

General Comments from Mark E. Odegard a member of the now defunct

“MADISON RIVER NEGOTIATED RULEMAKING COMMITTEE”

During our meetings it became clearer to me that there was not enough evidence that the rather harsh rules that were suggested in the 19 April 2018 “DRAFT RECREATION MANAGEMENT PLAN - ENVIRONMENTAL ASSESSMENT” needed to be implemented. This was also brought out during our evaluation of the various alternatives. Most of the alternative “consequences” used in the evaluation were related to the effect on users of the River. The “Status Quo” scored in the same range as the best alternative as shown in Figure 1. **This says that doing nothing at this time is as good as anything else.**

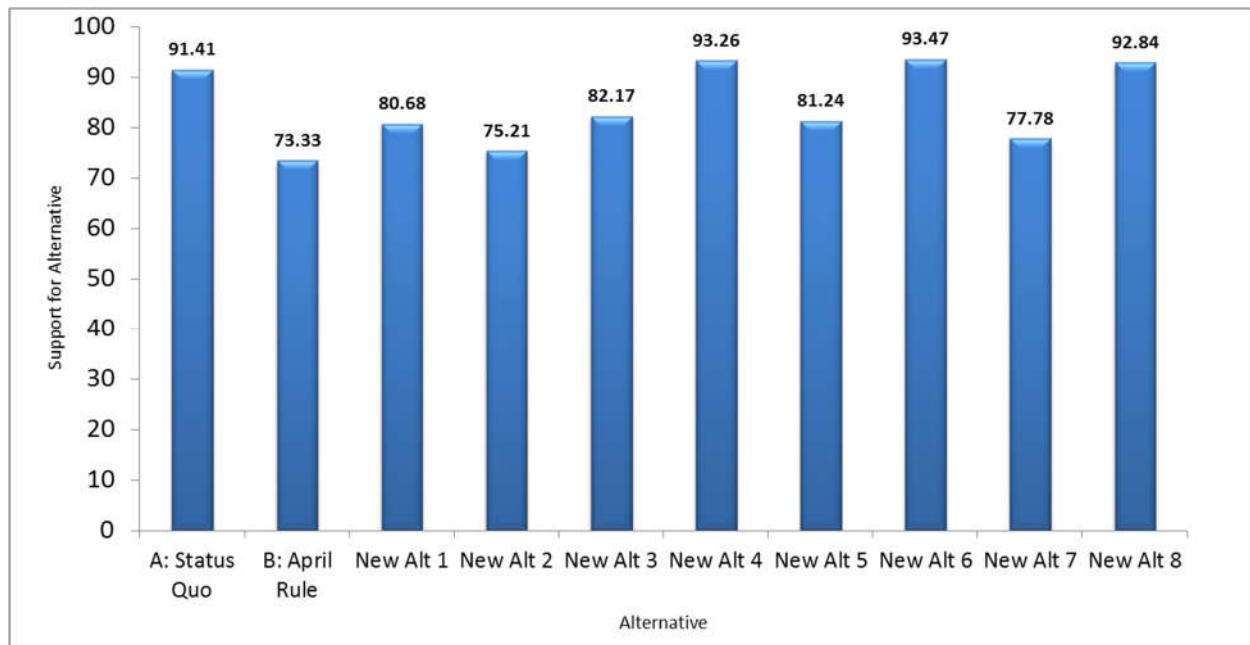


Figure 1: Scores of the various alternatives based on the consequences estimated by the group, the SDM decision analysis resulted in the following rankings of support for the alternatives. Higher scores indicate the alternative is predicted to do a better job at achieving objectives

Fishery

In addition, the Administrative Rule of Montana (ARM) 12.11.410 (1), shown below, states that the primary concerns for management of the River are basically the preservation of naturally occurring resources, with the highest priority that of the quality of the fishery. **From the data that we were given the fishery appears to be in good shape and does not indicate degradation at this time.** Items (2) and (3) offer some, non-quantitative guidelines, but the need does not seem

necessary. **This is because the current quantity of recreational use has not affected the fishery or other factors as yet.**

12.11.410 RIVER RECREATION MANAGEMENT PLANS AND RULES GENERALLY

- (1) The highest priority of a management plan is providing protection for the following resources:
 - (a) the quality of the fisheries;
 - (b) wildlife;
 - (c) water;
 - (d) riparian habitat; and
 - (e) other natural resources in or along the river.
- (2) Management plans or rules must not allow unlimited recreation to compromise long-term conservation.
- (3) Management plans and rules must maintain a balance between quality of experience and unlimited quantity of experience.

Experience

We were also presented the “Angler Satisfaction, Demographic, and Creel Surveys-Upper Madison River, 2015 – 2017” data showing some significant dissatisfaction primarily with the resident float fishermen and primarily in the mail survey. In my experience, having fished many of the western rivers, and having some experience with surveys, I make these comments:

- (1) Mail surveys are typically a problem in that dissatisfied people are more disposed to returning the surveys since they are dissatisfied. People with a satisfied or neutral experience do not have as much incentive to return a survey. There are some methods to mitigate these differences, but I don’t know if any were employed.
- (2) Having experienced near “Shoulder to Shoulder” fishing on rivers such as the Columbia and the Klamath in California, the limited crowding I see on the Madison is minimal in comparison. I too would like the number of fishermen to be at the same level as I fished with in the 1950’s but that is impossible. **I think the Madison fishing experience should be extended to as many as possible. I am not a “I’ve got mine, you can’t have yours” person.**

One thing I pointed out during the presentation on this is that anglers were only classified as “resident” or “non-resident”. Many people who live in the Ennis area and fish the River own land and dwellings but are part-time residents. These people, and land owners also have a vested interest in the health of the River. We have found in our Zoning Commission meetings that they make contributions, sometimes more than full-time residents. **This distinction should be included in future surveys.**

Economics and Business Development

As was pointed out in many comments at the end of our meetings, the management of the River will have a significant effect on towns and businesses along the River, and on those nearby as well. In reading the environmental assessment, no quantitative data was presented. There were

statements that “FWP predicts”, but no details on how the predictions were determined, or on how any “prediction” was arrived at.

The main conclusion was that any management plan would not affect the overall economy of the State. **To me this says that the effect on local economies of Ennis, West Yellowstone, Three Forks, and all the small businesses along the River is not important.**

The big problem with implementing a management plan quickly is the effect on current business planning in the River area. Developments are proceeding that assume there will be continued economic growth. These developments have already committed significant time and money. Any short-term implementation of a management plan would have severe consequences. **Any plan should be announced well ahead of implementation and/or phased in over a significant period of time.**

Commercial Float Fishing

The path favored by the MRCAC, FWP and the Commission to manage use of the River was to limit the number of guided, commercial float trips. I just do not understand the logic in this. The only effects will be a small limitation on the total number of angler days and the number recreational user days. It will not limit growth in the number of non-commercial float trips. And it will not limit the total number of anglers and recreational River users.

From my experience with other rivers, the only way to limit the total number of user days is with a permit plan. This, of course, is politically a problem, but will become necessary with time. **Any limitations should affect all user groups. I have great reservations about any plan that would target a single group simply because that is the easiest thing to do.**

Areas of Interest

I have included below, comments on two of the reaches of the River. These utilize an integrated ArcGIS project that I developed to help me understand the River system. It's the kind of work I do professionally for the oil, mining and environmental industries. In doing this I have found, as usual, inconsistencies in available data. There are also new questions that have come up. **I will probably keep on working on this as my schedule allows including doing some survey QA/QC.**

Comments on the Future of the Madison River

The two main and existential threats to the health of the River are (1) increase population in area of the Madison River, (2) a warming of the river, and (3) early, rapid melting of the snow-pack which will reduce summer and early fall flows to a dangerous level.

The second two threats are a result of global warming/climate change. The first threat is already occurring and will be exacerbated by climate change. Eventually normal population growth will be overwhelmed by climate migration, which is already beginning to occur.

I have included a PowerPoint presentation on global warming which I originally developed for use by the Ennis Zoning Commission because of the effects of population growth. I have modified parts of it dealing with the Madison River.

My, and others, main conclusion is that global warming to a temperature far above what we had hoped to limit it is now inevitable and will have a severe environmental impact.

I have been worrying about and following global warming, which is part of Earth sciences, since the late 60's. Much of what we know was known or suspected by then and in the 70's. Modeling has been developed which has led to quantitative predictability. I have carried these predictions a little further than most investigators who are generally afraid that the consequences will be to horrific and will not be believed. This could lead to loss of tenure in an academic setting or to the problems that the EPA has been subjected to. I am not constrained by these problems. My scientific reputation is secure.

At the end of these comments is also a non-color print out of the PPT with added comments. These comments include references of interest.

What to DO?

A plan should be developed for the management of the Madison River that takes account of all factors. This should include the identification of "tipping points" that trigger new initiatives (i.e. restrictions, permitting, etc.) This will be difficult.

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Comments on the Madison River below Black's Ford FAS.

The following figures are from the ArcGIS project I developed and from Google Earth. Note that the colors on entities controlling the land parcel are RED – FWP; Yellow – other State of Montana; Green – US Forest Service; Redish-Brown – BLM & USDA; and Pink – unknown and public, but probably all public lands.

My experience

I have only fished part of this section, mainly just down from Black's Ford. I did not realize that there was as much access as there is.

Access

Figure 1 is from the Black's Ford FAS to the Greycliff FAS, FWP land. Access is generally unrestricted in this area. Figure 2 and 3 show the other parts of the river in this area. The backgrounds are the State of Montana's NAIP Aerial Photographs from the State Library.

Figures 4 to 6 show the same areas but with the higher resolution Google Earth images.

In the 19 April 2018 "DRAFT RECREATION MANAGEMENT PLAN - ENVIRONMENTAL ASSESSMENT" it continually states: "The 18.9-mile reach of the lower Madison River between Greycliff FAS and the confluence with the Jefferson River is one of the most scenic and least developed reaches of the river." I would disagree with some of this statement. The area currently has minimal development, but outside of the FWP, State and public lands the area can have significant commercial and non-commercial development. I would also contend that the area is not particularly scenic as shown in Figures 9 and 10. The area will probably also see rapid development as soon as the water resources around Bozeman become totally used. (See my submitted climate change PPT and PDF.)

Figures 7 to 9 show the area around the Climbing Arrow Bridge. This area contains some public land at the bridge site. This could be used for fishing access. There are also roads along irrigation ditches near the river.

Because the land along about half of this section of the river (almost all below the Cobblestone area) is private there is limited access in these areas to wade fishermen. I would propose making access possible at the Climbing Arrow Bridge site. The reason use of this part of the river is limited is because the access is limited. I am sure the private landowners like this. These owners can develop up to the rivers high-water limit, which will make the scenic designation totally irrelevant.

For the same reasons I cannot understand why the Commission would want to limit the currently, very light commercial use on the river, other than to satisfy private landowners.

Mark E. Odegard

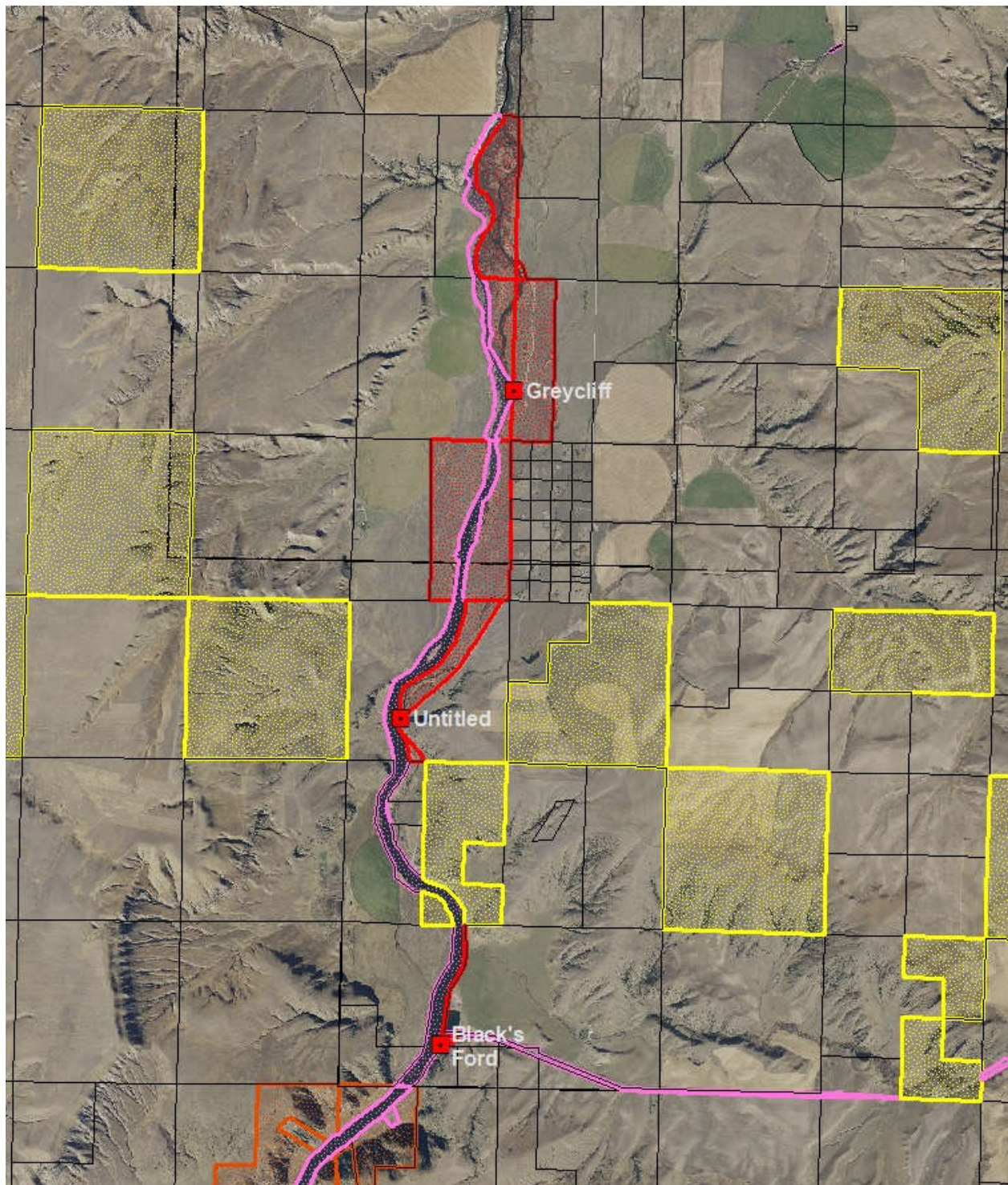


Figure 1: Black's Ford FAS to Greycliff FAS. Most of this section of the river is public land with private land outside the boundaries. Note that the "Untitled" FAS is not in the FWP GIS data base or in the FAS pamphlet. I don't think there is any document showing the location of public lands along this section of the river.

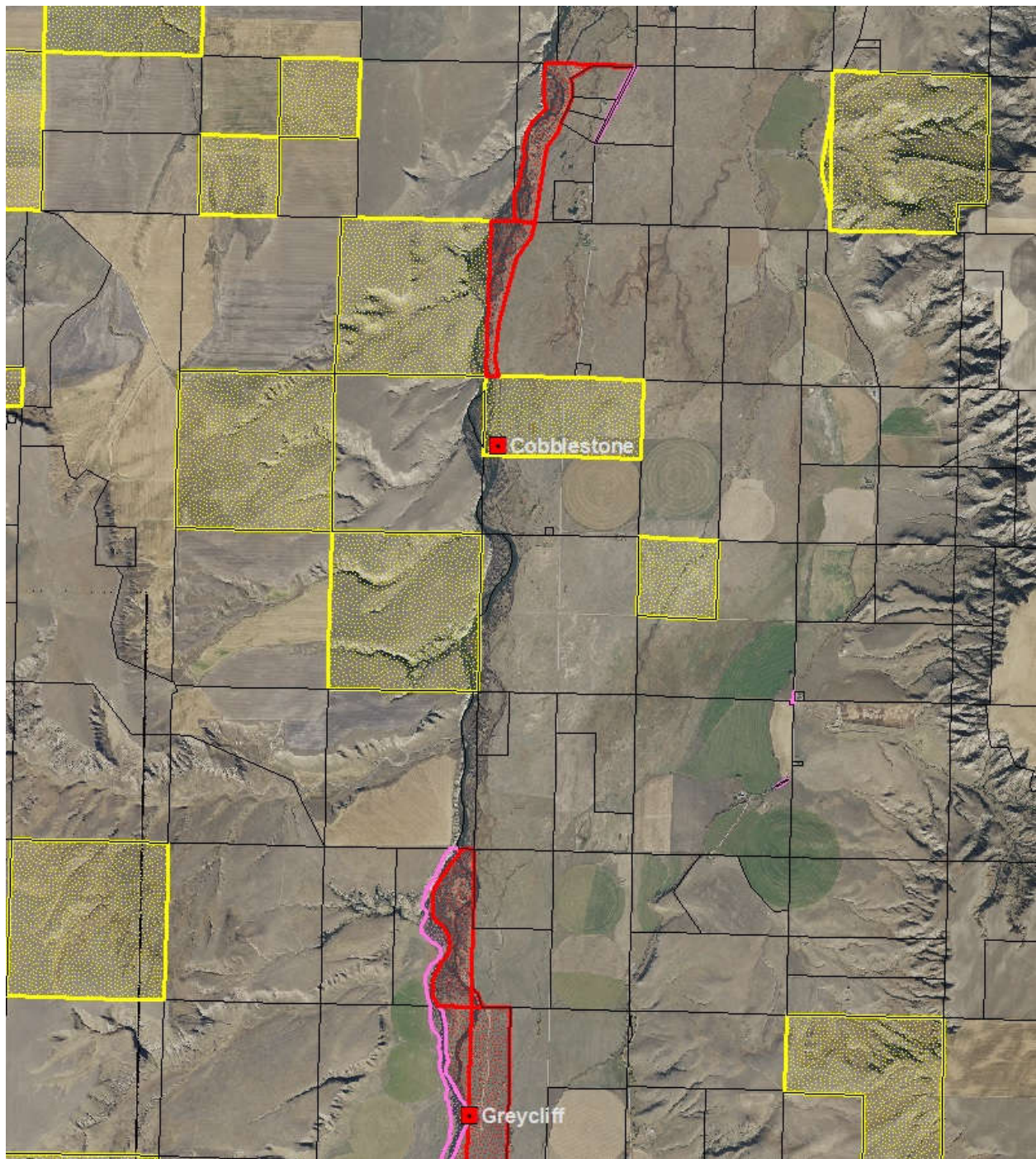


Figure 2: Greycliff FAS to Cobblestone FAS. About half the land along the river is private.

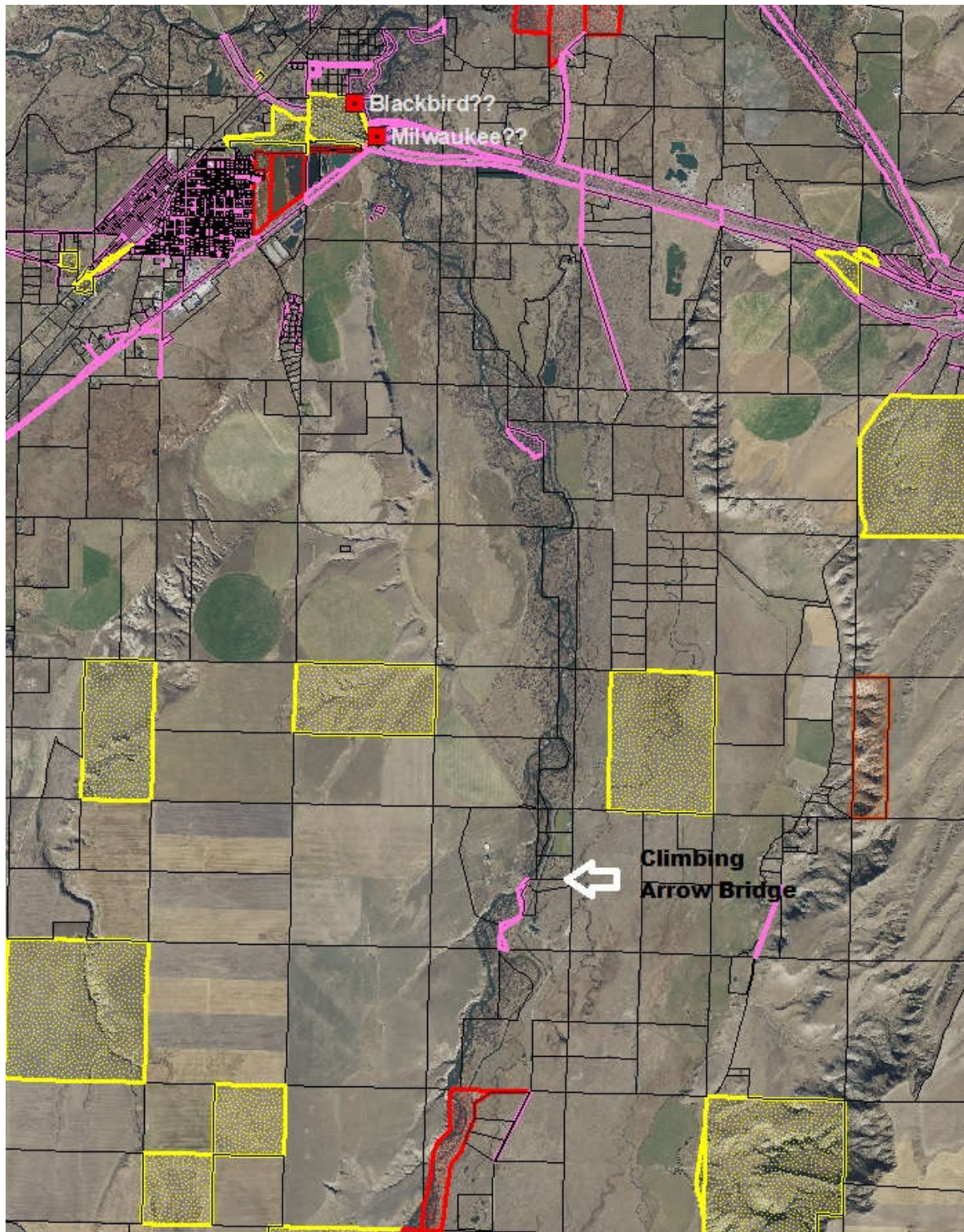


Figure 3: Shows the area of the river from the FWP land north of the Cobbelston FAS to the confluence with the Jefferson River. Most of the river banks are in private hands. Note the Climbing Arrow Bridge location.

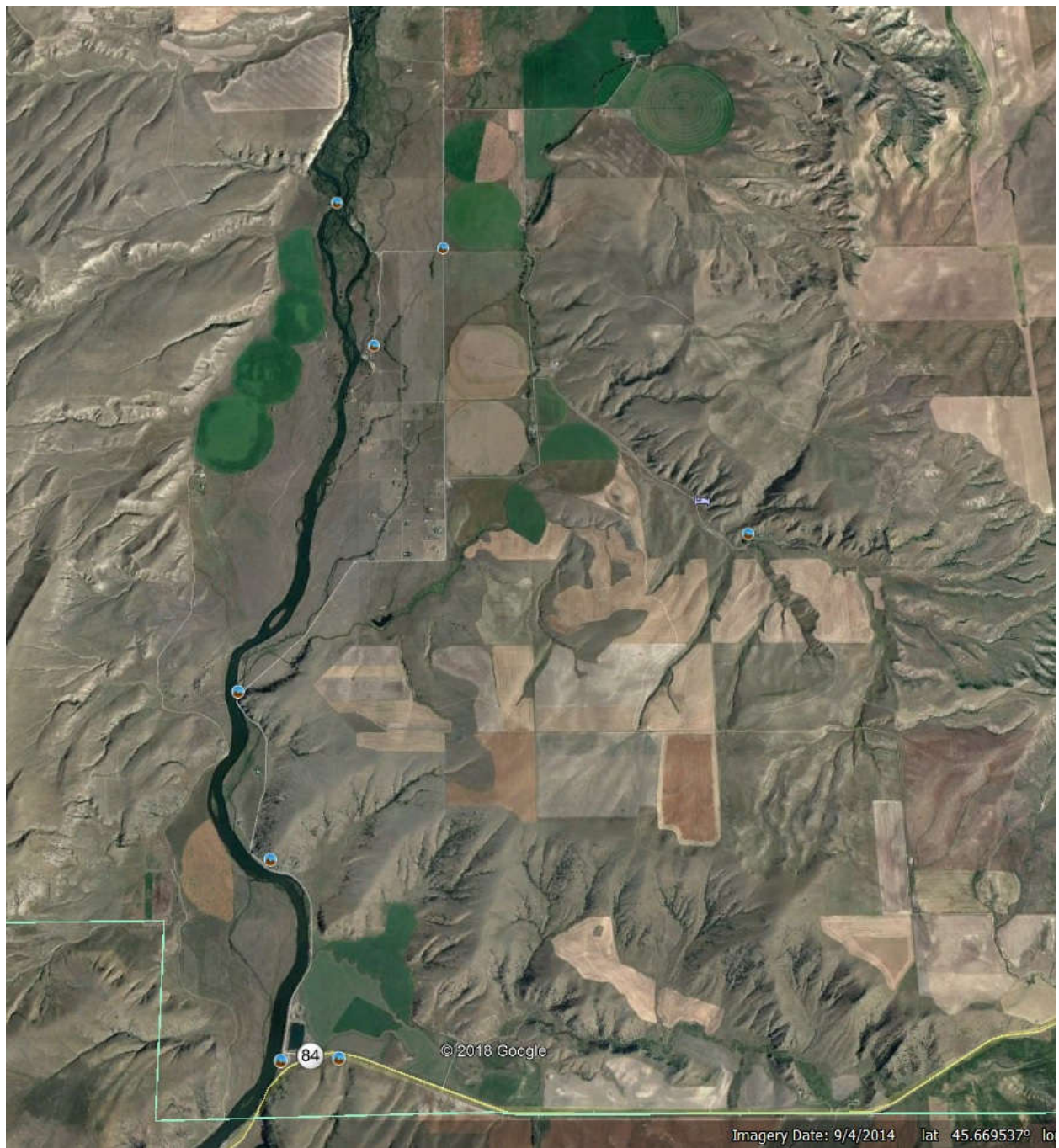


Figure 4: Google Earth image from Black's Ford to just down river from the Greycliff FAS.

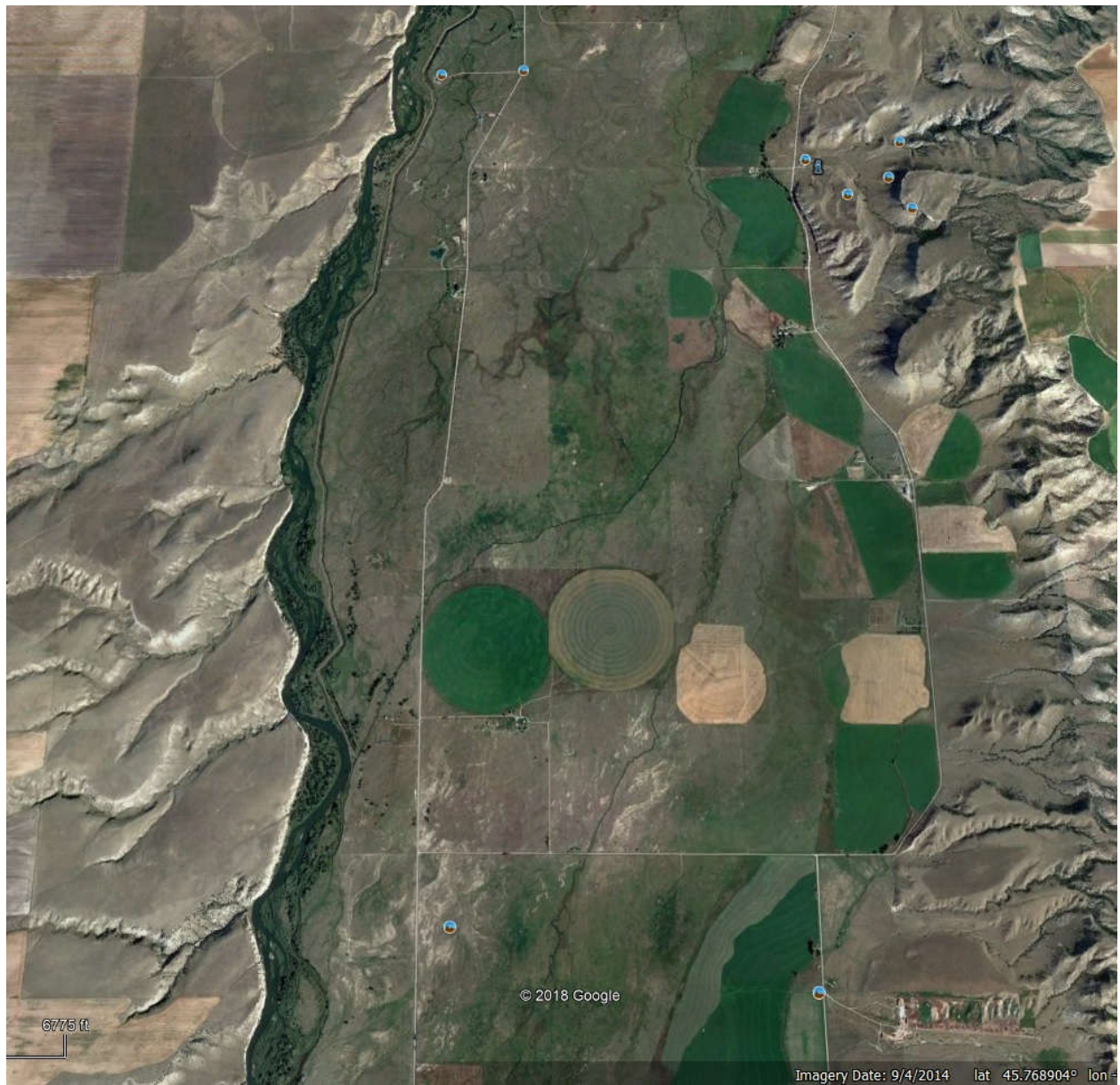


Figure 5: Google Earth image from just down river of the Greycliff FAS to the Cobblestone FAS.



Figure 6: Google Earth image from Cobblestone FAS to I90. Note road and bridge.



Figure 7: Google Earth image of the Climbing Arrow bridge area. The road along the river is on the left of the image.

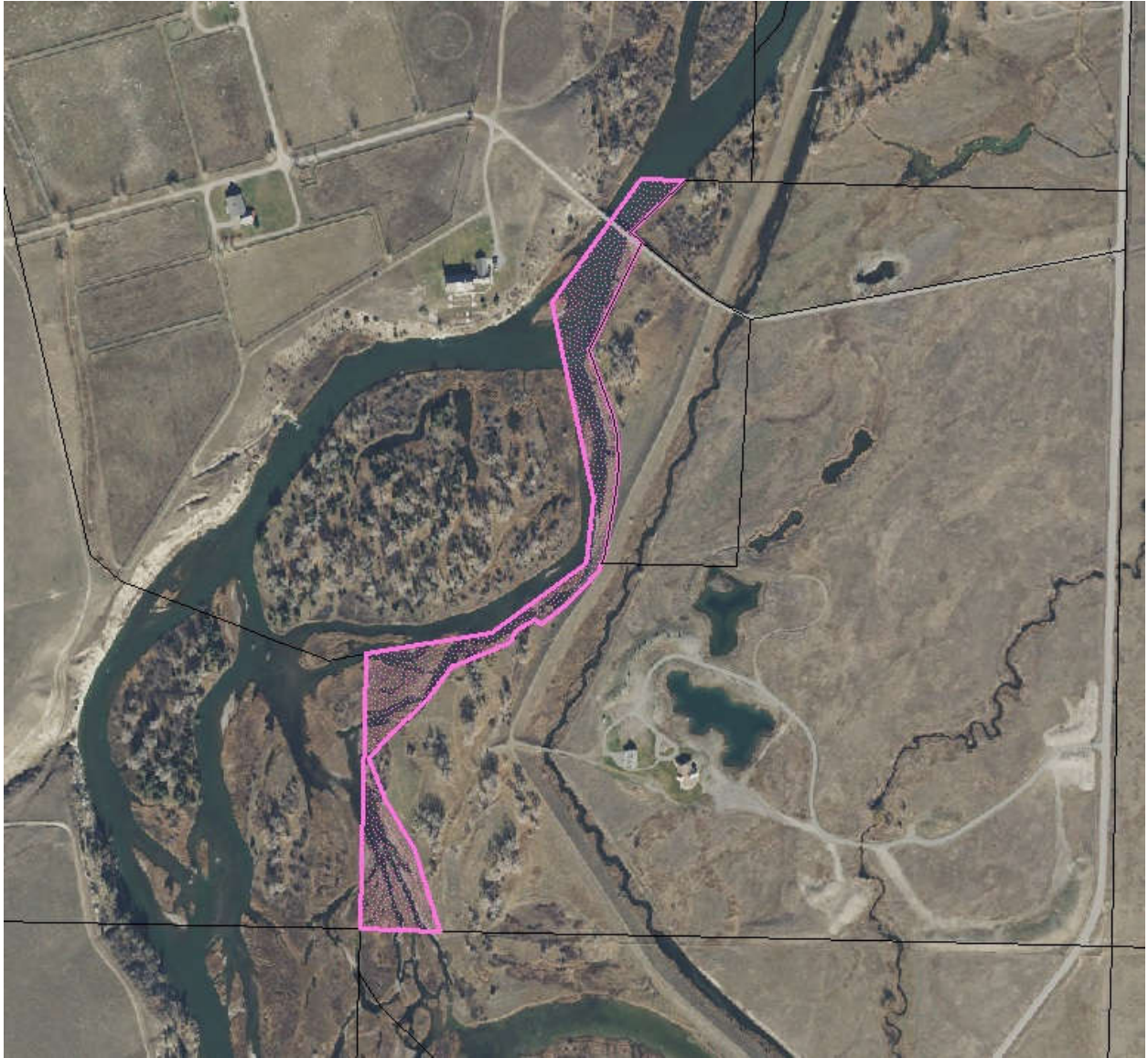


Figure 8. ArcGIS image of the Climbing Arrow Bridge area. There appears to be public land around the bridge and up and down River, but no FAS. The road in this area is also along an irrigation ditch. Not sure if the road has an easement.



Figure 9. Area around the Cobblestone FAS.



Figure 10. Some conditions that exist near the lower Madison below the Greycliff FAS, and the somewhat non-scenic view.

Comments on the Ennis FAS to Ennis Lake Section

The following figures are from the ArcGIS project I developed and from Google Earth. Note that the colors on entities controlling the land parcel are RED – FWP; Yellow – other State of Montana; Green – US Forest Service; Redish-Brown – BLM, USDA; and Pink – unknown or public, but probably all public lands. Background is the State of Montana's NAIP Arial Photographs from the State Library.

My experience

This has been my primary fishing area on the Madison since I was about 10 years old. My experience is that fishing success has been similar over that period. I was fishing Salmon and Steel Head in the Columbia River Basin during the “whirling disease” so I did not experience that period.

Access

Figure 1 is from the Ennis FAS to the Valley Garden FAS. Access is generally unrestricted in this area. Figure 2 is from the Valley Garden FAS to Ennis Lake. Figure 3 shows a Global Earth image of the location of a fence down to the river's edge with a FWP sign saying there is no access to the private land behind the sign. This effectively limits access down river from this sign during a lot of the year. This leads to overcrowding in the accessible section.

There is potentially access to the river above the lake through the BLM land on the south-east side of the lake to the river through the land inside the pink. I have not tried this and do not know if the footing is OK or if there are fences.

What this means is that for much of the year a little over one-third of this part of the river is only accessible using a personal water-craft for wade fisher-people. And if one is used it would need to be taken out at one of the FAS's or the BLM sites, which would require a shuttle. I can't afford a shuttle.

In the 19 April 2018 “DRAFT RECREATION MANAGEMENT PLAN - ENVIRONMENTAL ASSESSMENT” it states: “Conversely, the upper and lower wade-only reaches offer great access and opportunity for wading anglers.” As I have shown, this is not exactly the case.

I would propose that this remain as a Wade-Only sections. Also that float access be allowed in wade-only sections but no float-fishing. Float access is important for the young, the old and the disabled. I do not know what should be done with the other wade only section as I have not fished it in a long time.

Due to the warming climate this sections will probably have hoot-owl restrictions imposed on it in the near future. I understand from the FWP that the temperatures are already reaching this limit. I would propose moving the wade-only section up-river when this occurs.

Mark E. Odegard

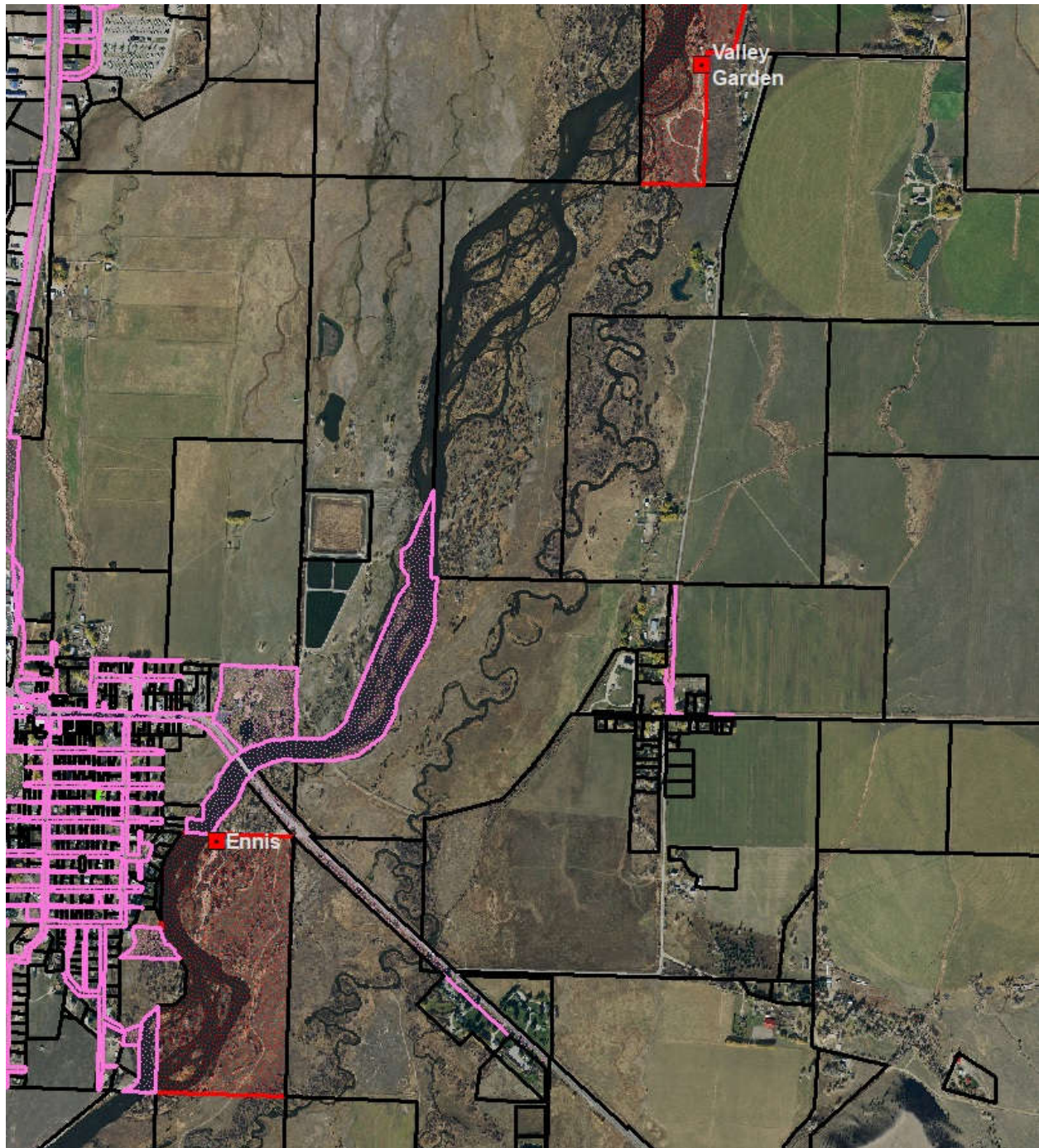


Figure 1: Ennis FAS to the Valley Garden FAS. I understand that the FWP land has been extended to the other side of highway 287 to possibly link with a trail on the moved Varney Bridge over the river from the park in Ennis.

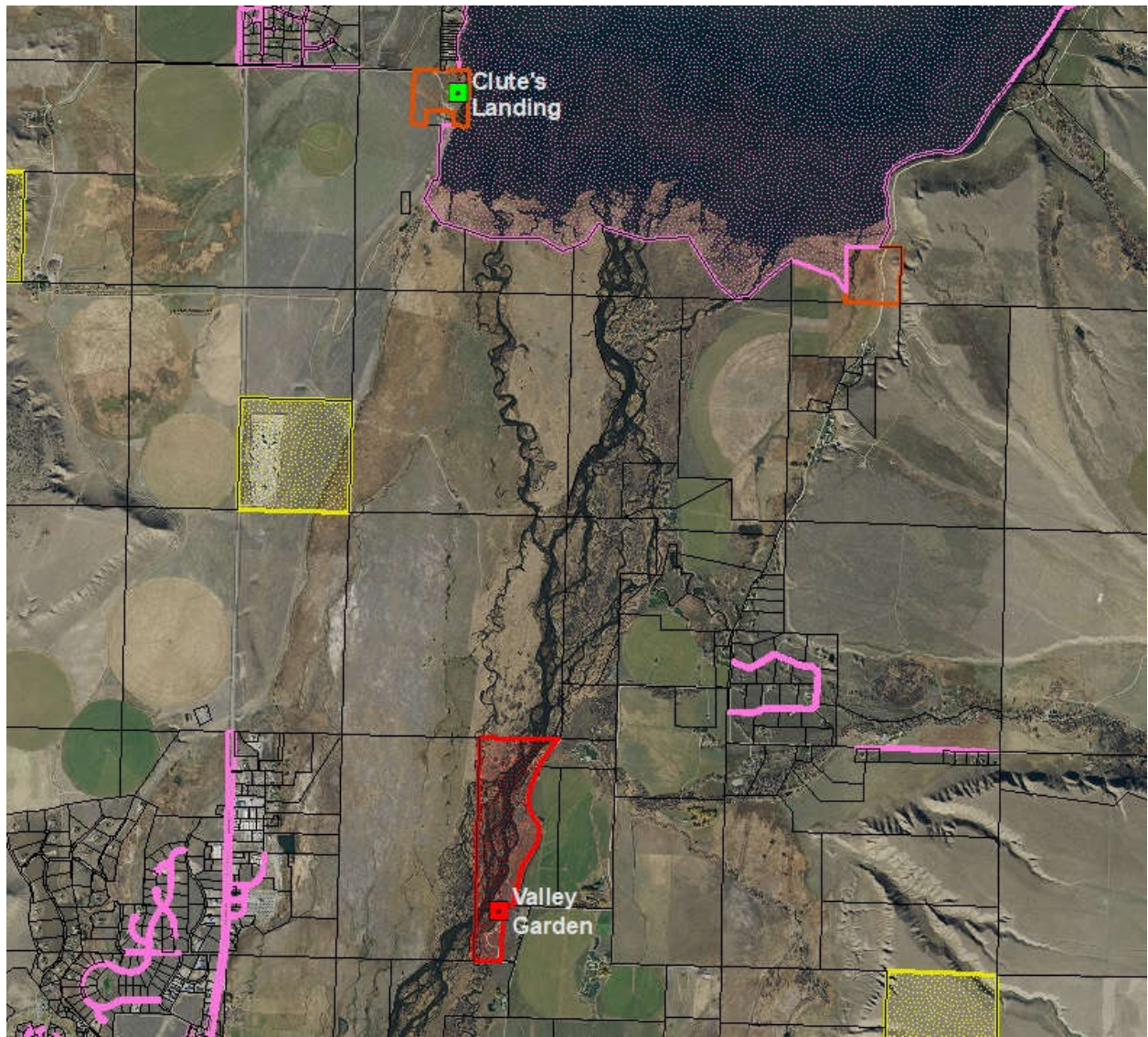


Figure 2: Valley Garden FAS to Ennis Lake. The BLM land is in the northeast corner of the image.



Figure 3: Google Earth image of the location of a fence down to the river's edge with a FWP sign (arrow) saying there is no access to the private land behind the sign. The river course has changed since this image was made and now limits access to wading in the river or by watercraft. If the river is high, wading is dangerous. The bank is very steep in this area. This is the NE limit of the Valley Garden FAS.

The effects of climate change on the Madison River Area, Montana

"Prediction is very difficult, especially about the future."
Niels Bohr, Danish physicist (1885-1962)

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From the Executive Summary of the United States Global Change Research Program transmitted to the Congress and the President

“Observations show that warming of the climate is unequivocal. The global warming observed over the past 50 years is due primarily to human-induced emissions of heat-trapping gases. These emissions come mainly from the burning of fossil fuels (coal, oil, and gas), with important contributions from the clearing of forests, agricultural practices, and other activities.”

“Warming over this century is projected to be considerably greater than over the last century. The global average temperature since 1900 has risen by about 1.5°F. By 2100, it is projected to rise another 2 to 11.5°F.”

<http://www.bozemanscience.com/ap-es-034-global-climate-change/>

<https://nypost.com/2018/10/01/trump-administration-says-climate-change-will-make-earth-a-living-hell-by-2100/>

Climate action

A new report from the World Bank Group warns that climate change is poised to interrupt the world as we know it.

Group CEO and acting president Kristalina Georgieva said that weather- and climate change-induced disasters cost \$220 billion worldwide during 2018.

The global financial organization also announced a \$50 billion budget for climate adaptation and resilience. The funds will help deliver better forecasts, warnings and other information to the most vulnerable areas.

Houston Chronicle, 20 Jan 18

Climate Science and Belief

“I don’t believe in climate change.”

“Science doesn’t care what you and I believe.”

MEO

Science is not about belief.

Even Major Oil Companies Have Accepted This

Thursday, 20 September 2018

U.S. energy giants led by Exxon Mobil join global coalition to slow down climate change

“Exxon Mobil said Thursday it was joining a corporate coalition working toward the goals of Paris climate change agreement, the boldest move yet by the oil giant that has faced criticism for past attempts to cast doubts about climate change.”

The Irving, Texas-based company is one of the newest members of the Oil and Gas Climate Initiative, described as a “CEO-led initiative which aims to lead the industry response to climate change”.

“Houston-based Occidental Petroleum and San Ramon, Calif.-based Chevron also announced their memberships on Thursday. Founded in 2014, the coalition now includes 13 of the largest oil and natural gas companies representing 30 percent of the world's oil and natural gas production.”

The Oil and Gas Climate Initiative says on its website that its members are “committed to the direction set out by the Paris Agreement on climate change. We support its agenda for global action and the need for urgency.”

<https://www.dallasnews.com/business/energy/2018/09/20/irving-based-exxon-mobil-joins-group-committed-paris-climate-change-agreement-zeroing-methane-emissions>

Dallas Morning News

U.S. energy giants led by Exxon Mobil join global coalition to slow down climate change

Exxon Mobil said Thursday it was joining a corporate coalition working toward the goals of Paris climate change agreement, the boldest move yet by the oil giant that has faced criticism for past attempts to cast doubts about climate change.

The Irving, Texas-based company is one of the newest members of the Oil and Gas Climate Initiative, described as a “CEO-led initiative which aims to lead the industry response to climate change.”

Houston-based Occidental Petroleum and San Ramon, Calif.-based Chevron also announced their memberships on Thursday. Founded in 2014, the coalition now includes 13 of the largest oil and natural gas companies representing 30 percent of the world's oil and natural gas production.”

Until now, the group did not include any firms based in the U.S., currently estimated to be the world's largest producer of crude oil.

"It will take the collective efforts of many in the energy industry and society to develop scalable, affordable solutions that will be needed to address the risks of climate change," Exxon Mobil chairman and CEO Darren Woods said in a statement. "Our mission is to supply energy for modern life and improve living standards around the world while minimizing impacts on the environment."

The importance of the Oil and Gas Climate Initiative is heightened since these are the companies responsible for a large percentage of world's greenhouse gas emissions. Fossil fuel combustion accounts for nearly 94 percent of U.S. carbon dioxide emissions, according to [data from the Environmental Protection Agency](#). Oil and natural gas production, as well as abandoned wells, contribute nearly one-third of U.S. methane emissions. The nonprofit CDP, formerly known as the Carbon Disclosure Project, calculated that 25 companies are responsible for 51 percent of industrial greenhouse gas emissions. Nine of those companies are now part of this global coalition. The Oil and Gas Climate Initiative says on its website that its members are "committed to the direction set out by the Paris Agreement on climate change. We support its agenda for global action and the need for urgency."

The group is also working toward zero methane emissions, according to its website. Methane is a powerful greenhouse gas that contributes to man-made climate change. Exxon Mobil officials announced in May a goal of reducing methane emissions by 15 percent in the next two years. The company also set a 2020 deadline to reduce flaring of natural gas by 25 percent.

Although this coalition predates President Donald Trump's administration, it does reflect a broader pushback against the U.S. decision to withdraw from the Paris agreement. Individual companies, including Exxon Mobil, and other corporate coalitions have announced action to combat climate change and support of the agreement.

The Paris agreement seeks to limit the rise in global temperatures to "well below" 2 degrees Celsius above preindustrial levels.

Investors — sometimes via proxy fights — have also demanded that companies publicly [disclose how climate change could affect their finances](#). Last year, a shareholder resolution insisting that Exxon Mobil give a fuller assessment of its climate change risks passed with 62 percent.

The leadership of Exxon Mobil, which opposed that resolution, announced in December that it would release a more detailed climate-risk assessment.

Without [#CCUS](#), the [@IEA](#) says the level of cuts needed to keep global warming to 2 degrees Celsius probably can't be achieved. This is why we're investing in innovative, economically viable & scaleable solutions to separate, capture, utilize and store co2.

<https://t.co/kbVHLvQUc8>

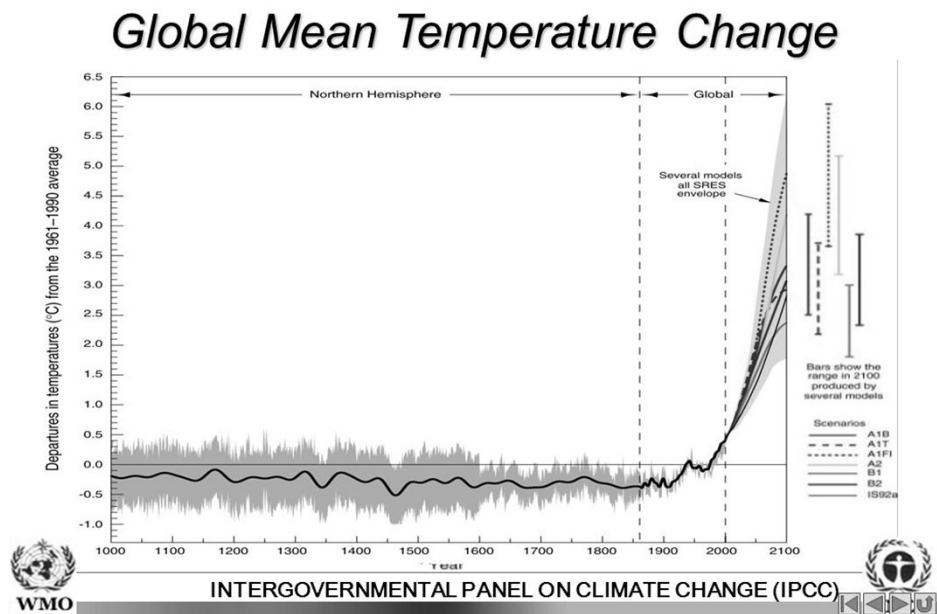
— OGCI (@OGCInews) July 31, 2018

Besides focusing on member contributions to climate change, the Oil and Gas Climate Initiative created a \$1 billion fund to invest in technologies that could reduce emissions. So far, the fund has targeted companies that could make fossil fuel use less polluting or offset emissions, rather than replacing traditional fuels.

The Environmental Defense Fund described that amount as not enough.

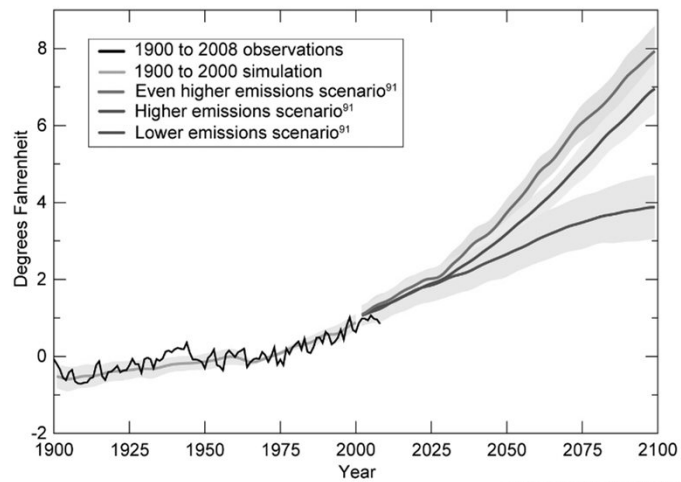
"We must dramatically reduce the total amount of fossil fuels we use — coal, oil, and natural gas — and dramatically ramp up deployment of renewable resources — solar, wind — and aggressively pursue energy efficiency and vehicle electrification," wrote Mark Brownstein, the group's vice president of climate and energy.

**Display of
past and
possible
future global
temperature.**



Display of recent and possible future global temperatures. A more recent estimate.

With the US withdrawal from the Climate Accords the “Lower emissions scenario” is no longer probable. This predicted a 4 degree rise by the end of the century. Current projections are for at least a 7 degree rise.



Observed and projected changes in the global average temperature under three IPCC no-policy emissions scenarios. The shaded areas show the likely ranges while the lines show the central projections from a set of climate models. A wider range of model types shows outcomes from 2 to 11.5°F.⁶⁸ Changes are relative to the 1960-1979 average.

<https://nypost.com/2018/10/01/trump-administration-says-climate-change-will-make-earth-a-living-hell-by-2100/>

What about the Madison River area?

This is from an article in the Mountain Journal, September 10, 2017:

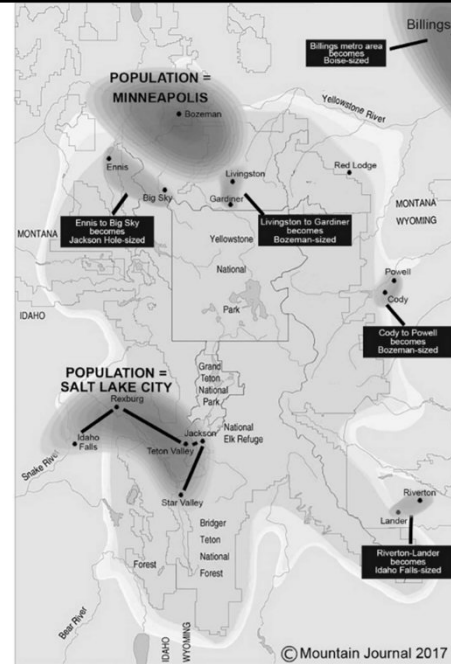
“Just based on current population growth patterns the Ennis-Big Sky area is projected to grow to about the size of the current Jackson, WY area by 2065.”

“Bozeman/Gallatin, by 2041, will equal the size of Salt Lake City proper (minus its suburbs). Even more sobering, in less than half a century, 2065, based on the same rate of annual growth, there will be a population of 420,000 here, equal to present-day Minneapolis proper. And Carpenter says that could actually be a conservative estimate, with this scenario arriving faster than people think.”

The Bozeman area growth will most-likely be limited by water supply. The projected population increase will “spill over” into areas with adequate water such as the lower Madison River.

What about the Madison River area?

Just based on current population growth patterns the Ennis-Big Sky area is projected to grow to about the size of the current Jackson, WY area by 2065. Bozeman is projected to become the size of Minneapolis.



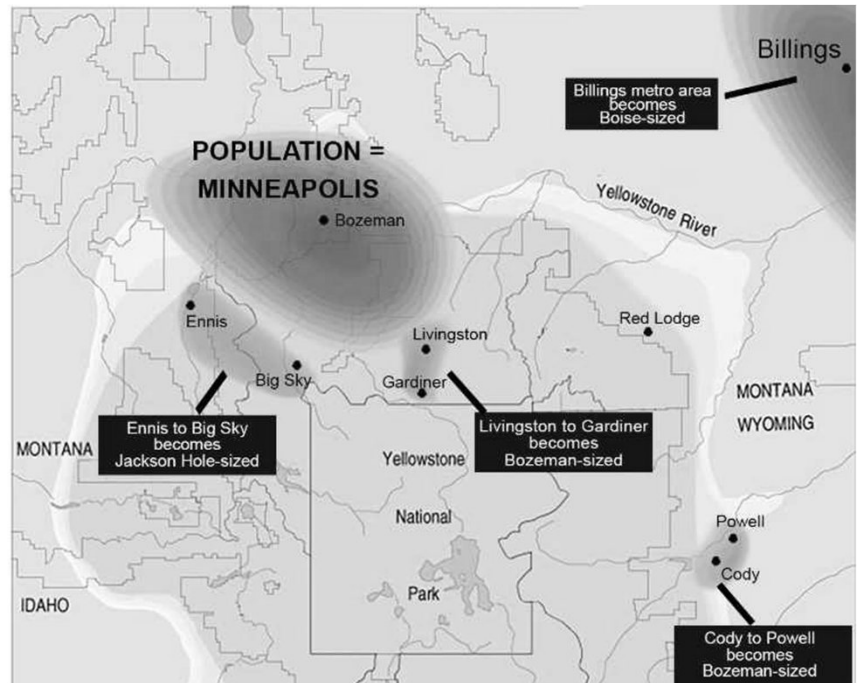
Predicted population growth in
Greater Yellowstone Ecosystem by 2065

<https://mountainjournal.org/the-wildest-ecosystem-in-america-faces-death-by-too-many-people>

**What about the
Madison River area?**

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**This is from an article
in the Mountain
Journal, September
10, 2017.**



<https://mountainjournal.org/the-wildest-ecosystem-in-america-faces-death-by-too-many-people>

Climate Migration

From the same article: “And then you look at Houston and Hurricane Harvey and Florida and Hurricane Irma, and Phoenix broiling in 120-degree heat, the water shortages coming to cities in the desert Southwest, and the fires in southern California,” Carpenter says from the slope of the Bridgers. “The current explosive growth in Greater Yellowstone is happening because the region is attracting a lot of people coming here with a lot of money wanting to live quieter lives closer to nature. They are the first big wave.”

That alone, he says, is creating a nightmare of cascading growth-related issues, to which leadership in the Greater Yellowstone Ecosystem is either unable, unwilling or ill-equipped to confront.

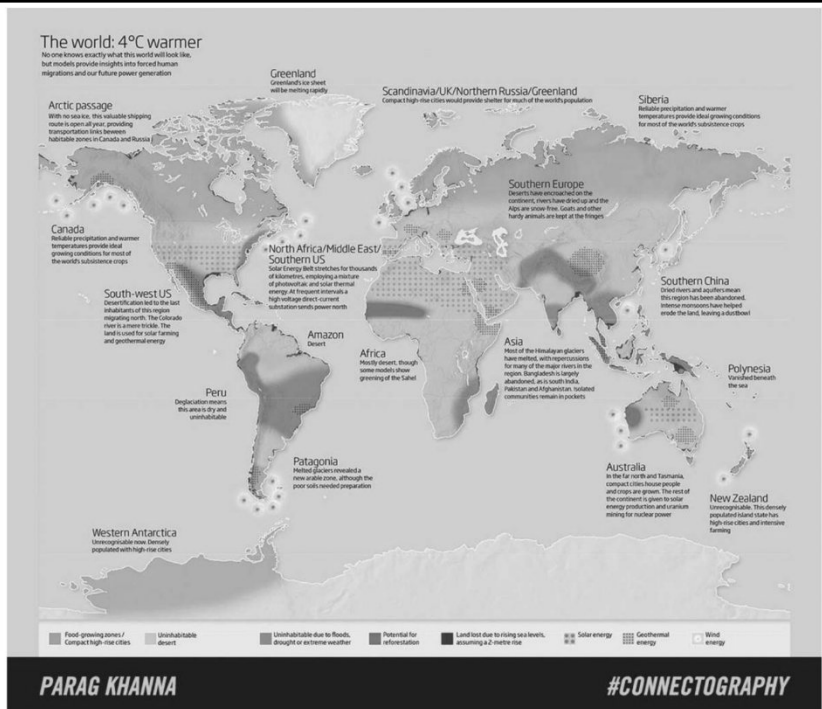
“But how are the counties and towns going to handle a potential flood of climate refugees on top of the current inundation?” Carpenter asks. He doesn’t even need to speak the answer.

The “flood” seems to have started at our southern border. See:

<https://www.nytimes.com/2019/06/05/opinion/guatemala-migrants-climate-change.html>

The world with a 7 degree rise in temperature

4 degrees centigrade is about 7 degrees Fahrenheit.



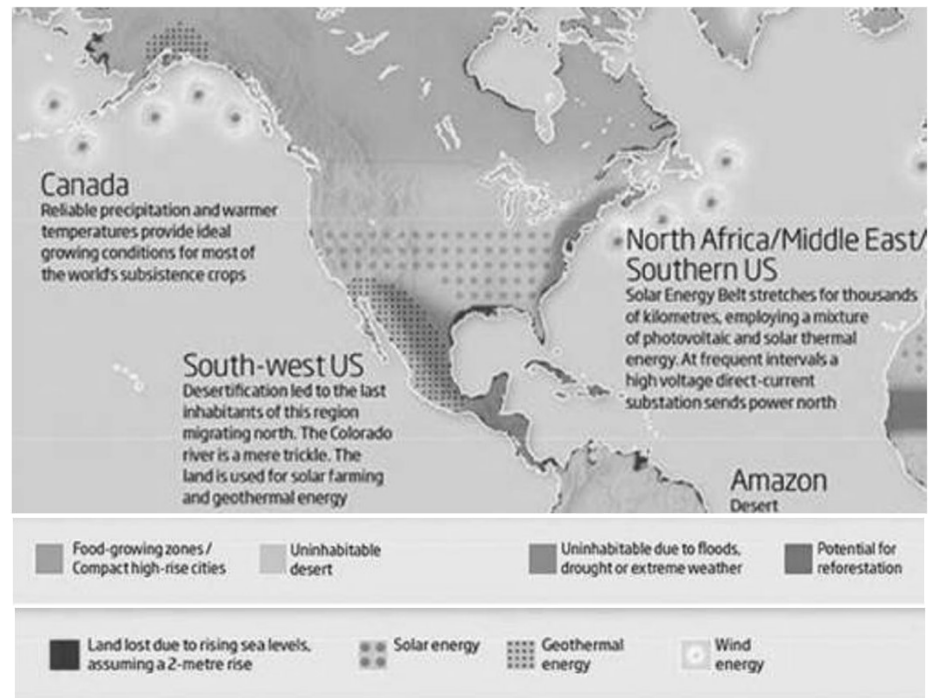
Imagine, for the purposes of this thought experiment, that we have 9 billion people to save — 2 billion more than live on the planet today.

A wholesale relocation of the world's population according to the geography of resources means abandoning huge tracts of the globe and moving people to where the water is. Most climate models agree that the far north and south of the planet will see an increase in precipitation. In the northern hemisphere this includes Canada, Siberia, Scandinavia and newly ice-free parts of Greenland; in the southern hemisphere, Patagonia, Tasmania and the far north of Australia, New Zealand and perhaps newly ice-free parts of the western Antarctic coast.

The citizens of the world's wealthiest and most populous nations will become climate refugees, which means things are going to get really, really ugly for everyone else.

**North America
with a 7 degree
rise in
temperature**

**The southern US
will become a
desert with the
forced migration
of tens of millions
of people to the
north. This will be
somewhat
mitigated by
advances in
technology.**



The primary technology use will probably be desalinization. However this requires lots of energy, from where? But water conservation implementation through engineering and population education will also be important.

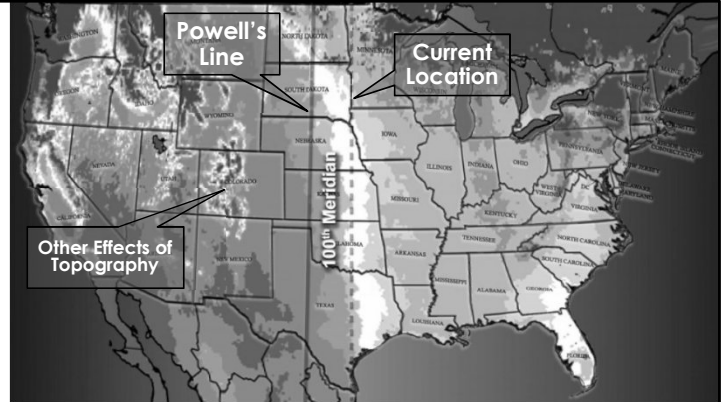
<https://www.technologyreview.com/s/534996/megascale-desalination/>
<https://www.scientificamerican.com/article/israel-proves-the-desalination-era-is-here/>

“The shortage of natural water is the worst that has been measured in about 100 years and is bringing water sources in the north to an unprecedented low point,” Energy and Water Minister Yuval Steinitz said on April 9, 2018. Consequently, the water ministry announced a plan to build two more desalination plants to reinforce the five built along the Mediterranean coast over the past 13 years. It did not include their price, but similar facilities in Israel have cost about \$400 million.

<https://www.npr.org/sections/parallels/2015/06/14/413981435/israel-bringing-its-years-of-desalination-experience-to-California>

Modifying Elements

Two previous slides are somewhat symbolic in that they show the general effect of temperature rise, but do not adequately show the effects of topography, weather patterns and other factors.



A striking example is shown in the migration of the 100th meridian which divides the arid west from the moister east. This line was first described in 1879 by a geologist, John Wesley Powell. It has recently been investigated with modern techniques and has been shown to have moved east about 140 miles, most probably due to the rise in average temperature. The line is caused by the “rain shadow” effect of the Rocky Mountains and by the change in moisture coming up out of the Gulf of Mexico.

Nearly a century and a half later, a Columbia University study published in the April issue of the journal *Earth Interactions* re-examined the boundary line—and presented two central findings: first, that the boundary is real, and second, that climate change is causing it to migrate east, expanding the dry part of the country.

Despite the fact that many farmers still don't acknowledge the link between human activity and climate change, only 18 states have climate mitigation plans in place, and the U.S. Environmental Protection Agency (EPA) has removed numerous climate-related documents from its own website, the resulting changes to agriculture will likely be hard to deny.

“There’s no point in sticking your head into the sand—or into the tilled earth—about this: these changes are going to be happening,” said climate scientist Dr. Richard Seager of Columbia’s Lamont-Doherty Earth Observatory and the study’s lead author.

“In any decision-making, it’s worth thinking that conditions *are* going to change and it’s going to require some adjustment in how the land is used agriculturally. What’s the best thing to do that will minimize destruction and suffering that will occur?”

Though most contemporary Americans have probably never heard of the 100th Meridian, it’s an environmental reality. In fact, Seager’s team confirmed its existence by examining east-west differences in vegetation, precipitation, temperatures, and atmospheric circulation, as well as human approaches to settlement and agriculture.

But There Are Always Problems with Mitigation

**One of the main water mitigating methods could be de-salinization.
However:**

Desalination brine:

The nearly 16,000 plants around the world that extract fresh water from the sea are discharging far greater amounts of toxic brine back into the ocean than previously thought, a new U.N. study reveals.

It says the salt-laden liquid is increasing the density of salinity where it is released, and poses a significant risk to marine life and ecosystems.

More than half of the 5 billion cubic feet of brine discharged each day worldwide comes from desalination plants operating in Saudi Arabia, the United Arab Emirates, Qatar and Kuwait.

Houston Chronicle, 20 January 2019

<https://www.nytimes.com/aponline/2019/01/14/world/europe/ap-eu-united-nations-desalination.html>

Too Much Brine? Study Highlights Growing Toxic Brine Problem

By The Associated Press

Jan. 14, 2019

BERLIN — The world's thirst for fresh water is causing a salty problem.

Desalination plants around the world are producing enough brine waste to swamp an area the size of Florida with a foot of salty water every year, according to a U.N.-backed report released Monday.

The study by researchers from Canada, the Netherlands and South Korea warned that much of the brine is being dumped untreated into the sea, and some is laden with toxic chemicals, causing harm to sea life.

The authors called for better brine management, particularly in countries that rely heavily on desalination for their water needs, such as Saudi Arabia, the United Arab Emirates, Kuwait and Qatar.

"We know that water scarcity is increasing in many regions across the world due to increased water demands, which are associated with population increase and economic growth," said one of the authors, Manzoor Qadir, assistant director of the United Nations University's Canada-based Institute for Water, Environment and Health.

At the same, climate change is making the availability of freshwater less predictable, such as by changing the amount of runoff snow in some regions, he said.

The authors examined 16,000 desalination plants worldwide and found they produce 142 million cubic meters (5,014 million cubic feet) of brine each day, or 51.8 billion cubic meters a year. That's about half more than previous studies had estimated, said Qadir.

The researchers called for better brine management, noting that studies have shown it can be used in aquacultures to boost yields of salt-tolerant species of fish, and the metals and salts contained in it — such as magnesium and lithium — could be mined.

Climate Migration and the Madison River

From the previous slides showing the world with a 7 degree rise in temperature, it appears the Madison River area could remain about the same in terms of rain and snow fall. However the temperature will be higher and the snow will melt earlier so that stream flows in summer will be lower. This combined with rising maximum temperatures may doom trout in our rivers unless there is some way to mitigate the lower river flows with higher water temperatures. Elk and other animals will also be affected adversely.

In the lower Madison, increasing temperatures will probably reduce or eliminate the trout population. This may lead to their replacement by more heat tolerant species of fish. Closure of this part of the river during the longer summer will be probable.

<https://yellowstoneinsider.com/2018/03/04/yellowstone-expert-warns-climate-change-park/>

Climate Migration and the Madison River

The major effect will come from increased migration of the population to the north. This will come because of the inundation of southern areas by desert conditions. These will include the drying up of the Colorado and Sacramento rivers. With no water, these populations will be forced to migrate to the northern US and Canada.

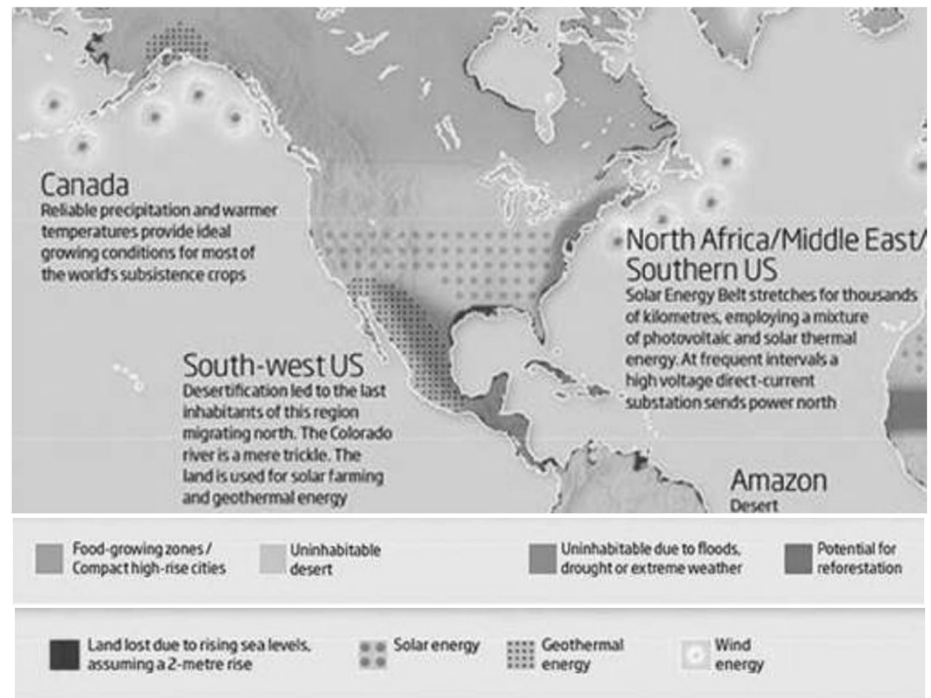
Migration will probably have a large effect on the lower Madison and the Three Forks area. This will probably be because the Bozeman-Gallatin area will not have enough water to sustain a population as large as shown above. The population will spill over into other areas with a better water supply.

<https://yellowstoneinsider.com/2018/03/04/yellowstone-expert-warns-climate-change-park/>

**North America
with a 7 degree
rise in
temperature**

**The main
question is
where will that
yellow to green
transition be?**

**Will it be
further north
or south as
shown here?**



Possible Mitigation of Lower Stream Flows and Higher Water Temperatures

- **The Madison River has one method to mitigate the rising temperatures and earlier snow melt. This is using the Hebgen reservoir.**
- **If a significant amount of water can be released during the summer this will raise stream flow and lower water temperatures.**
- **Then the reservoir can be refilled during the earlier spring runoff.**
- **However the lower water levels in the reservoir will affect businesses, and residents and visitors to the area.**
- **There will be significant opposition to a plan like this.**
- **One unknown effect will be the withdrawal of ground water.**
- **MTFWP must start considering this mitigation, as does this task force.**

<https://www.usbr.gov/gp/hydromet/hebr.html>

Welcome to the Bureau of Reclamation, Great Plains Region

Hydromet System for Hebgen Lake, Madison River near West Yellowstone, Montana

Climate Migration and the Ennis Area

It is impossible to predict the exact expected population of the Madison Valley by the year 2050 and beyond, but it could easily be 100,000 plus.

The limiting factor will be our **water resources. Areas such as the west bench aquifer being studied by the MBMG/GWIP/Montana Tech could be severely affected. Parts of this area could be without water from wells if the population becomes too large and the water table falls or disappears. There may not be enough water entering the system to sustain a large population in the Madison Valley.**

These factors must be considered by the Town and Zoning Commissions of Ennis, by the County Commissioners, and the State and National Governments.

"It's good business," said Bruno Sarda, head of sustainability at NRG Energy. "All these questions ... are actually just good governance and good risk management."

Climate Migration and Affordable Housing

One aspect of climate migration is the financial side. Wealthier families will have the resources to migrate to areas with better climate. These families will generally be able to purchase homes at higher prices than current residents. This could mean there will be **NO “affordable housing” in these areas.**

In these areas the effect on the lower income peoples may be to increase the density of residents in sub-standard housing units. Will this result in “slums” in our valley?

What needs to be done **nOW to mitigate this?**

The citizens of the world's wealthiest and most populous nations will become climate refugees, which means things are going to get really, really ugly for everyone else.

Fund managers who have staked hundreds of millions of dollars want to know how climate change might affect those businesses, from supply chain disruptions to changing customer demand. Such disclosures, they say, would help investors better understand the long-term risks involved with a given company.

"Everyone had something in their 10-K [report] about carbon or climate," said Swami Venkataraman, a senior vice president at Moody's Investors Service, which now includes climate change risk in its ratings. "But their disclosures tend to be very inadequate. ... They simply say that carbon regulations are possible, and that's a risk facing the business. It doesn't really articulate the nature of that risk, the magnitude of that risk, the kind of exposure the company faces."

NRG Energy, which owns Houston-based Reliant Energy, is one of more than 200 major companies that have adopted a new climate change disclosure framework that emerged from the G20, a group of 19 of the world's wealthiest nations plus the European Union. Chaired by billionaire and former New York City Mayor Michael Bloomberg, the Task Force on Climate-Related Financial Disclosures has the support of Dow Chemical, Dupont, Royal

Dutch Shell, Statoil, Bank of America and other global behemoths.

"It's good business," said Bruno Sarda, head of sustainability at NRG Energy. "All these questions ... are actually just good governance and good risk management."

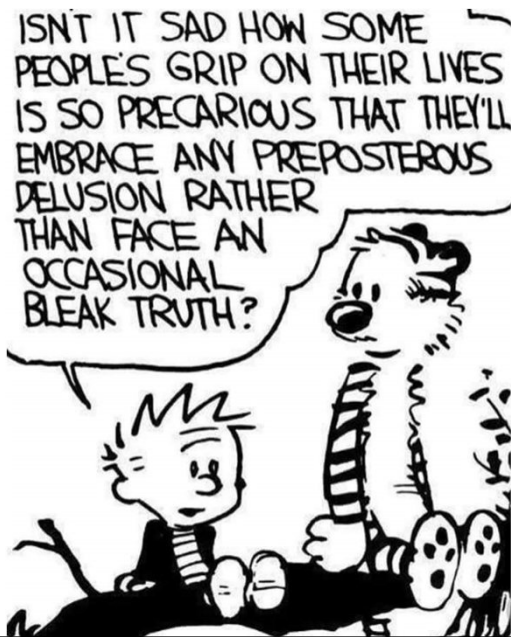
Comments

The above slides were done before I heard about this book on NPR. This book has similar conclusions, but they are even more disastrous:

https://www.amazon.com/Uninhabitable-Earth-Life-After-Warming/dp/0525576703/ref=sr_1_1?ie=UTF8&qid=1550785789&sr=8-1&keywords=the+uninhabitable+earth



Comments



Unfortunately

Primary Sources

Climate Change, Migration, and Population Growth (2010) Population Action International, 1300 19th Street, NW Suite 200
Washington, DC 20036-1624 USA

The Ennis Groundwater Investigation (2018) Andrew Bobst and Mary Sutherland; *Ground Water Investigation Program (GWIP)*, MONTANA BUREAU OF MINES AND GEOLOGY, 1300 West Park Street, Butte, MT 59701-8997 USA

Global Climate Change Impacts in the United States (2009) Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson,
(eds.); U.S. Global Change Research Program, Cambridge University Press.

Groundswell: Preparing for Internal Climate Migration (2018) Kumari Rigaud, Kanta, Alex de Sherbinin, Bryan Jones, Jonas Bergmann, Viviane Clement, Kayly Ober, Jacob Schewe, Susana Adamo, Brent McCusker, Silke Heuser, and Amelia Midgley; Washington, DC: The World Bank Group, 1818 H Street NW, Washington, DC 20433, USA.

A map of the world after four degrees of warming (2009 & 2018) Gaia Vince; New Scientist magazine, page 28-33, issue 2697; <https://wanderinggaia.files.wordpress.com/2010/03/how-to-survive-the-coming-century-environment-25-february-2009-new-scientist.pdf>

Primary Sources

Migration and Climate Change (2008) Oli Brown; International Organization for Migration, 17 route des Morillons, 1211 Geneva 19, Switzerland

Unnatural Disaster: Will America's Most Iconic Wild Ecosystem Be Lost To A Tidal Wave Of People? What Does It Mean For Greater Yellowstone If Bozeman Becomes Minneapolis-Sized And Jackson Hole Becomes An Anchor For Salt Lake City-Like Sprawl? (2017) Todd Wilkinson, Mountain Journal, P.O. Box 11251, Bozeman, MT 59719

Where the Rain Falls: Climate Change, Food and Livelihood Security, and Migration (2013) Warner, K., Afifi, T., Henry, K., Rawe, T., Smith, C., de Sherbinin, A. (2012). Where the Rain Falls: Climate Change, Food and Livelihood Security, and Migration. Global Policy Report of the Where the Rain Falls Project. Bonn: UNU and CARE. A background paper prepared for the 11th Coordination Meeting on International Migration.

Whither the 100th Meridian? The Once and Future Physical and Human Geography of America's Arid-Humid Divide. Part II: The Meridian Moves East (2018) Seager, R., J. Fekdman, N. Lis, M. Ting, A. P. Williams, J. Nakamura, H. Liu, and N. Henderson, *Earth Interactions*, *V. 22, N. 5*.

Disclaimer!

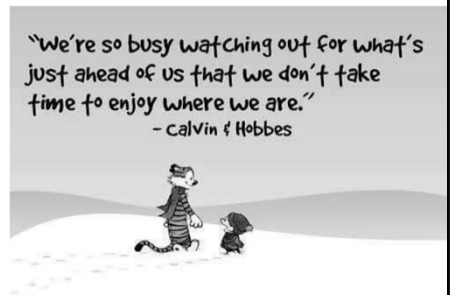
These projections are based on my reading and interpretation of currently available reports and the scientific literature.

They do not reflect in any way the policies of local, county, state or federal governments with which I might be associated. They are purely my product and have been supported solely by my finances.

Mark E. Odegard; Grizzly Geosciences



But we must not forget:



Comments on Two Areas of the Madison River, Montana

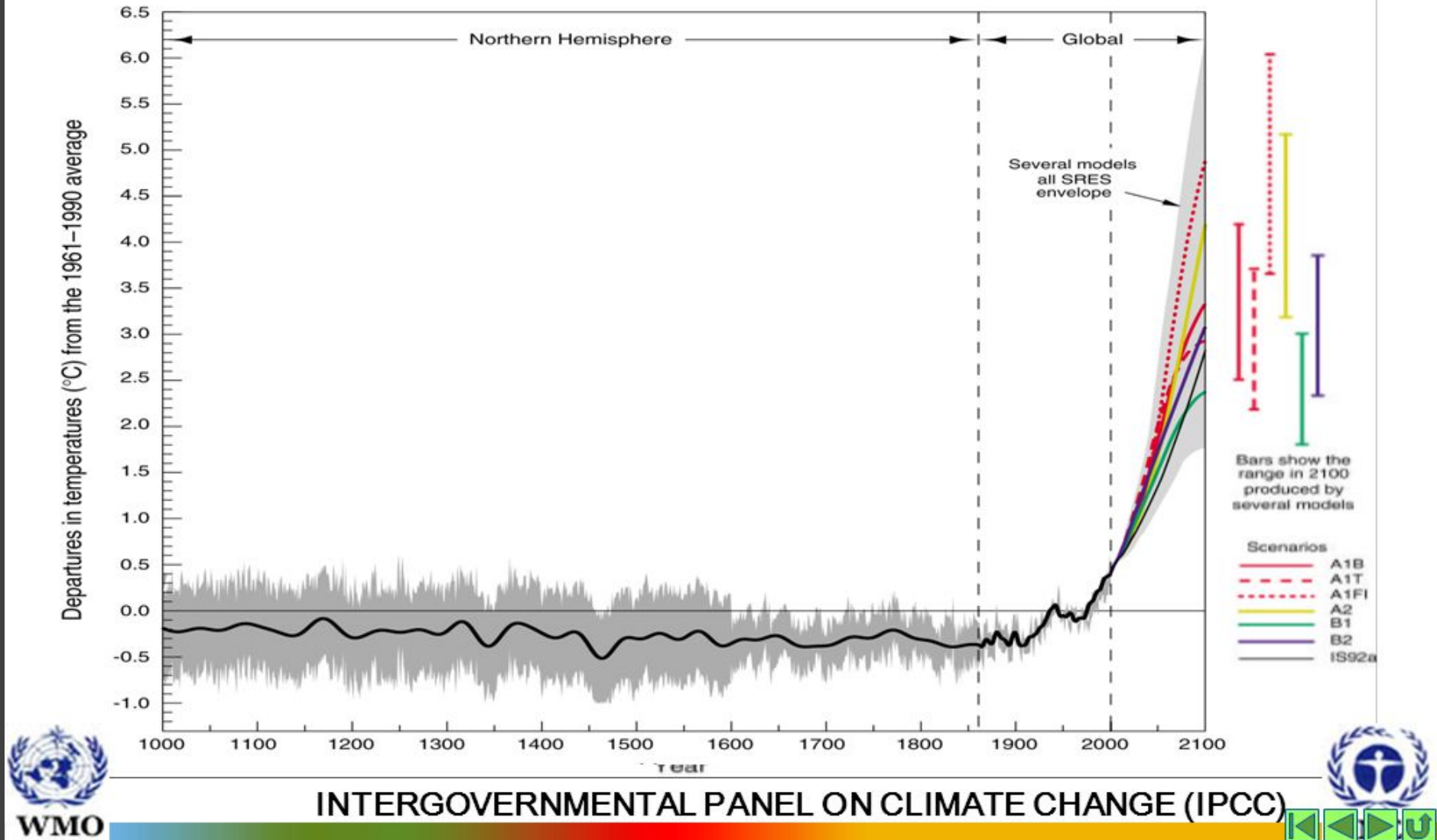
"Prediction is very difficult, especially about the future."
Niels Bohr, Danish physicist (1885-1962)

Mark E. Odegard, PhD
Grizzly Geosciences
Ennis, MT
www.grizgeo.com

**From the Executive Summary of the United States Global Change
Research Program transmitted to the Congress and the President**

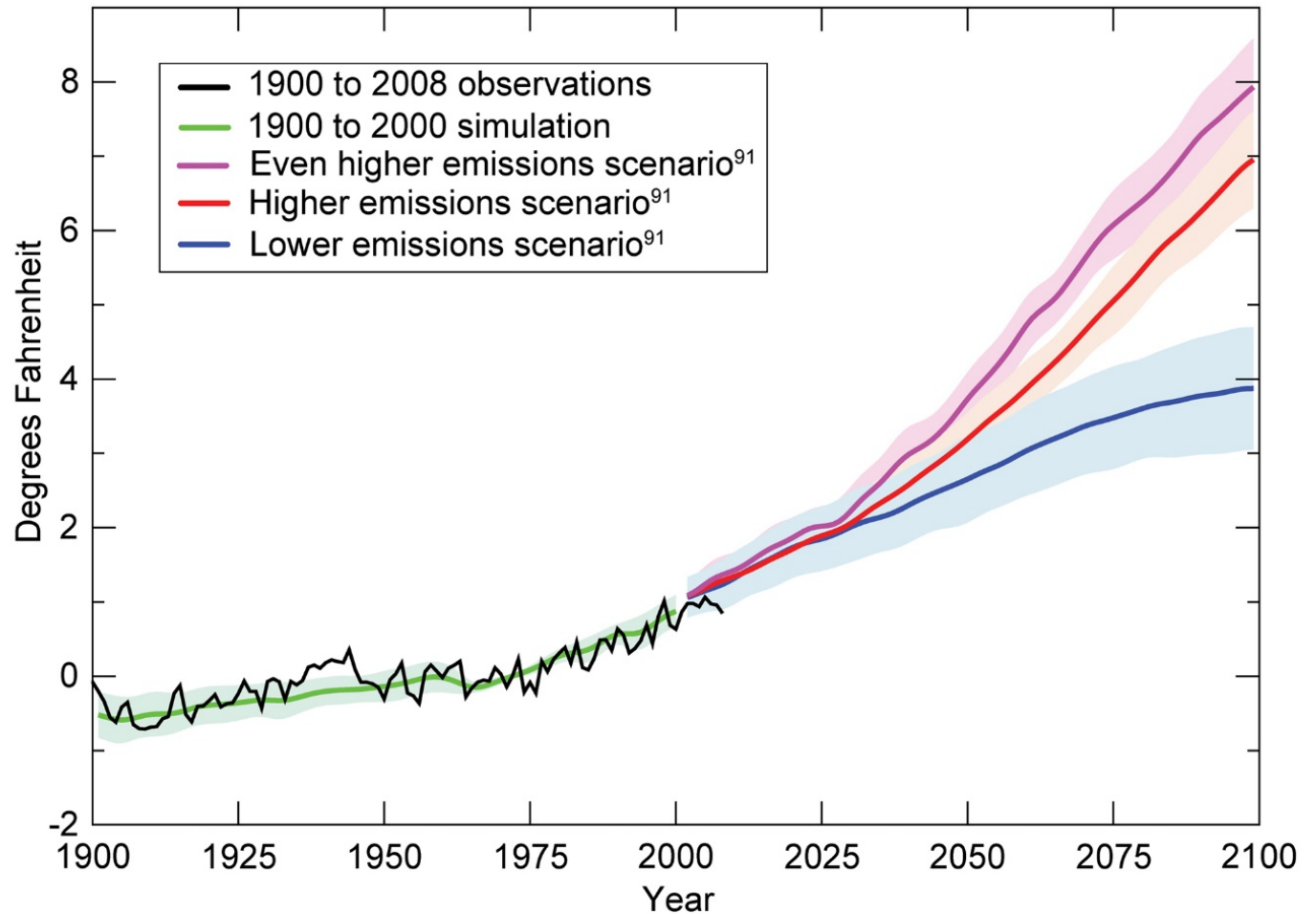
Display of
past and
possible
future global
temperature.

Global Mean Temperature Change



Display of recent and possible future global temperatures. A more recent estimate.

With the US withdrawal from the Climate Accords the “Lower emissions scenario” is no longer probable. This predicted a 4 degree rise by the end of the century. Current projections are for at least a 7 degree rise.



Smith *et al.*⁷²; CMIP3-A⁹³

Observed and projected changes in the global average temperature under three IPCC no-policy emissions scenarios. The shaded areas show the likely ranges while the lines show the central projections from a set of climate models. A wider range of model types shows outcomes from 2 to 11.5°F.⁶⁸ Changes are relative to the 1960-1979 average.

Comments



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