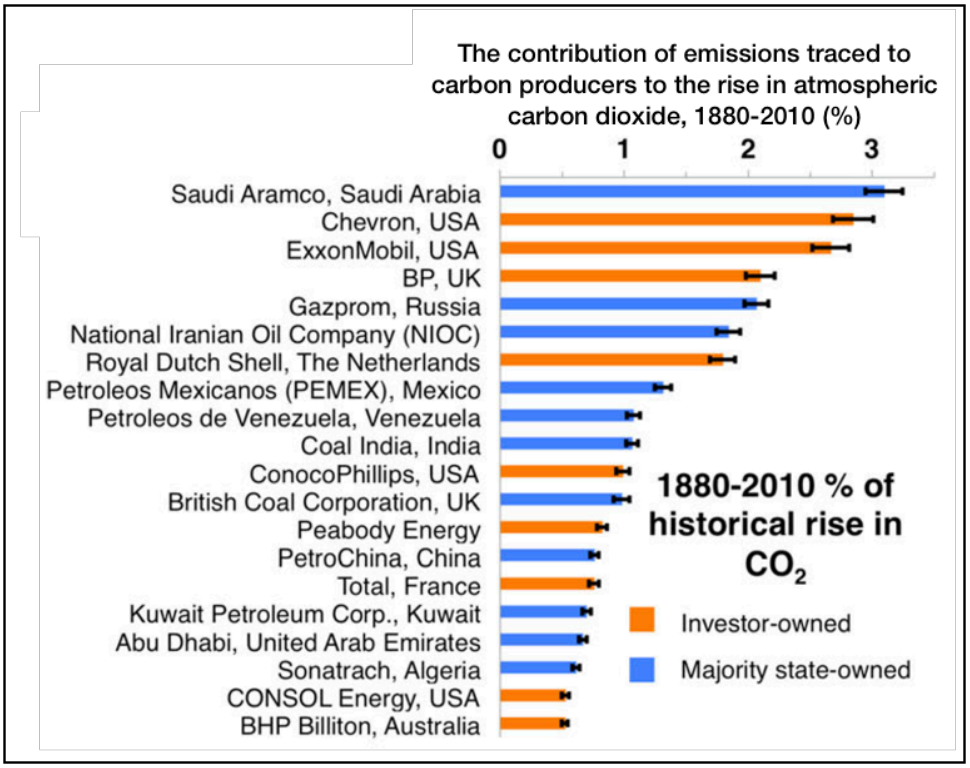
world's oceans will continue to rise as the climate system comes into balance with the roughly 50 percent increase in atmospheric CO_2 concentration since the dawn of the industrial revolution. Given the inevitability of sea-level rise and Honolulu's and Maui's vulnerability to sea-level rise of just one or two feet, there is no plausible emissions reduction scenario where these communities can avoid the substantial cost of adapting to and protecting itself from rising seas attributable primarily to the combustion of fossil fuels.

The portion of total CO_2 in the atmosphere attributable to each company's fossil fuel products is well established.[21] This work demonstrates that the emissions produced by the products of the 90 major carbon producers contributed 57 (±2.9) percent of the total increase in atmospheric CO_2 from 1880 through 2010 (Figure 2). Nearly half of that was attributable to the 20 largest entities. And nearly half of that was attributable to five of the Appellants in this case. Chevron was the 2nd largest CO_2 producer during that period. ExxonMobil is the 3rd largest, BP is the 4th largest, Shell ranks 7th and ConocoPhillips is

[21] Ekwurzel, B, et al., "The Rise in Global Atmospheric CO_2, Surface Temperature, and Sea Level from Emissions Traced to Major Carbon Producers," *Climatic Change*, 144(4) *Climate Change,* 579 (2017).

11th. These calculations prove that Appellants' fossil fuel products are a substantial factor in the injuries and damages that Honolulu and Maui have suffered and will continue to suffer for decades to come.

Figure 2. Top twenty investor- & state-owned entities and attributed CO_2 emissions. Emissions from these companies contributed about 27.2 (±2.9) percent of increase in cumulative atmospheric CO_2 between 1880 and 2010. Figure modified from: Ekwurzel, B., et al., *supra*, fn 21 .



II. Hawaii Is Facing Unavoidable, Costly, and Dangerous Impacts from Climate Change and Future Socio-Economic Viability Is At Risk.

The impacts of climate change fall disproportionately on vulnerable populations.[22] As an isolated, and remote group of islands without the capacity to exchange critical resources such as freshwater, food, or medical supplies with neighboring states, Hawaii is especially vulnerable to the impacts of climate change. Several major categories illustrate the breadth of risk to Hawaii: air, precipitation, land and ocean ecosystems, sea level rise, human communities, and food security.

A. Rising Air Temperature

In Hawaii, the rate of air temperature increase has accelerated in recent years.[23] At a rate of 0.17 degrees Celsius per decade, the air is warming four times faster than half a century ago.[24] Statewide, the average air temperature has risen by 0.42 degrees Celsius over the past

---

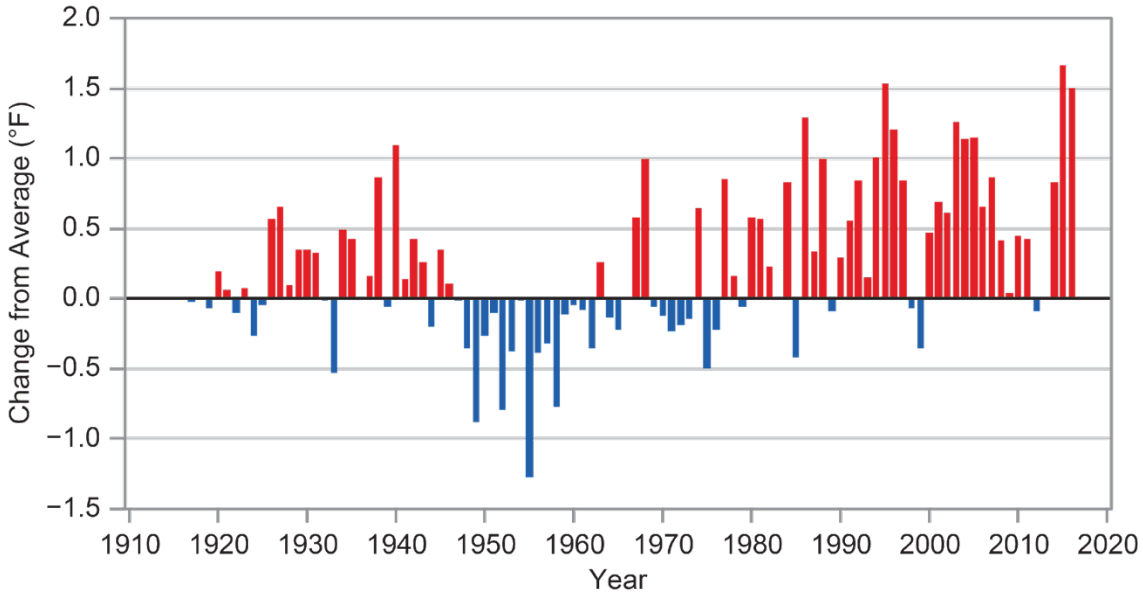
[22] UN World Social Report 2020, "Inequality in a Rapidly Changing World", www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/01/World-Social-Report-2020-FullReport.pdf

[23] Giambelluca, T.W., et al., "Secular Temperature Changes in Hawaii", 35 *Geophysical Research Letters*, L12702 (2008).

[24] Ibid.

100 years, and 2015 and 2016 were the warmest years on record (Figure 3).[25]

Figure 3. The difference in annual average temperature compared to the average from 1944 to 1980. Although both warming and cooling periods occurred, the average annual temperature change in Hawaii over the past century shows a statistically significant warming trend. Red bars-years with above average temperatures; Blue bars-years with below average temperatures. Keener, V., et al., "Hawaii and U.S.-Affiliated Pacific Islands", in *Impacts, Risks, and Adaptation in the United States*, Vol. II, *4th National Climate Assessment* (2018).



Rapidly increasing air temperature is detrimental to the delicate balance of Hawaii's ecosystems. Under sustained greenhouse gas

[25] McKenzie, M.M., "Regional Temperature Trends in Hawaii: A Century of Change", (MS thesis), Dept. of Geog., University of Hawaii at Mānoa (1916-2015).

emissions, high elevations (above 3000 meters) are projected to warm an additional 4 to 5 degrees Celsius by the late 21st century.[26] This increases thermal stress on native flora and fauna, sets the stage for increased wildfire, threatens human health, and impedes precipitation (the source of Hawaii's freshwater).[27]

As air temperature rises, the impact of El Niño events grows. During the strong El Niño of 2015, where Honolulu set 11 days of record heat,[28] the local energy utility was compelled to issue emergency public service announcements asking residents and businesses to curtail escalating air conditioning use that stressed the electrical grid.[29] El Niño years affect Hawaii specifically by hosting record-breaking hot

---

[26] Timm, O.E., "Future Warming Rates Over the Hawaiian Islands Based on Elevation-Dependent Scaling Factors", 37 *Int. J. Clim.* 1093, doi:10.1002/joc.5065 (2017).
[27] University of Hawaii Sea Grant College Program, "Climate Change Impacts in Hawaii - A Summary of Climate Change and Impacts to Ecosystems and Communities", *UNIHI-SEAGRANT-TT-12-04*, (2014).
[28] New York Times, www.nytimes.com/interactive/2016/02/19/us/ 2015-year-in-weather-temperature-precipitation.html# honolulu_hi.
[29] *Hawaiian News Now,* www.hawaiinewsnow.com/story/26551141/ hawaiian-electric-asks-oahu-customers-to-conserve-power-tonight.

days, intense rains, windless days, active hurricane seasons, and spikes in sea surface temperatures.[30]

Climate models project that there will be increasing frequency and strength of El Niño and La Niña events as a result of continued warming in the 21st Century.[31] Strong El Niño events are associated with extreme rainfall and flooding, drought, high heat, extreme tides, active hurricane seasons, high sea surface temperatures and coral bleaching, extraordinary high waves on North-facing shores, and compound events such as intense rain at high tide which lead to urban flooding. Models project a near doubling in the frequency of future extreme La Niña events, from one in every 23 years to once in every 13 years.[32] Approximately 75 percent of the increase occurs in years following extreme El Niño events, thus projecting more frequent swings between opposite extremes from one year to the next.

---

[30] Keener, V., et al., "Hawaii and U.S.-Affiliated Pacific Islands" in *Impacts, Risks, and Adaptation in the United States:* Vol. II, *4th National Climate Assessment* (2018).
[31] Cai, W., et al., "Inc. Freq. of Extreme La Niña Events Induced By Greenhouse Warming", *Nature Climate Change*, 5, doi: 10.1038/nclimate2492 (2015).
[32] *Id.*

B. Precipitation

Precipitation patterns are being disturbed in Hawaii due to climate change. Hawaii has seen an overall decline in rainfall (Figure 4) over the past 30 years, with a particularly dry period from 2008 to now.[33] Consecutive wet days and consecutive dry days are both increasing in Hawaii.[34] The heavy rainfall and drought periods have intensified, increasing runoff, erosion, flooding, and water shortages.[35] This disruption is detrimental to freshwater availability. This has also depleted stream flow in Hawaii, which results in declining groundwater levels. Oahu's water supply is mainly derived from groundwater.[36] Chronic water shortages are also a possibility as rainfall decreases and the water requirements of a growing human population increase. Across

[33] Bassiouni, M., and D.S. Oki., "Trends and Shifts in Stream Flow in Hawaii", *Hydrological Processes* 27(10) (2013).
[34] Kruk, M.C., et al., *supra*, fn 38 (2015)
[35] Ibid.
[36] Oki, D. S., et al., "Ground Water Atlas of the United States", Segment 13, Alaska, Hawaii, Puerto Rico, and the U.S. Virgin Islands, *U.S. Geological Survey* (1999).

the state of Hawaii, extreme precipitation events are more frequent in La Nina years and less frequent in El Nino years[37].

Average daily wind speeds are declining as well. Winds have declined in Honolulu and Hilo while remaining steady across Western and South Pacific sites.[38] Already, trade winds interact with ridgelines in ways that produce less cloud cover and less rainfall, resulting in reduced water supply and higher water demand.[39]

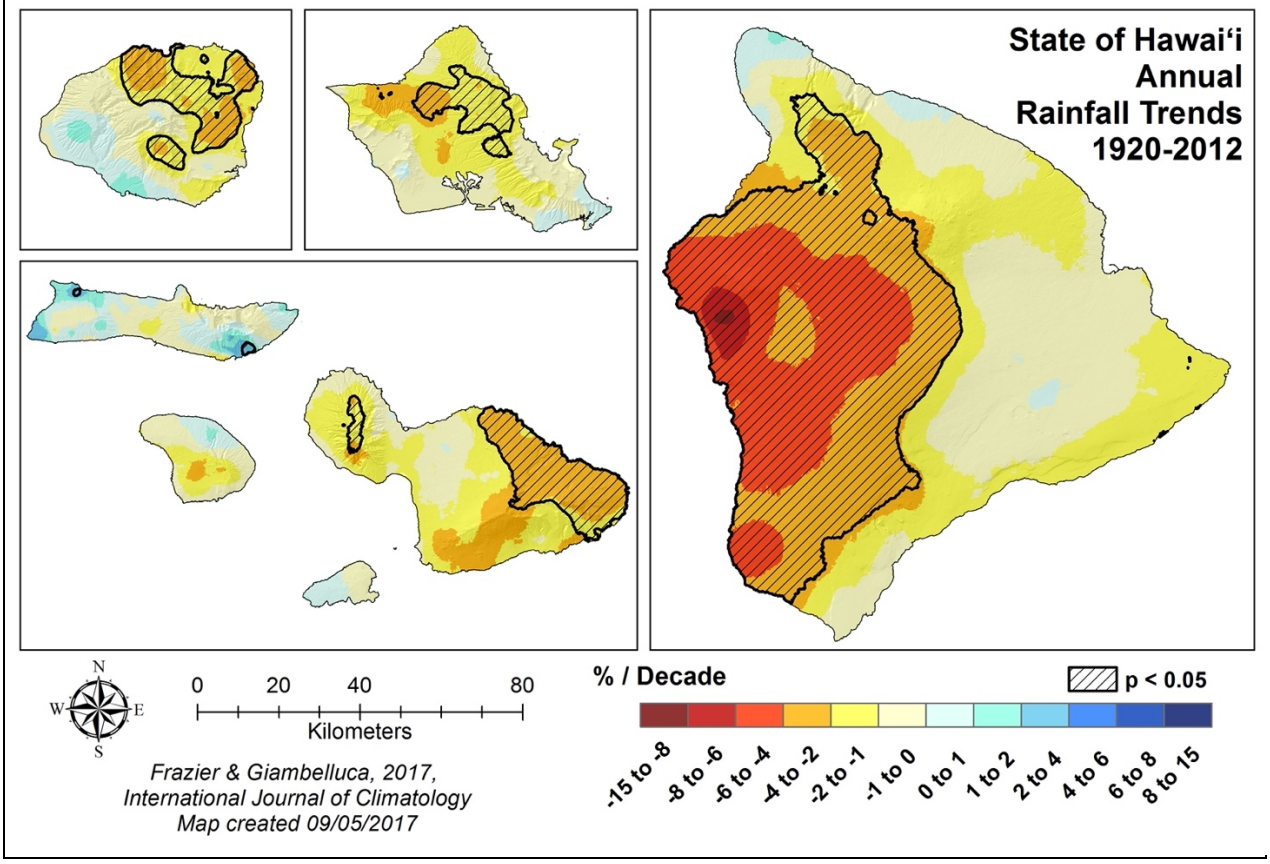
---

[37] Chen, Y. R., P.-S. Chu, "Trends in Precipitation Extremes and Return Levels in the Hawaiian Islands Under a Changing Climate", *Int. J. Climatol*, 34 (2014).

[38] Marra, J.J. & Kruk, M.C., "State of Environmental Conditions in Hawaii and the U.S. Affiliated Pacific Islands Under a Changing Climate", www.coralreefwatch.noaa.gov/satellite/publications/state_of_the_environment_2017_hawaii-usapi_noaa-nesdis-ncei_oct2017.pdf (2017).

[39] Kruk, M.C., et al., "On the State of the Knowledge of Rainfall Extremes in the Western and Northern Pacific Basin", 35 *Int. J. Climatol,* (3) (2015).

Figure 4. Changes in annual rainfall (percent per decade) from 1920 to 2012. Statistically significant trends are indicated with black hatching. Almost the entire state has seen rainfall decrease since 1920. The sharpest downward trends are found on the western part of Hawaii Island. On other islands, significant decreases have occurred in the wetter areas. The majority of O'ahu has seen a decrease in rainfall. Giambelluca, T.W., et al., "Online Rainfall Atlas of Hawaii", 94 *Bull. Amer. Meteor. Society* 154, doi: 10.1175/BAMS-D-ll-00228.1 (2013).



C. Land Ecosystems

Hawaii's abundant flora and fauna are particularly susceptible to the harmful effects of climate change. Hawaii is home to 31 percent of the nation's plants and animals listed and threatened or endangered,

and less than half of the landscape on the islands is still dominated by native plants.[40] Natural ecosystems are the key to aquifer recharge. Indigenous vegetation that captures cloud water is responsible for nearly 40 percent of groundwater recharge.[41] Studies indicate that endemic and endangered birds and plants are highly vulnerable to climate change and are already displaying shifting habitats.[42] Increases in the frequency of events such as wildfires, tropical cyclones, drought periods, hurricanes – all exacerbated by climate change – threaten the balance of Hawaii's delicate ecosystems. Even moderate warming will cause 10 of 21 existing native forest bird species to lose over 50 percent of their range by the year 2100.[43] Three others are projected to lose more than 90 percent of their range which characterizes them as a high concern for extinction. Warmer temperatures also bring mosquito-borne

---

[40] Conry, P. J., and R. Cannarella, "Hawaii Statewide Assessment of Forest Conditions and Resource Strategy", *Hawaii Department of Land and Natural Resources/Division of Forestry and Wildlife*, Honolulu, HI (2010).
[41] Giambelluca, T.W., et al., "Online Rainfall Atlas of Hawaii", 94 *Bull. Amer. Meteor. Soc.*, 154, doi: 10.1175/BAMS-D-11-00228.1 (2013).
[42] Jacobi, J.D., et al., "Baseline Land Cover", *USGS*, http://pubs.er.usgs.gov/publication/pp1834 (2017).
[43] Fortini, L., et al., "Large-Scale Range Collapse of HI Forest Birds Under CC and the Need for 21st-Century Conservation Options", 20 *PLoS ONE* (2015).

diseases to previously safe upland forests which further drives native bird species towards extinction.[44]

D. Ocean Ecosystems

Because of climate change, the oceans are becoming warmer and more acidic.[45] Over 90 percent of the heat trapped by greenhouse gases since the 1970's has been absorbed by the oceans and today the oceans absorb heat at twice the rate they did in the 1990s.[46] Globally averaged, sea surface temperatures have already increased by 1.0 degree Celsius over the past 100 years, with half of this rise occurring during the 1990s.[47]

A marine heatwave developed in the waters around Hawaii in 2019, the warmest year for global ocean water temperatures on

---

[44] Paxton, E.H., et al., "Collapsing Avian Community on a Hawaiian Island", 2 *Science Advances* 9 (2016).
[45] Barton, A., et al., "The Pacific Oyster, Crassostrea Gigas, Shows Negative Correlation to Naturally Elevated Carbon Dioxide Levels: Implications for Near-Term Ocean Acidification Effects", *Limnology and Oceanography* 57(3) (2012).
[46] Cheng L., et al., "Global Upper Ocean Heat Content Estimation: Recent Progress and the Remaining Challenges", *Atmospheric and Oceanic Science Letters*, 8, doi:10.3878/AOSL20150031 (2015).
[47] Marra and Kruk, *supra*, fn 38 (2017)

record.[48] Heat records were set across Hawaii and by October 2019, Honolulu had recorded 45 days of record high temperature, including 29 days from June to August, equal to more than two record highs per week.[49] Beginning August 10, Honolulu hit 32.2 degrees Celsius each of the next 37 days. Nighttime lows also set records. From 1950 to 2018, only 14 nights failed to drop below 26.6 degrees Celsius; 2019 featured 19 such nights. 2019 saw the 1st, 2nd, and 3rd hottest calendar days on record in Honolulu. Honolulu hit 35 degrees Celsius on the final day of August, a record for hottest August temperature in a century, and tied the record for hottest year-round temperature.

Of four long-running weather monitoring stations in Hawaii, three saw their warmest summer on record. Only the station in Hilo did not. In Lihue, Aug 24 to Sept 12 set daily heat records. In July, Aug, and Sept, 48 days set record highs, 44 nights set record high lows, and zero

---

[48] Amaya, D.J., et al., "Physical Drivers of the Summer 2019 North Pacific Marine Heatwave", *Nature Communications*; 11, doi: 10.1038/s41467-020-15820 (2020).

[49] Washington Post, "Hawaii Goes 20 days in a Row Setting a Heat Record During Its Hottest Summer Ever", https://www.pennlive.com/nation-world/2019/09/hawaii-goes-20-days-in-a-row-setting-a-heat-record-during-its-hottest-summer-ever.html (2019).

days or nights set record lows. Over 300 records were tied or broken in 2019. Only 5 of these were for record lows, revealing a strong warming shift in median temperature across Hawaii. The cause of this extraordinary summer was a record-setting marine heat wave, the result of weak atmospheric circulation that produced very calm wind patterns.[50]

Sea surface temperature increase has also intensified in areas of tropical cyclone genesis relevant to Hawaii suggesting a connection with strengthened storminess.[51] Increased heat and evaporation contribute to a more extreme hydrological cycle and more extreme weather, in particular hurricanes. More frequent tropical cyclones are also projected for waters near Hawaii because of the new tracks that storms will likely follow as a result of climate change[52].

In addition to warming, the accumulation of CO_2 in the atmosphere causes the ocean to become more acidic because of the

---

[50] *Ibid.*
[51] Defforge, C.L., Merlis, T.M., "Observed Warming Trend in Sea Surface Temperature at Tropical Cyclone Genesis", *Geophys. Res. Lett.*, 44, doi: 10.1002/2016GL071045 (2017).
[52] Murakami, H., et al., "Projected Increase in Tropical Cyclones Near Hawaii", 3 *Nature Climate Change*, 749 August (2013).

chemical reaction that occurs when water bonds with CO_2. Data collected from station ALOHA regarding marine pH levels shows an 8.7 percent increase in ocean acidity over the past 30 years.[53] Ocean acidification interferes with the natural processes of marine organisms and ecosystems. It reduces the ability of marine organisms to build shells and other hard structures.[54] It also contributes to coral bleaching: an event that turns entire coral reefs white and more vulnerable to mortality.[55]

Extended periods of coral bleaching first occurred in Hawaii in 2014 as part of an extended three-year global-scale bleaching event, the longest on record. The number of coral reefs in Hawaii impacted by bleaching has tripled from 1985 to 2012.[56] Globally, ocean warming and acidification are projected to cause annual bleaching on over 98 percent of reefs by 2050.[57] This will not only devastate reef systems and the marine life that depends on them, but it will threaten human

---

[53] Marra and Kruk, *supra*, fn 38 (2017)
[54] *Ibid.*
[55] *Ibid.*
[56] van Hooidonk, R., et al., "Opposite Latitudinal Gradients in Projected Ocean Acidification and Bleaching Impacts on Coral Reefs", 20 *Glob Change Biol*, 103, www.doi.org/10.1111/gcb.12394 (2014).
[57] *Ibid.*

communities and economies that depend on a healthy ocean. Reef collapse leads to lower fisheries yields and loss of coastal protection and habitat.[58] Experts estimate that it will take marine ecosystems thousands of years to recover from these climate-related upheavals.[59] Scientists have concluded that when seas are hot enough for a sustained amount of time, nothing can protect coral reefs. The only hope for securing a future for coral reefs is urgent and rapid action to reduce global warming.[60]

E. Sea Level Rise

Climate change is also contributing to a rising sea level to which Hawaii is particularly vulnerable. The frequency of high tide flooding in Honolulu has increased from 6 to 11 days per year since the 1960s.[61] Due to global gravitational effects, estimates of future sea level rise in Hawaii and other Pacific islands are about 20 to 30 percent higher than

---

[58] Yates, K. K., et al., "Divergence of Seafloor Elevation and Sea Level Rise in Coral Reef Ecosystems", 14 *Biogeosciences* 1739, https://doi.org/10.5194/bg-14-1739-2017 (2017).
[59] S.E. Moffitt, et al., "Response of Seafloor Ecosystems to Abrupt Global Climate Change", 112(15) *PNAS 4684*, doi: 10.1073/pnas.1417130112 (2015).
[60] Hughes, T.P., et al., "Global Warming and Recurrent Mass Bleaching of Corals", 543 *Nature*, 373, doi: 10.1038/nature21707 (2017).
[61] Marra and Kruk, *supra*, fn 38.

the global mean.[62] With a projected 0.98 meters of sea level rise, 25,800 acres will experience chronic flooding, erosion, and/or high wave impacts.[63] One-third of this land is designated for urban use, and impacts include more than $19 billion in assets.[64] Currently, over 70 percent of beaches in Hawaii are in a state of chronic erosion[65] due to long term sea level rise[66] and coastal hardening.[67] This has caused a combined loss of 24.1 kilometers (9 percent) of sandy beaches on Kaua‘i, O‘ahu, and Maui.[68] The Hawaii Department of Transportation estimates that with a 1 meter of sea level rise 10 to 15 percent of the

---

[62] Sweet, W.V., et al., “Global and Regional Sea Level Rise Scenarios for the United States”, *NOAA Technical Report,* NOS CO-OPS 083, *NOAA/NOS Center for Operational Oceanographic Products and Services* (2017).

[63] Hawaii Climate Change Mitigation and Adaptation Commission, "Hawaii Sea Level Rise Vulnerability and Adaptation Report”, prepared by *Tetra Tech, Inc. and the State of Hawaii Depart. Land Nat. Res, OCCL,* (2017).

[64] *Ibid.*

[65] Fletcher, C.H., et al., “National Assessment of Shoreline Change: Historical Shoreline Change in the Hawaiian Islands”, *U. S. Geo. Survey Open File Rep., 2011-1051* (2012).

[66] Romine, B.M., et al., “Are Beach Erosion Rates and Sea-Level Rise Related in Hawaii?”, 108 *Global and Planetary Change*, 149 (2013).

[67] Romine, B.M. and Fletcher, C.H., “Armoring On Eroding Coasts Leads to Beach Narrowing and Loss on O‘ahu, HI" in Pilkey et al., *Pitfalls of Shoreline Stabilization*, Chap. 10 (2012).

[68] Fletcher, et al., s*upra*, fn 65.

state's highway system would be affected.[69] A total $15 billion of coastal roadway is threatened under a scenario of 1 meter of sea level rise. This figure assumes the state will need $7.5 million for every mile of highway road that must either be raised, pushed back, or relocated entirely to escape erosion and flooding in the next 50 to 100 years — and $40 million for every mile of bridge.[70]

In Hawaii, there are no mitigation measures against groundwater inundation because of the heavily karstified limestone that underlays the dense urban communities of Waikiki, Kakaako, Iwilei and others. Studies show that groundwater inundation is the earliest and heaviest flood hazard caused by sea level rise and here is no way to stop it. This means that with only 2 to 4 feet of additional sea level rise the water table will turn these areas into polluted urban wetlands against which there is no defense as seawalls, pumping, and other engineering steps cannot stop this phenomenon.[71]

---

[69] *Hawaii Department of Transportation*, www.hawaii.gov/wp-content/uploads/2019/10/20190830-Statewide-Hazard-Mitigation-Forum.pdf (2019).
[70] "Civil Beat, A $15 Billion Price Tag to Protect Hawaii Highways From Climate Change", www.civilbeat.org/2018/04/a-15-billion-price-tag-to-protect-hawaii-highways-from-climate-change/ (2018).
[71] Habel, Fletcher, C., et al., *supra*, fn 90.

F. Human Communities

Indigenous populations will be disproportionately impacted by climate change due to their reliance on natural resources and the land for sustenance.[72] About 550 Hawaiian cultural sites are exposed to chronic flooding with a sea level rise of 0.98 meters.[73] Sea level rise impacts fishpond maintenance, cultivation of salt, crop cultivation, and gathering from nearshore fisheries: all traditional and culturally significant practices.[74] Detachment from traditional land and practice interferes with indigenous ways of living and harms both the spiritual and mental health of the people.[75] Climate change impacts such as reduced streamflow, sea level rise, ocean acidification, saltwater

---

[72] Yeo, Sophie, "5 Ways CC Harms Indigenous People", *Climate Home News*, www.climatechangenews.com/2014/07/28/five-ways-climate-change-harms-indigenous-people/ (2014).
[73] Hawaii Climate Change Mitigation and Adaptation Commission, *supra*, fn 63.
[74] Sproat, D. K., "An Indigenous People's Right to Environmental Self-Determination: Native Hawaiians and the Struggle Against Climate Change Devastation", 35 Stanford Environmental L. J. 157 (2016).
[75] Akutagawa, M., et al., "Health Impact Assessment of the Proposed Mo'omomi Community-Based Subsistence Fishing Area", *The Kohala Center* (2016).

intrusion, and long periods of drought all interfere with the livelihood and security of Pacific communities.[76]

Studies have documented significant and harmful effects on the Native Hawaiian community and their traditional and customary rights and practices.[77] Climate change impacts on Native Hawaiians can be categorized in three general ways: impacts on upland forests; impacts on traditional agriculture; and impacts on coastal and nearshore waters.[78]

Hawaiians considered the uplands the realm of the gods, or "wao akua," due to its importance in the ecosystem and for being a source of physical and spiritual nourishment.[79] With the rapid decline of Hawaii's

---

[76] Gillett, R., et al., "Tuna: A Key Economic Resource in the Pacific Islands", *Pacific Studies Series*, *Manila, Philippines: Asian Development Bank* (2001).

[77] *See generally* D. Kapua'ala Sproat, *An Indigenous People's Right to Environmental Self-Determination: Native Hawaiians and the Struggle against Climate Change Devastation*, 35 Stanford Environmental L. J. 157 (2016) (discussing Native Hawaiian responses to the impacts of climate change and how native peoples claim and realize an indigenous right to environmental self-determination).

[78] *Id.* at 172-78.

[79] *Id.* at 174. "Forests are a vital system for the continuum of life cycles in Hawaii, capturing fresh water in the form of mist and rain, and absorbing and releasing it into streams and aquifers78 which eventually feed nearshore marine areas, the ocean, and communities.

native forests, Hawaii's native species have also perished and this "both limits the perpetuation of cultural knowledge across generations and severs the connection between [Hawaiians] and natural and cultural resources."[80] Hawaiian practices in the upland that will be affected by climate change also include the collection of timber and medicinal plants, and collection related to traditional hula.[81] Although cultural practitioners continue to collect these materials, "it is now difficult to find the necessary resources."[82]

In the "wao kanaka," or the realm of man, traditional Hawaiian agriculture practices are at high risk of becoming unsustainable in the future due to climate change.[83] Changing rainfall, diminished

---

Trees house the seeds necessary for regeneration, acting as a food source for insects, birds, animals, and others." *Id.*

[80] *Id.* at 174 (discussing the loss of Hawaii's endemic birds).

[81] *Id.* at 175. "Healthy forests are essential to the perpetuation of this sacred art that has preserved history through oral tradition since ancient times and holds invaluable significance in contemporary Hawaii." *Id.*

[82] *Id.*

[83] *Id.* at 176-677. "Sea level rise will further aggravate this problem by reducing the area available for farming and increasing the salinity of groundwater resources, which provide more than 90 percent of drinking water and about half of the water used for agricultural irrigation on O'ahu, where nearly 70 percent of Hawaii's population currently resides." *Id.* at 177.

streamflow, rising temperatures, and rising sea levels causing saltwater intrusion threaten Hawaiian farming practices and food security.[84]

Climate change also poses significant risk of disrupting or preventing numerous traditional and customary Hawaiian practices at the coastline and in nearshore areas on Oahu and Maui.[85] Climate change has the potential to impact the practice of burying and the already buried Hawaiian remains in soft sand dunes,[86] cultivating and

---

[84] *Id.* "Maoli communities relied and continue to rely on streams and springs to satisfy many needs, primarily for distributing flow sufficient to cultivate the staple crop kalo and to gather native stream life." *Id.* at 177-78.

[85] *Id.* at 178.

[86] "Coastal erosion and rapid sea level rise threaten the cultural practice of burying ʻiwi kilpuna (ancestral bones) along Hawaii's shores, which prevents the ʻuhane (spirit) from joining the ʻaumākua (family or personal gods; deified ancestors) in eternity, causing injury and spiritual trauma to both the deceased and living descendants." *Id.* at 179.

collecting sea salt, gathering marine life, using and maintaining fishponds,[87] fishing, and paddling and sailing in the open ocean.[88]

CONCLUSION

There is no longer any doubt that human influence has warmed the atmosphere, ocean, and land.[89] Hawaii is one of the world's most vulnerable locations. Even under the most ambitious emissions reductions scenario, the world's oceans will continue to rise as the climate system comes into balance with the increase in atmospheric CO_2 concentration caused by anthropogenic combustion of fossil fuels. Studies show that with less than 1 meter of sea level rise Hawaii is

---

[87] "Ancient Hawaiian fishponds are another ecologically and culturally significant resource that are vulnerable to climate change's impacts, including sea level rise, increasing surface water runoff, and saltwater intrusion into springs. These changes are interrupting the delicate balance between salt and fresh water as well as the indigenous management system that fishpond practitioners carefully designed." *Id.* at 180; *See also* Dillon Ancheta, "As Climate Change Takes Shape Fears Over Its Threat to Cultural Resources Grow", *Hawaii News Now* (Aug. 28, 2017) .

[88] Miles, A., "If We Get Food Right, We Get Everything Right: Rethinking the Food System in Post-COVID-19, Hawaii, Position Paper", wwwhdl.handle.net/10790/5248 (2020).

[89] Intergovernmental Panel on Climate Change, "Summary for Policymakers", *Climate Change 2021: The Physical Science Basis* (2021).

exposed to severe flooding,[90] environmental loss,[91] and economic damage.[92] There is no plausible emissions reduction scenario where Hawaii can avoid the substantial cost of adapting to and protecting itself from rising seas, declining rainfall, increased exposure to tropical cyclones, expanding drought, record-setting heat, and marine devastation that result from the combustion of fossil fuels, including the Appellants' products.[93]

In sum, we know that the present damage and future risk to coastal communities such as Hawaii posed by rising sea levels, declining rainfall, expanding drought, increased risk of landfalling tropical cyclones, flooding, environmental loss, threats to fundamental

---

[90] Habel, S., Fletcher, C., Anderson, T., & Thompson, P., "Sea-Level Rise Induced Multi-Mechanism Flooding and Contribution to Urban Infrastructure Failure", 10 *Nature Scientific Reports* (2020).
[91] Tavares, K., Fletcher, C.H. & Anderson, T.R., "Risk of Shoreline Hardening and Associated Beach Loss Peaks Before Mid-Century: O'ahu, Hawaii", 10 *Nature Scientific Reports*, 13633, doi: :10.1038/s41598-020-70577-y (2020).
[92] Anderson, T., Fletcher, C., Barbee, M., Romine, B., & Lemmo, J., "Modeling Multiple Sea Level Rise Stresses Reveals Up to Twice the Land at Risk Compared to Strictly Passive Flooding Methods", *Nature Scientific Reports*, 8, doi: 10.1038/s41598-018-32658-x (2018).
[93] Heede, R., "Update Carbon Majors 1965-2018", *Climate Accountability Institute* Press Release, www.climateaccountability.org/pdf/ CAI%20PressRelease%20Dec20.pdf (Dec. 9, 2020).

indigenous identity, and food and water impacts that put in question the long-term viability of the Hawaiian Islands as a socio-economic entity, is caused by global warming and related impacts. We know that the Appellants' production and marketing of fossil fuels is the primary cause of that global warming. We can prove what portion of global CO_2 emissions are associated with each of their products and can attribute some portion of global warming impacts to these products. All of these matters can be proven at trial through the introduction of evidence in the form of well-established scientific facts.

We therefore urge the Court to affirm remand of this case to state court for further pretrial proceedings and trial.

Respectfully submitted,

By /s/ *William A. Rossbach*
William A. Rossbach
ROSSBACH LAW, P.C.
401 N. Washington Street
P. O. Box 8988
Missoula, MT 59807
Tel: (406) 543-5156
Fax: (406) 728-8878

Attorney for Amicus Curiae

CERTIFICATE OF SERVICE

I hereby certify that I caused the foregoing to be electronically field with the Clerk of the Court for the United States Court of Appeals for the Ninth Circuit by using the appellate CM/ECF system on September 24, 2021.

I certify that all participants in the case are registered CM/ECF users and that service will be accomplished by the appellate CM/ECF system.

/s/ *William A. Rossbach*
William A. Rossbach

CERTIFICATE OF COMPLIANCE

Pursuant to Federal Rule of Appellate Procedure 29(a)(4)(g), I certify that:

This Brief complies with Rule 29(a)(5)'s type-volume limitation, because it contains 5,875 words as determined by the Microsoft Word 2016 word-processing system used to prepare the brief, excluding the parts of the brief exempted by Rule 32(a)(7)(B)(iii).

This Brief complies with Rule 32(a)(5)'s typeface requirements, and Rule 32(a)(6)'s type-style requirements because it has been prepared in a proportionately spaced typeface using the 2016 version of Microsoft Word in 14-point Century Schoolbook font.

/s/ *William A. Rossbach*
William A. Rossbach