

Dedicated to the increase  
and diffusion of knowledge  
about how the nation's  
lands are apportioned,  
utilized, and perceived.

# The Lay of the Land

The Center for Land Use Interpretation



WINTER 2020

A physical delineation of nature terminates at the point where the sphere of intellect begins, and a new world of mind is opened to our view.

-Alexander von Humboldt

## VOICE OF AMERICA THE LONG REACH OF SHORTWAVE



*Voice of America: The Long Reach of Shortwave*, an exhibit about federal shortwave transmission sites in the USA, was featured at the CLUI space in Los Angeles in 2019, and included a shortwave radio speaker emitting a live transmission from the Edward R. Murrow Transmitting Station, in Greenville, North Carolina, the remaining active VOA shortwave broadcasting facility in the USA. CLUI photo

THE VOICE OF AMERICA BROADCAST federally produced radio programs to targeted nations around the world during World War Two. After the war, the programming continued, and expanded through the Cold War, using five powerful shortwave transmitting plants in the USA, boosted by relay stations overseas. The technology of mass communication has, of course, radically evolved since the age of radio. Now VOA is just one of several federal media entities generating and distributing official content in dozens of languages across numerous platforms, including TV, web, and

*continued on page 5*

## CONTINENTAL DIVIDE BETWEEN HERE AND THERE



The Continental Divide is indicated inside the overlook building atop Monarch Pass, Colorado. CLUI photo

THE CONTINENTAL DIVIDE IS ONE of the largest, most physical, and most incontrovertible lines in the nation. It runs along the crest of the continent, from Alaska to Mexico and beyond, marking the line where a drop of water falling on one side flows to the Atlantic Ocean, and on the other, to the Pacific Ocean. But of course it's not that simple.

In the past, the Continental Divide was one of the primary barriers to breach in order to link the nation, where the resistance in a sense was at its utmost, and costs—human and economic—to get through it reached their peak. The Divide was, however, conquered, surtopped with roads and rail through mountain passes, and undermined by tunnels. The flow of people and goods pushed its way though. The course of the very rivers that once defined the Divide have been altered, too, especially the Colorado, the southwest's major river, which has been substantially diverted eastward, into the faucets of the expanding Front Range. And some of the largest mines in the nation have been dug directly on the Continental Divide, altering drainage in ways that have not been mapped.

So where the Divide is, exactly, today, is a bit of a mystery. That mystery was the subject of an extensive research project at the CLUI over the past year, culminating in *Continental Divide*, an exhibit which opened in December, 2019 at the CLUI space in Los Angeles. The exhibit took in the Continental Divide as a whole, as a cultural artifact of the past and the present, and shows how we collectively, through our built environment, have responded to it, as a divider and uniter of these United States.

*A trip down the Divide begins on page 10, and is on our website at [www.clui.org](http://www.clui.org).*

### Editor's Note

Welcome to the 43rd CLUI newsletter, which covers the past year of CLUI programming, in 2019. This was a period of national divisions, international influence, and self-reflection—at least in terms of the subject of our programs. Any similarity to political conditions in the country are purely coincidental, as much as anything is. But, as our lengthy journey down the Continental Divide suggests, it is in the zone of division where opposing sides actually come together. So thanks for being here *and* there.

### IN THIS ISSUE

|                                  |    |
|----------------------------------|----|
| VOICE OF AMERICA.....            | 1  |
| CONTINENTAL DIVIDE.....          | 1  |
| GOLDEN SPIKES.....               | 2  |
| SHORTWAVE IN THE USA.....        | 7  |
| DOWN THE CONTINENTAL DIVIDE..... | 10 |
| SEEING THE SALTON SEA.....       | 36 |
| CLUI PROGRAMS AND PROJECTS.....  | 38 |
| BOOK REVIEWS.....                | 39 |

## GOLDEN SPIKES A SESQUICENTENNIAL CELEBRATION



Golden Spikes are a big deal at the 150th anniversary of the connection of the first transcontinental railroad. CLUI photo

THE GOLDEN SPIKE NATIONAL HISTORIC SITE in Promontory, Utah, is a remote interpretive reconstruction that marks the time and place where the first transcontinental railroad was completed, in 1869. Every year, for at least the past 50 years, restagings of the ceremonies held there in 1869 to celebrate the completion of the railroad has been performed, but no more so than last year, the 150th anniversary of this important event.

Promontory may be one of the most significant historic sites in the nation, commemorating the initial connecting of east and west through mechanical means, and the closing of the frontier, in a nation that had recently been split North and South by the Civil War. In addition to bringing legions of settlers west, the railway established the first rapid and reliable commercial link between the cities and bankers of the northeast with the bounty of the Orient off the Pacific Coast.

It is therefore of little surprise that as the event's 150th anniversary loomed, railway companies, politicians, railway historians, and fans of important interpretive sites (like members of the CLUI), started getting excited. In 2017, a group known as Spike 150 was formed by the state of Utah to plan and coordinate commemorative programming over the whole of 2019, including several exhibitions, but especially the grand reenactment and ceremony about the May 10, 1869 ceremony. This occurred on May 10, 2019, and was attended by more than 20,000 people.



The meeting of the reconstructed trains, in 2019.

CLUI photo



This monument was erected in 1916 by Southern Pacific Railroad to commemorate the site of the Golden Spike. It sat alone until the 1960s, when the National Park Service acquired the site, and built other interpretive facilities. In 2001, the monument was moved to a more secure and prominent location (in front of the visitor center) and restored. CLUI photo

### THEN

The construction of the railway was initiated by the Pacific Railway Act, signed by President Lincoln in 1862. Over the following seven years, thousands of people, in the west mostly Chinese workers, laid 1,912 miles of track, connecting Omaha, Nebraska to Sacramento, California. This included 15 tunnels blasted through the Sierras, and involved laying as much as ten miles of track in a single day.

Gaining territory as they went, the Central Pacific Railroad (building the line from the west) and the Union Pacific Railroad (building the line from the east) went past each other for 200 miles, before Congress stepped in and designated the meeting point at Promontory. Central Pacific got there by May 1, 1869. Union Pacific was a bit behind schedule, but agreed to a May 8 meeting time. However, the train bringing the dignitaries of Union Pacific to the event was forced into a siding by railworkers, who held the company's Vice President, Thomas Durant, hostage, and threatened his life, until payment they were owed was produced. When it was, Durant was released, and the train made it to Promontory for the delayed celebration on May 10.

What actually, exactly, happened at the Ceremonial Driving of the Golden Spike in 1869 is debated. The event was hastily planned, and firsthand accounts are surprisingly few, and conflicted. Though the event was attended by at least several hundred people, mostly railroad workers and soldiers, it was difficult to see and hear what was happening around the short piece of track where the ceremonial activities were taking place.



Just as it was in 1869, the event was crowded, making it difficult to see. CLUI photo



## GOLDEN SPIKES

It is generally accepted that at around 12:30 pm, after speeches by Arizona's governor, a newspaper editor, and railroad representatives, the president of Central Pacific, Leland Stanford, was handed two ceremonial spikes manufactured for the event, and Thomas Durant, vice president of Union Pacific, was given another two. The two executives placed the spikes into four pre-drilled holes in a polished ceremonial railroad tie, made by a billiard table manufacturer in San Francisco. The spikes were then tapped into place by Stanford and Durant with a ceremonial maul.

Soon after, the anointed precious metal spikes were removed for safe-keeping, and the ceremonial tie was replaced by an ordinary pine tie, into which three ordinary and functional iron spikes were driven, by someone, probably a railway worker. Then, according to one account, a special spike hammer that was wired to a telegraph, so that the world could hear the pounding of the real and final last spike, was handed to Leland Stanford, whose swing missed the spike, and hit the tie. It was then given to Thomas Durant, who missed the spike and the tie completely (he was said to have been hungover from the celebrations the night before, in Ogden, or maybe was just out of sorts from being held hostage).

The hammer was then handed over to a rail worker who expertly drove it in. The Western Union operator at the nearby telegraph table made up the missing dots and dashes to send out the final one word message—DONE, and the railway was thus opened to traffic, uniting the nation.



Just as it was after the ceremony of 1869, at the end of the day in 2019, it was good to be D.O.N.E!  
CLUI photo

That traffic started with a traffic jam, as the two trains bringing the dignitaries from east and west were pointed head to head, as depicted in the famous photo of celebrants by Andrew J. Russell. The trains used the nearby Y-track to turn around, and then headed back to where they came from, crossing over the last spike in the last tie for the first time.

Immediately after the ceremony, spikes were pulled out of the last tie for souvenirs, and replaced with others, generating possibly dozens of additional, unofficial last spikes. The tie itself was scraped away by souvenir hunters, and replaced a number of times. Eventually things settled down, and stayed in place, at least for the next 50 years or so.

This stretch of the transcontinental railroad ended in 1904, when the Lucin Cutoff opened, with its wooden trestle spanning straight across the Great Salt Lake, shaving 44 miles off the original route, from Promontory over the north shore of the lake. Apparently no commemoration was held at the site for the Golden 50th anniversary of the Golden Spike, in 1919.

After a few decades of little to no use, the tracks from Corrine to Lucin were removed to provide steel for the war. As part of this, on September 8, 1942, a "pulled golden spike" was ceremoniously removed at Promontory, before a crowd of railroad and state officials, including the Governor of Utah, in front of two steam locomotives facing each other. This marked the end of the old rails, though they would return as reconstructions a few decades later.

In the meantime, the lack of tracks didn't stop people from coming out. Local historically-minded citizens, including members of the Sons and Daughters of the Pioneers, arranged educational reenactments annually on the anniversary, where Leland Stanford was frequently portrayed missing the spike with his hammer.

Lobbying efforts to increase awareness and appreciation of the site gained momentum in the 1960s, with the approach of the 100th anniversary of the Golden Spike. The federal government acquired the land, and in 1965, the Golden Spike National Historic Site was established on paper. A visitor center, displays, and staff housing for the remote site were constructed by the time of the centennial celebrations and reenactments, which were attended by as many as 12,000 people.

After the centennial, at least once every year, and often more often, the Golden Spike ceremony of 1869 has been performed by reenactors on site, as a kind of local national pageant, developing its own mythic mutations of fact and lore. On the 110th anniversary, replicas of the two locomotives that were present in 1869 were placed on a 1.5 mile stretch of re-laid track, into which golden spikes were pounded and removed year after year. Since then this has occurred over and over on weekends between May 1 and Labor Day.



There were many more dignitaries in attendance and giving speeches in 2019 than there were in 1869. The 2019 ceremonies included the federal secretaries of Transportation and Interior, members of Congress, as well as the heads of Union Pacific Railroad, and of the Mormon Church.  
CLUI photo



Displays were set up outside in the space around the visitor center, which was closed to the public, as crowds were simply too big (it was used instead as a VIP staging area and refuge).  
CLUI photo

## NOW

On the sesquicentennial, May 10, 2019, events began with a Chinese lion dance, and an address by the head of the Chinese Historical Society of America, attempting to make up for the historic lack of acknowledgement of the role that Chinese workers had in building the railway, especially in the western section, where many lives were lost, and racism was rampant.

More addresses followed, first by the Secretary of the Interior, who speculated that President Trump would have loved to be here, and would have enjoyed this event. Then the superintendent of the Golden Spike National Historic Park spoke, followed by prayer, blessing, and drumming and dancing by members of the Northwestern Shoshone. A pledge of allegiance was then led, followed by singing of the National Anthem. Then the Governor of Utah spoke, followed by a Congressman.

Several VIPS then collected on the stage, including Mitt Romney, when Russell Nelson, the president of the Mormon Church, started a ceremony to hammer in a new ceremonial spike. This one, made of copper, was offered up by Rio Tinto, meant to correct the imbalance of commemorative state spikes: there were two for California, one for



Unlike at the 1869 ceremonies, in 2019 there were many historic exhibits, displays, and retail opportunities.  
CLUI photo

Nevada, and one for Arizona, but none, up to this point, for Utah. Its inclusion also recognizes the fact that Rio Tinto's copper mine, the Bingham Pit, has been one of the largest generators of revenue in Utah for over a century and is called the "Biggest Hole on Earth."

After this ceremony, the Federal Secretary of Transportation gave a speech, followed by comments from Lance Smith, the CEO of the Union Pacific Railway, now the largest railway in the land, having swallowed up most of the others, including the Central Pacific. Then the keynote speaker, the historian and author Jon Meacham, took the podium. And so went the day, until the reenactment of the 1869 Driving of the Golden Spike, by the professional commemorative Golden Spike drivers of the Golden Spike Association, followed by a toast led by the Ambassador of Ireland, and a video address by the Chinese Ambassador. A musical performance called As One, and a children's chorus closed the festivities.



All kinds of spikes were for sale.

CLUI photo

## AND WHAT OF THE SPIKES?

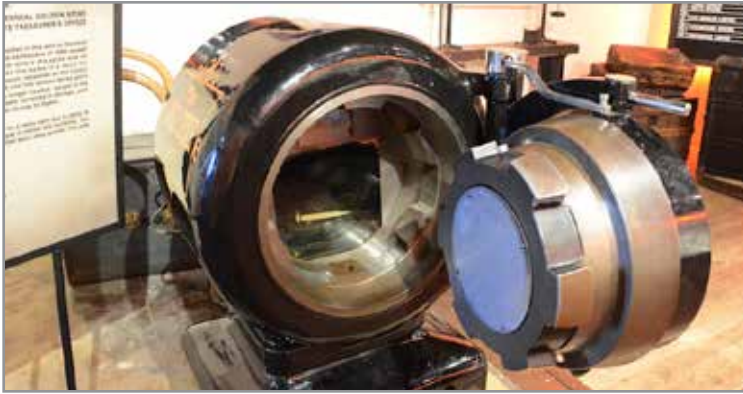
The notion of a "golden spike" as an anchor of time and place was established and asserted here at Promontory, like nowhere else. Its effect is like that of a map pin, placed on a one-to-one scale map of the landscape. However, the actual golden spikes, removed from the site, made their own journeys, becoming historical reference points.

Three of the four ceremonial spikes from 1869 ended up in collections and are often on public display. The main Golden Spike is the one made by David Hewes, an early developer of San Francisco, and a friend of Leland Stanford. It apparently was his idea to make a Golden Spike for the ceremony, so he is the likely progenitor of the concept, and the term. The spike he had made for the event was cast in 17.6 carat gold, and weighed 14 ounces.

Hewes donated some of his art and artifact collection to Stanford University in 1892, and the spike is generally on display there (at the Cantor Arts Center), though on May 10, 2019 it was on display in the Utah State Capitol, joining two other spikes used in the 1869 ceremony—three out of the four golden spikes together again for the first time since the 1869 ceremony.

Unknown to most people, Hewes actually had two golden spikes made for the event. The other stayed in his family's possession until 2005. It is now on display at the California State Railroad Museum in Sacramento.





The most golden of the Golden Spikes used in the 1869 ceremony spent much of its life on display in a custom-made safe at Stanford University. It was relocated on occasion to other displays, such as at the Wells Fargo Bank in San Francisco, from 1936 to 1954, then again after the Loma Prieta earthquake of 1989. It was returned to Stanford when the Cantor Center for the Arts opened in 1999, where it has resided ever since, except when it is out on loan. The safe, not used for its display at the Cantor Center, was left in storage until it was put on display at the Utah Railway Museum, in Ogden, in 2011. The golden spike inside the safe is a replica. CLUI photo

One of the four official ceremonial Golden Spikes was made of silver, not gold, as it represented Nevada, the Silver State. It was made hurriedly in Virginia City days before the event, and was given to Leland Stanford when he was on his train in Reno, on his way to the ceremony at Promontory. It became part of the collection at Stanford University, and is often displayed with the main Golden Spike.

The Arizona Spike used in the 1869 ceremony is an iron spike plated in gold and silver. It was presented by the governor of the Arizona Territory at the Golden Spike event, then taken back to the New York City headquarters of Union Pacific, and owned by its president, Oliver Ames. His family donated it to the Museum of the City of New York, which has loaned it to Union Pacific's museum at Council Bluffs, Iowa, since 2003.

The fourth Golden Spike used in the 1869 ceremony is the rogue spike. It was made for the event by the eccentric San Francisco newspaperman and aviator Frederick Marriott, who is said to have personally given it to Leland Stanford before he left San Francisco for the ceremony. It is an inch or so shorter than the main Golden Spike, but is also made of gold. It is suspected to have been lost in the chaos of the 1906 earthquake in San Francisco, when the ceremonial railroad tie was also lost, in a fire. Whether it was or not, or was secretly recovered, or remains in the debris in the ground, or in private hands, is unknown to history, at present. ♦



A golden spike has been on display at the CLUI Orientation building in Wendover, Utah for more than a decade. Its origins are unknown. CLUI photo

*continued from first page*

social media. Four of these five domestic shortwave plants, once the largest radio transmission facilities in the nation, have been abandoned in place, becoming monuments to the waning power of radio. One of them remains online, still pushing the Voice of America across the globe, where an estimated 250 million people listen in on shortwave radios.

Voice of America programming is produced in Washington DC, and the VOA is one of several entities operated as part of the U.S. Agency for Global Media, which includes Radio Free Europe, Radio Free Asia, the Middle East Broadcast Network, and Radio y TV Martí (which produces programming specifically for Cuba). The agency employs 3,500 people, who work over a wide spectrum of media, including FM and AM radio, television, web, and social media platforms, distributed by radio, satellite, and internet around the world, in more than 50 languages. To do so, the agency operates 19 transmitting stations, in countries that include Kuwait, Djibouti, Burkina Faso, Botswana, Germany, Guam, Thailand, Tajikistan, South Korea, and the Philippines. Some of these overseas facilities have been enhanced by transmitters and parts that were salvaged from the four closed US transmission plants.



Bethany Station, West Chester, Ohio.

CLUI photo

### **The former Bethany Relay Station**

The Bethany Relay Station was the first dedicated VOA transmission station to be constructed, going online in 1944. It was located in Ohio, further inland from existing transmission facilities on the east coast that were vulnerable to ship and submarine attack. Bethany was initially powered by six 200,000-watt transmitters built and operated for the government by the Crosley Broadcasting Corporation, the Cincinnati-based company that operated a powerful AM radio station nearby. Using 24 rhombic antennas and two large curtain antennas, the plant broadcast several simultaneous transmissions to targeted regions overseas, including to relays in the Mediterranean that boosted the signal into the Soviet Union.

The facility closed in 1994, and most of its transmitters were shipped to other facilities abroad. The antennas were removed, and the square mile of land was converted into a park and a shopping center. The building has become a museum, focusing on the early days of the VOA, the Crosley Corporation, and local radio and television entertainment history.



Dixon Transmission Station, Dixon, California.

CLUI photo

### The former Dixon Transmission Station

During World War Two, the Office of War Information ordered the rapid construction of two shortwave transmitters on the west coast, in addition to the one in Bethany, Ohio. NBC built and operated this one for the government in Dixon, California, west of Sacramento. It went online in late December 1944. After the war, the site was updated with more transmitters, and ultimately had ten in operation, each capable of transmitting programs simultaneously through dozens of antenna arrays. Transmissions were directed to the Pacific Rim, including Japan, Australia, and the Philippines.

The facility was mothballed in 1979, but broadcast Spanish programs intermittently until 1988, when it became the first of the five continental VOA transmission stations to close. The facility was declared surplus in the 1990s, and was sold at auction in 1998 for \$160,000. Since then it has been used by private companies for aircraft communications, but is currently, apparently, inoperative. The Navy has maintained a large transmission facility next to it, broadcasting at very low frequencies to communicate with ships and submarines in the Pacific.



The entrance to the former Delano transmission station.

CLUI photo



Delano Transmission Station, Delano, California.

CLUI photo

### The former Delano Transmission Station

The Los Angeles division of the broadcasting company CBS built this transmitting facility for the Office of War Information (the precursor of Voice of America) in 1944, in the town of Delano, north of Bakersfield. It was nearly identical to the one built at the same time by NBC in Dixon, and like that one it directed its programs to the Pacific Rim and Asia.

Like Dixon, and the Bethany Station in Ohio, it was expanded with more and larger transmitters, exceeding a million watts of broadcasting power by the early 1950s. As with the other two, the federal government took direct control of the facility from private contractors in 1963, as the Cold War heated up. Unlike the other two, Delano was enhanced with television broadcasting capabilities, using satellite transmission dishes. Delano ceased operating in 2007, the last of the three World War Two-era VOA facilities to close.

As with Dixon, its antennas are still in place, though most of the transmitters have been removed and reused. One of them was recently acquired and moved to a broadcasting museum in Bloomfield, New York. The 800-acre site is still owned by the federal government, which is waiting to hear if the town of Delano's proposal to build an airport at the site will be approved by the FAA. If it is, the towers will have to be removed, and the fate of the main building is unknown.



Transmission Station A, Greenville, North Carolina.

CLUI photo



### The former Greenville Transmission Station A

Just as there were two similar shortwave transmitters pushing VOA programming over the Pacific, there were two nearly identical transmitters doing the same over the Atlantic: Site A and Site B, 15 miles apart, near Greenville, North Carolina. They were both built in 1962, as the Cold War was raging through the Cuban Missile Crisis, and atomic testing reached its peak.

Site A was closed in 2007 and was eventually transferred to the state's Wildlife Resources Commission, which operates most of the 2,700-acre site as a bird habitat, and hunting grounds. The commission had the antennas demolished and removed in 2016, but the transmitter building, behind a fence in the middle of the site, is unused and unmaintained. Most of its transmitters are still in place, though stripped of some useful spare parts. Vandalism and scavenging has just begun.



Transmission Station B, Greenville, North Carolina.

CLUI photo

### Transmission Station B

The transmitting station in Greenville, North Carolina, known as Site B, and also as the Edward R. Murrow Transmitting Station, has broadcast Voice of America programming globally via shortwave since 1963, and is the only federal facility in the USA that continues to do so.

It is the largest shortwave broadcast transmission facility in the country, with nine 500,000-watt transmitters and 39 antenna arrays, with masts as high as 450 feet, in a clearing that covers four square miles. A dozen federal employees keep the transmitters and antenna arrays functioning, often themselves manufacturing spare parts for the old equipment.

The facility typically uses at least three of its transmitters for Spanish programming aimed at Cuba. English language news and music is also broadcast from here to Africa, Europe, and the Middle East, and by relays to former Eastern Bloc countries. ♦

*More on Transmission Stations A and B on the CLUI website at [www.clui.org](http://www.clui.org).*

## SHORTWAVE IN THE USA

BROADCASTING TO EVERYONE ELSE (MOSTLY)

*Shortwave is very long in its range, and very directional. It reflects off the layer of charged atoms in the ionosphere, so broadcasters point their antenna arrays towards their intended target audience, even if they are thousands of miles away, and angle the signal upwards, so it bounces off the ionosphere at the right point to come back down to earth over the target area, skipping over the curvature of the globe. Shortwave also is affected by interference from near frequencies, weather, and from solar activity, making it advantageous to shift frequencies based on other global broadcasts, and time of day. It is not generally used for broadcasting inside the USA, as we have developed more stable and regionally based systems for this, such as AM, FM, VHF, and UHF. Shortwave, technically HF (high frequency) is used instead to send programming beyond the nation's borders. For years it was not even permitted to be used for audiences in the United States.*

THE US GOVERNMENT'S AGENCY FOR Global Media's Voice of America facility at Greenville, North Carolina is the largest shortwave radio broadcasting facility in the USA, but it is not the only one. There are dozens of others, including those that come and go with periodic programming. The largest and most powerful ones are for religious broadcasting, operated by Christian missionary organizations, and targeted at places like South America. Indeed, audio and radio equipment companies founded by missionaries, like Crown International, have often led the way in increasing the durability, power, and reach of amplifiers and transmitters.

Since the audience is outside the country, continental US based transmitters tend to be located on the edge of the country that is closest to the overseas target area, though some distance inland also works, given the long reach of shortwave. Stations in the southeastern USA, for example, can have antennas pointed south towards the Caribbean and South America, as well as east, to Europe and Africa.

The largest licensed commercial and religious shortwave broadcasting stations in the country include:

### WEWN - Irondale, Alabama

WEWN, the Worldwide Eternal Word Network, is a powerful Catholic shortwave broadcasting station located in Irondale, Alabama, outside of Birmingham. With four 500,000-watt transmitters, broadcasting English programming to Africa, India, Southeast Asia, the Middle East, and Europe, and Spanish programs to the Caribbean, Mexico, and Central and South America, it is owned by Eternal Word Television Network, which was founded by Mother Angelica, a Birmingham-based Catholic nun who became a religious television personality.

### WHRI - Furman, South Carolina

WHRI, World Harvest International, operates a large broadcasting facility near Furman, South Carolina, sending Christian programming in English via shortwave to Asia, Europe, the Caribbean, and Central and South America, using two 500,000 watt transmitters, among others. It has also operated transmitters in Greenbush, Maine; Hawaii; and Palau, Indonesia, all of which have been closed,

concentrating its shortwave power in South Carolina. It is owned by the Family Broadcasting Corporation, a Christian television network, headquartered in South Bend, Indiana.

## **WTWW - Lebanon, Tennessee**

WTWW, We Transmit World Wide, is a Christian shortwave station in Lebanon, Tennessee. It opened in 2010, and uses a 100,000-watt Continental transmitter and a Harris 50,000-watt transmitter to broadcast programming to eastern Canada, Europe, northern Africa, and the Middle East. It is owned by the Leap of Faith company.

## **KVOH - Simi, California**

KVOH, the Voice of Hope, which broadcasts from Chatsworth Peak, above Simi, California, covers the Caribbean, Cuba, Mexico, Central and South America, with evangelical Christian programs using a 50,000-watt RCA transmitter, broadcasting on 9,975 kHz during Western Hemisphere evenings and 17,775 kHz during Western Hemisphere daytime. It was established in 1986 by the millionaire evangelist Dr. George K. Otis, who founded High Adventure Ministries, based in Simi, which operated missionary stations around the globe, starting with a station in Lebanon in the 1970s, broadcasting the Gospel and country music throughout the Middle East.

## **WINB - Red Lion, Pennsylvania**

WINB is a Christian shortwave radio station in Red Lion, Pennsylvania, with a 50,000-watt Continental Electronics transmitter. It is what they call a brokered shortwave broadcasting station, meaning it broadcasts content generated by others for a fee, rather than its own or other single source programming. This is a common way for shortwave broadcasters not owned by wealthy evangelical or missionary organizations to stay in business. WINB, also associated over the years with WGCB, WLYH, and WBPH, started broadcasting in 1962, and claims to be the oldest private international shortwave station in the USA.

## **WWCR - Nashville, Tennessee**

WWCR, World Wide Christian Radio, is a brokered Christian shortwave radio station in Nashville, Tennessee, with four 100,000-watt Continental Electronics transmitters, broadcasting over 400 religious and talk radio programs, including right wing commentators like Alex Jones. Target regions range from South America to Africa, Europe, and the Middle East.

## **WBCQ - Monticello, Maine**

WBCQ The Planet, is a shortwave station in northern Maine, that transmits a wide (perhaps the widest) variety of programs on legal shortwave. It is the only licensed (non-pirate) shortwave station dedicated to free speech, and is managed by former pirate radio broadcaster Alan Weiner. In 1986 Weiner became well known for operating an unlicensed radio station on a ship in international waters off the shore of New York City, which was raided by federal authorities within a few days, and destroyed. Since then he has built up a powerful free speech shortwave and AM station that broadcasts legally on property he owns in Monticello, Maine. He has a 500,000 watt Continental transmitter, and a few additional 50,000-watt transmitters. Programming, especially religious programming, pays

the electric bills, but WBCQ will consider almost any content that is sent to them.

## **WRMI - Okeechobee, Florida**

WRMI, Radio Miami International, is currently the largest commercial shortwave station in the in the USA. Like many of the others, it is a brokered station, meaning it sells time for whoever pays for it. This includes a fair amount of religious programs, but WRMI tries to focus on international news and business programs, selling airtime for as little as \$1 per minute, as well as local cultural programs in Spanish and English. It also serves as a relay, boosting the signal for international shortwave broadcasts from the Ukraine, Italy, Japan, and several other nations in Europe and Eastern Europe. In 2013, the station purchased the former WYFR facility in Okeechobee, Florida, and now has 12 100,000-watt transmitters, and antennas pointed at many parts of the world.

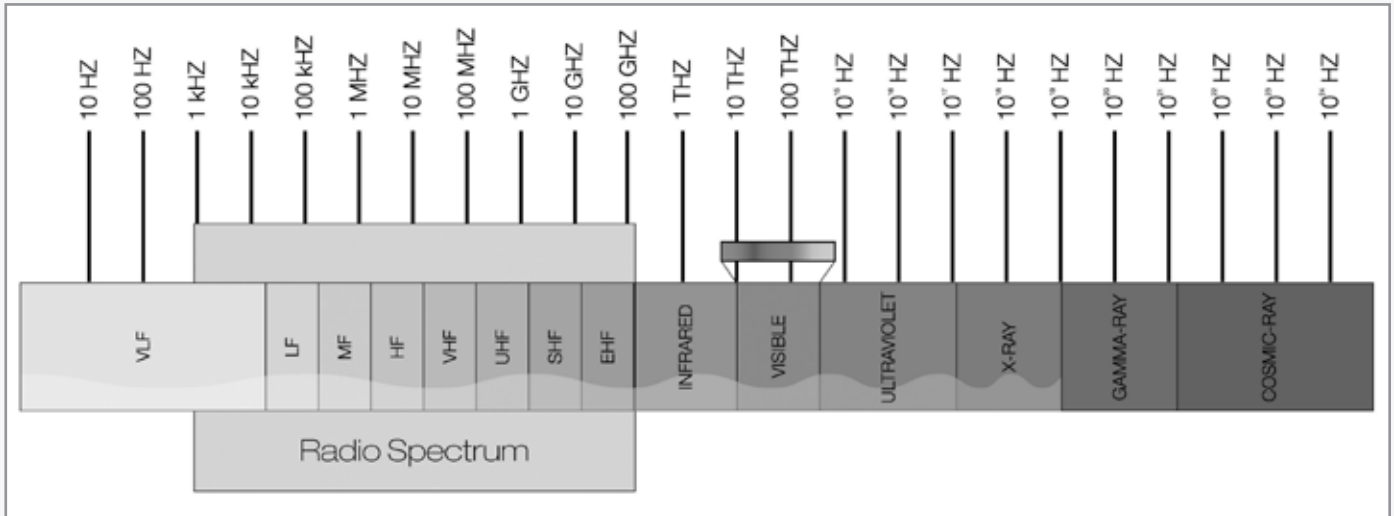
There are other federal broadcasting facilities that use the shortwave portions of the radio spectrum, including the American Forces Network, which produces and broadcasts television, radio, and other media content for the US armed forces domestically and overseas, through a system of transmission facilities connected by satellite and cables all over the world, though it apparently does not operate any shortwave radio facilities in the continental USA anymore. It uses Navy shortwave transmitters and relays at Diego Garcia, Puerto Rico, Guam, and other international sites to send programming to ships at sea, while facilities at Pearl Harbor, Hawaii and Key West, Florida are no longer used.

Strategic military uses of shortwave have been explored for long range communication with ships and submarines, too, including at the experimental "ionospheric heating" facility in Alaska, known as the High-Frequency Active Auroral Research Project (HAARP). Generally though these global forms of communication use very low frequencies, with long waves, far outside the higher frequencies of shortwave. Shortwave bands from the 1950s to 1990s were also used for over the horizon radar, to detect rockets and aircraft, including at major antenna arrays at Moscow Air Force Station in Maine, covering the east coast, and two facilities on the west coast (in Oregon and northern California). These have been closed, though their footprint and some outbuildings remain.

The government also operates a shortwave broadcasting station that is said to be the longest continuously operating radio station of any kind, in the USA, if not the world. Known as WWV, in Fort Collins, Colorado, and its sister station WWVH, in Hawaii, these are time stations operated by the National Institute of Standards and Technology. WWV broadcasts time on several frequencies, and has been doing so since 1919 (though at other locations until the facility was built at Fort Collins in 1966).

In addition to electronic signals used automatically by receivers to synchronize clocks and machinery, the station transmits voice and tones to announce Coordinated Universal Time every minute, and makes other recorded announcements on an hourly schedule. The Colorado station uses a male voice for this, while the station in Hawaii uses a female voice. ♦





NASA image

## Radio is Everywhere

We are, of course, immersed in a continuous deluge of radio waves, from human and non-human sources, which along with the rest of the oscillations of the electromagnetic spectrum, are flying in all directions everywhere around us and through us, mostly invisible, and traveling at the speed of light. Radio is the portion of the electromagnetic spectrum that we chose to detect, with devices tuned to decode the signals embedded in the waves.

Radio is the low-energy end of the electromagnetic spectrum, where waves are long and oscillations slow. Like most things, radio waves can be measured in time, as well as space. In time, it is usually by frequency, meaning how many waves occur per second. This is generally described in units known as hertz, named after Heinrich Hertz, the 19th century German physicist who was among the first to understand the electromagnetic spectrum.

Described spatially, instead of by time, radio waves can be measured by wavelength—looking at the size of each wave's length. For example, since radio waves, like other electromagnetic waves, generally travel at the speed of light, the occurrence of a single oscillation in one second of time—a frequency of one hertz—would be the distance covered traveling at the speed of light in one second, which is around 186,000 miles. That is a very long wave.

Radio waves are commonly described as having frequencies ranging from 1,000 hertz to 100 billion hertz (100 gigahertz), which corresponds to wavelengths ranging from 185 miles in length to three millimeters in length. Wavelengths smaller than that approach the microwave part of the electromagnetic spectrum, in the infrared. As the waves continue to shrink to the infinitesimal, wavelengths move from invisible waves in the infrared, into visible light waves, then beyond the visible again into ultraviolet, x-rays, then gamma rays.

The range of radio can be divided into a dozen bands, from extremely low frequency (ELF) and very low frequency (VLF), through medium frequency (MF), high frequency (HF), very high frequency (VHF) to tremendously high frequency (THF), which is well into the microwave range. Over the past 120 years, all of these bands have been used to carry electronic signals from one place to another.

Guglielmo Marconi was the first to develop long distance radio transmitters and receivers, using a medium frequency of around 850,000 hertz to send a faint signal across the Atlantic for the first time in 1901. Ship-to-shore radio developed quickly after that, followed by commercial radio, after World War One, with the emergence of RCA, NBC, and CBS, in the USA. These, too, used medium frequency

ranges, settling on the 540,000 hertz to 1,600,000 hertz (540-1600 kilohertz) still used by AM radio in the USA today.

Television emerged as a broadcast medium after World War Two, using VHF frequencies that bookended those used by FM. FM stereo broadcasting begins in the 1960s, using the 88,000,000 hertz to 108,000,000 hertz range, familiar to Americans as the “88MHz-108MHz” of the FM dial. TV eventually expanded into the UHF range too. Unlike the longer waves used by AM, FM and VHF don't make it over the horizon, limiting broadcasters to a range of around 30-50 miles or so. This is generally why the towers are placed on mountaintops near the population centers they serve.

Military research during and after World War Two expanded the use of other bands of the radio spectrum, such as extremely low frequency, ELF, whose long waves—less than 30 hertz, and a single wavelength of more than 6,000 miles in size—travel through earth and water, enabling communications with submarines around the world. Military research and applications for things like communications, radar, and electronic countermeasures, run into the microwave ranges, and beyond.

With the recent proliferation of consumer communications electronics and commercial data networking, civilian use of the radio spectrum, while limited in its range of spectrum use, is greater than military use in its consumption of bandwidth. Cell phones, Bluetooth, and wifi communicate on the super high frequency range, from 1 gigahertz to 6 gigahertz. These small waves do not penetrate well, and are best used for communication between two fixed points, and at short range, though they can carry large amounts of data.

Due to the long distance capabilities of some radio signals, and the effects of one signal on another, radio is governed by national and international regulatory agencies, such as the FCC in the USA, and the International Telecommunication Union, headquartered in Geneva, which is among the oldest global international organizations (and now part of the UN).

Historically, international cooperation has been necessary, especially because of shortwave. State-controlled shortwave radio programming is still broadcast by dozens of nations, including the UK (the BBC), India, China, Japan, Saudi Arabia, Romania, Korea, Afghanistan, Albania, Algeria, Angola, Turkey, Russia, and the USA.

Though few listen to shortwave in the USA beyond some ham radio hobbyists and DXers, it remains popular in other parts of the world, especially those not served well by broadband or cable, or short range forms of radio, like FM and television bands on UHF and VHF. ♦

## DOWN THE CONTINENTAL DIVIDE

ONE WAY OR ANOTHER

*The Continental Divide is the American apogee, and a fulcrum, backspace and bottleneck. We have shaped it, and been shaped by it. A voyage down the line, from top to bottom, Canada to Mexico, is a trip that looks at a common territory, along the shared space of divergence.*

## PART 1: MONTANA



Logan Pass, where Going to the Sun Road travels over the Continental Divide in Glacier National Park. CLUI photo

**The Great Divide in Glacier National Park**

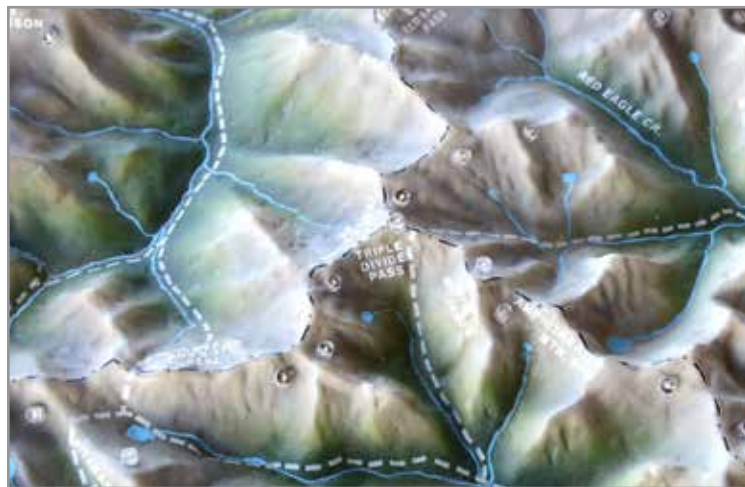
In the US, the Continental Divide emerges perpendicularly from another great dividing line—the US/Canada border (the subject of a similar linear portrait exhibit at the CLUI a few years ago). Technically, however, the Continental Divide starts in the Bering Sea in Alaska, and travels across that state, then through the Canadian Rockies, until entering the contiguous continental USA. But given our interest in the cultural landscape, less prominent in the Alaskan wilderness, and our focus on the USA, we will begin our stroll down the Divide where it enters the nation, in Montana.

The southern part of the boundary between the Canadian provinces of Alberta and British Columbia follows the Continental Divide, so where this provincial boundary meets the international border, an east-west line set by treaty at the 49th parallel, is where the US portion of the Continental Divide begins. The land is in Glacier National Park, a one million-acre park established in 1910, with numerous 8,000 and 9,000-foot peaks, more than 100 lakes, 50 small alpine glaciers, and three grand lodges. The US Government bought the initial 800,000 acres that would become the park from the Blackfeet Indians, whose principal reservation covers nearly two million acres east of the park.

Twenty linear miles south of the border, after following remote peaks and ridgelines, the Divide crosses pavement for the first time, next to the parking lot for the visitor center at Logan Pass. At 6,646 feet above sea level, Logan Pass is the highest point on the Going to the Sun Road, the only road through the park. The road was built between 1921 and 1932, and given the steep topography, is considered an engineering landmark. It is closed for much of the year, due to snow and avalanche danger. At the height of winter, drifts bury the road at Logan Pass in as much as 80 feet of snow. The opening sequence of the film *The Shining*, familiar to many, was shot

along this road, and shows the doomed family's little yellow VW Bug heading towards Logan Pass.

Going to the Sun Road is 50 miles long, and connects the east entrance of the park to the west entrance. The east entrance is at the town of St. Mary, where there is a visitor center, and a gate where people pay the park entrance fee. At the other end of the road is the west entrance to the park, and the community of West Glacier. Logan Pass is at the halfway point on the road, and the apogee.



Triple Divide Peak, as indicated on a raised relief map in the visitor center at Glacier National Park. CLUI photo

**Triple Divide Peak**

A few miles south of Logan Pass, the Continental Divide reaches its highest point in the park, at Mount Jackson, 10,052 feet above sea level. A few miles further, the Divide goes through a mountain top called Triple Divide Peak, a place that challenges the notion of a binary Continental Divide. The east side of the peak is drained by Atlantic Creek, which flows into the Cut Bank River, which flows into the Marias River, which flows into the Missouri River, which flows into the Mississippi, which drains into the Atlantic Ocean.

The west side of the peak is drained by Pacific Creek, which flows into Nyack Creek, which flows into the Flathead River, which flows into the Clark Fork River, to the Pend Oreille River, to the Columbia River, which drains into the Pacific Ocean.

The north side of the peak, however, drains into Hudson Bay Creek, which as the name implies, flows, eventually into Hudson Bay, in the Canadian north, which opens into the Arctic.

Not all of the water gets there though. Hudson Bay Creek flows into Red Eagle Creek, which flows into St. Mary Lake, which flows through a channel behind the park visitor center, leaving the park and entering Lower St. Mary Lake. At the other end of that lake is a diversion dam, where much of the flow of the St. Mary River is diverted into a canal. After a few more miles, and just a few miles from the Canadian Border, the canal crosses over the river in a set of pipes, and heads eastward. What remains of the St. Mary River flows into Canada, and is a major source for agricultural water in Alberta, before draining into Hudson Bay.

Meanwhile, the diverted water in the canal drains into the Milk River, and is used for agriculture in Montana, before the Milk River joins the Missouri River, where the Missouri spills out of the Fort Peck Dam in eastern Montana, and eventually into the Mississippi in St. Louis, and the Atlantic Ocean, south of New Orleans. Triple Divide Peak could perhaps be renamed Two and a Half Divide Peak.



## CONTINENTAL DIVIDE



Monuments and interpretive plaques at Marias Pass.

CLUI photo

### Marias Pass and the Great Northern Railroad

Just outside the southern end of the park is Marias Pass, where the Continental Divide, heading south, crosses its second road, US Highway 2, and the tracks of the Great Northern Railway. Highway 2 is the country's northernmost continental highway, running from the Great Lakes in northern Michigan to Puget Sound in Washington State.

A wayside at the pass has a number of monuments, the largest of which is a stone obelisk. It was erected by the federal highway bureau in 1930, when the highway through the pass was completed. It is dedicated to US President Theodore Roosevelt, in commemoration of his leadership in conservation, and quotes him as saying, "The forest problem is in many ways the most vital internal problem of the United States."

Next to the obelisk is a more modest monument commemorating the trapper and prospector who lived here and gave up his land for the Roosevelt memorial. On the other side of the obelisk is a figurative statue of John F. Stevens, the railroad engineer who "discovered" the pass, which had long been in use by Blackfeet and other tribes. Stevens was there when the statue of him was dedicated in 1925.

Great Northern Railway built its main line over the pass in 1891, one of a few transcontinental rail lines connecting the nation in the late 19th century. It connected St. Paul, Minnesota with Seattle in 1893, helping the Seattle region to rise as a Pacific metropolis. Great Northern Railway was also the primary developer of Glacier National Park, with stations at West Glacier and East Glacier, providing access to the area decades before roads were built over the Divide. Amtrak's Empire Builder passenger railway still stops at West and East Glacier, bringing tourists who stay in the grand Swiss style lodges built by Great Northern inside and outside the park.

### The Bob

Heading south down the Continental Divide from Marias Pass, it is a hundred linear miles till the next road over the divide. Most of the region between these roads is National Forest, and is designated as the Bob Marshall Wilderness, an area larger and more remote than Glacier National Park. Bob Marshall was a federal forester, and co-founder of the Wilderness Society. The area was named in his honor when it was established as part of the Wilderness Act in 1964.



Forest Service map of the Bob Marshall Wilderness, which is affectionately known locally as "the Bob."

Motorized and mechanical equipment is banned from the area, even bicycles. It is one of the largest roadless regions in the nation, and its landscape is experienced primarily by hikers. Some of these hikers are on the Continental Divide National Scenic Trail.

The Continental Divide National Scenic Trail runs along the Divide for 3,100 miles, between Mexico and Canada. Though the trail does not follow the Divide exactly all the time, due to conditions of private land, impassable terrain, and other factors, it stays as close as it can, and provides the most consistent direct contact with the Divide, for those willing to make the effort. Like the Pacific Crest Trail and the Appalachian Trail, the Continental Divide Trail is one of the ways in which people can get a sense of the size and shape of the continent, at a human scale, and see some of the most remote terrain the Lower 48 has to offer.

The trail travels mostly over federal land, like National Forests, National Parks, and BLM land, and is still a work in progress, considered about 70% complete. Perhaps 200 people walk it from end to end every year, with most of them starting in the south and heading north, taking around five months to go from one end to the other. Many others hike portions of it, or one part at a time over a few years, rather than all of it at once. It is open to equestrian use too.

The trail is managed by volunteers and nonprofit entities like the Continental Divide Trail Coalition, which publishes detailed maps of the route, and helps arrange trail markers, water caches, gateway communities, and advocates for the trail's continued development.

Portions of the Continental Divide Trail are used by bicyclists who otherwise have their own "continental divide" routes, including the Adventure Cycling Association's Great Divide Mountain Bike Route. Unofficially endorsed bike races in the summer, like the Great Divide Race, attract hundreds of cyclists who attempt to ride the Divide from one end to the other, generally southbound. Some have done the route in less than two weeks.



The few dozens of southbound through-hikers walking the trail annually, who have been in the wilderness for more than a week up to this point, encounter the asphalt here. A set of stairs helps them transition through highway department terrain.

CLUI photo

## Land of Lincoln

State Highway 200, at Rogers Pass, is the first road to cross the Continental Divide south of the Bob Marshall Wilderness. The closest town is Lincoln, Montana, 15 miles west on Highway 200. This small town is an official gateway community for the Continental Divide Trail, providing services for hikers, including a drop box, a post office, motels, groceries, and transportation services.

Heading south out of town, towards the Divide, is Stemple Pass Road, with scattered cabins and a few larger homes. It is here, just off the road, where Ted Kaczynski, a 30-year old former math professor at UC Berkeley, built his cabin, in 1971, to live simply, and alone, off the grid. It was just a three-mile bike ride into town, where he volunteered at the library, did his limited shopping, and visited the post office. Around 1978, he began sending mail bombs, starting the longest and most expensive manhunt in FBI history.

Over the years his bombs killed three people and injured nearly two dozen others. In 1995 he sent a letter to newspapers, including the *New York Times*, saying he would stop his terrorism, if they published his manifesto, "Industrial Society and its Future" which condemns industrial society, argues for a back to "wild nature" lifestyle, and criticizes both the liberal left, and the righteous right. The 35,000-word essay was published in the *Times* and the *Washington Post*, and his brother recognized the writing, leading to his identification as the "Unabomber," and his arrest in a carnival of media and law enforcement that changed the town forever.

After he was arrested in 1996, the cabin itself was removed as evidence, and traveled around the country a bit, before it found its way to the Newseum, a museum about the news industry in Washington DC. The cabin site off Stemple Pass Road has been sold, and its current owners are not interested in sharing its history. Kaczynski is serving several life sentences at the supermax prison in Florence, Colorado.

Most people in Lincoln want people to forget this part of its history, and look for other things to put it on the map, like Blackfoot Pathways, a contemporary art sculpture park in the woods on the edge of town, where Kaczynski's cabin might be more at home on the walking trail, than as a sensationalistic specimen in the Newseum.



Railway tunnel under/over the Divide at Mullan Pass.

CLUI photo

## Mullan Pass and the Northern Pacific Railway

The next major pass on the Divide south of Stemple Pass, Mullan Pass, is a dirt road over the Continental Divide west of Helena, Montana, named after the Army engineer who identified it and had a road built over it in 1860, reportedly the first engineered road to be built in Montana. Like many road passes over the Divide, there are buried utilities crossing here as well; in this case, a gas pipeline.

But it is the railroad that dominates the pass, with winding, spindly bridges and a tunnel, as this was the first mainline transcontinental route for the Northern Pacific Railway, which opened in 1883, connecting Minnesota to Puget Sound, like its chief rival, the Great Northern Railway did by a more northerly route ten years later.

The tunnel, 330 feet lower than the top of the pass, is the longest rail tunnel in Montana, even though it was shortened by 400 feet in 2009 (to 3,426 feet). When it was originally built in 1883, it was less than 13 feet wide, which provided less than three inches of room to spare for some loads. Work done in 2009 widened it by three feet, and increased its height by five feet, allowing more air in the tunnel, which helps to keep the high horsepower helper engines from overheating. The line is now operated by Montana Rail Link, a local rail system with 900 miles of track, including this stretch between Helena and Missoula.

Four miles south down the Divide from the Mullan Tunnel is US Highway 12, the only highway heading west from Helena, the State Capital. The modern highway goes over the Divide at MacDonald Pass, over an old toll road that first opened in 1866.

On a rise on the south side of the pass are ruins of a former vista point, which still has a nice view east towards Helena. There is an active microwave relay tower, a common sight at mountain passes, adorned with cellular and other antennas now too. A less common sight at the pass is an old airway beacon, now abandoned. Though it postdates the incident, it makes an interesting memorial to a singular aviation event that occurred here in 1911, when a pilot named Cromwell Dixon was the first person to fly over the Continental Divide, doing so just a couple miles north of here. He landed his biplane nearby and wired New York from the west side of the Mullan Tunnel, to announce he had made it, and so he could collect the \$10,000 award. Dixon continued on to a fair in Spokane, where he died in a crash two days later.



## CONTINENTAL DIVIDE

Across from the old vista point at the pass, slightly visible through the trees, is what looks like an old western fort. It's a former locally famous attraction called Frontier Town, built starting in 1948 by a visionary Wild West enthusiast named John Quigley. It grew into a rambling self-built structure with 48 rooms, and things like the "largest one-piece bar in the world."

Quigley died in 1979, though the place remained open, run by his family. Financial trouble forced the sale of much of his collection in the 1990s, and the property was sold at auction in 2001 for \$190,000, and is now a large, crumbling, private residence, off limits to the public.



Our Lady of the Rockies overlooking the city and mine pit in Butte, from the top of the Continental Divide. CLUI photo

### The Great Butte Overlooker

South from MacDonald Pass, the Continental Divide meanders along the ridgeline of the Boulder Mountains for more than 40 miles, with just a few small forest service trails and tracks passing over the Divide, and a few old mining areas littering its flanks. The Divide drops out of the Boulder Mountains just north of Butte, and crosses Interstate 15 at Elk Park Pass.

The old road, on the west side of the interstate, is abandoned and dead-ends where the mining operations begin, south of the pass. On the east side of the interstate is a dirt road that climbs up the hill, crossing the Divide a few times along the way. Along the ridgeline at the top of the Divide are antennas for TV and radio stations in Butte. After passing through a final gate, the road reaches its end, at the back side of Our Lady of the Rockies.

Our Lady of the Rockies is directly on top of the Continental Divide, and looms above the town and mining pits of Butte. It was the vision of a local resident, Bob O'Bill, and was designed by Laurien Eugene Riehl, a local mining engineer.

The sculpture was fabricated off site, and airlifted in five sections, which were stacked on top of one another over a few relatively wind-free days in late December 1985, by a military team using a Sikorsky Skycrane helicopter.

Our Lady of the Rockies, at 90 feet tall, is likely the fourth largest Virgin Mary in the world, following a 153-foot one in Venezuela, a 148-foot one in Bolivia, and a 108-foot one in France—all of

which are soon to be overshadowed by a 315-foot tall statue of the virgin under construction in the Philippines, which is expected to be completed in 2021.

A door in the back leads inside the sculpture, but visitors are not allowed to climb up too far inside, and there is no viewing area at the top (as there is at the comparably scaled Statue of Liberty, which is 111 feet from foot to crown). The view from the top looks westward, over the city of Butte, and the Berkeley Pit, where mining stopped in 1982, and the pit began filling up with acidic water.



Signs marking the Divide, for ghost riders along the abandoned railway at Homestake Pass. CLUI photo

### Homestake Pass and the Northern Pacific Railway

Homestake Pass is the first pass south of Our Lady of the Rockies' perch on the Continental Divide, five miles away, and 2,117 feet higher up. Interstate 90, the northernmost transcontinental interstate, which connects Boston to Seattle, was built through here in 1966. The pass was first developed by Northern Pacific Railway in 1889, to connect Butte with its mainline to the east, at Logan. Railways extend westward from Butte, along a corridor now shared with Interstate 90. BNSF ended up owning the line through the pass, and continued passenger service until 1979. The company stopped using the tracks in 1983, as its grades are steep for freight, and the line through the Mullan Tunnel, west of Helena, is more efficient.



The abandoned rail tunnel at Pipestone Pass.

CLUI photo

## CONTINENTAL DIVIDE

### Pipestone Pass and the Milwaukee Road

Just a few miles south of Homestake Pass is Pipestone Pass, which used to be the main highway over the Divide, connecting Butte to points east (formerly known as Highway 10, it is now Highway 2). When Interstate 90 was built through Homestake Pass, use of this road diminished.

The transcontinental railway known as the Milwaukee Road came through here in 1909, connecting Chicago to the Pacific Northwest. The line, now abandoned, went through a tunnel under Pipestone Pass. The Milwaukee Road eventually lost out to BNSF, which abandoned the line in 1980, after which the tracks were removed. Though crumbling and dangerous, the half-mile long tunnel is one of several along the two abandoned railways southeast of Butte, enjoyed by teenagers and other explorers.



Interpretive sign guiding the way at Lost Trail Pass.

CLUI photo

### Lost Trail Pass and the Idaho State Line

Ten miles south of Butte, the Divide goes through Deer Lodge Pass, crossing Interstate 15 for the second time. The Divide continues westward along the ridgeline and is crossed again by Highway 569, south of Anaconda, where the smelter that once served the mines at Butte was located. After that the Divide snakes through the crest of the Anaconda Range, passing through 10,000-foot peaks, until it hits Idaho, near Lost Trail Pass. Southbound, from this point on, the Divide line is the Idaho/Montana state line, all the way to Wyoming.

Lost Trail Pass is traversed by US Highway 93, a major north/south two-lane highway, running from the Canadian border to southern Arizona. There is also a ski resort at the pass, the Lost Trail Ski Area, where the state line heads northward, following a ridgeline in the Bitterroot Mountains, and the route of a chairlift. Trails at the resort are in both states.

As its name suggests, Lost Trail Pass is a complicated and even contradictory place. Signage at the wayside describes some of the history of the region, which includes confusion about where the legendary pathfinders Lewis and Clark were, exactly, when they came through here in 1805.

Prior to the highway coming through in the 1930s, the main pass used by travelers in the region was Gibbons Pass, a few miles north, now on a rarely used dirt road. A bit south on the Divide is Big Hole Pass, which was also used by early travelers, and near that is Chief Joseph Pass, which is also on the Divide, less than a mile from Lost Trail Pass, on Highway 43.

These names reflect a famous conflict involving the Nez Perce Indians here, in 1877, known as the Battle of the Big Hole, with Captain Gibbons leading the forces of the US Army, and Chief Joseph, a leader of the Nez Perce. The battle was among the worst in the months-long Nez Perce War, where US forces fought with Indians trying to escape to safety in Canada. Some of the story is told at a National Historic Park at the base of the mountains, 12 miles east, where much of the battle took place, a few miles west of the town of Wisdom.



Interpretive rock and contemplative bench at Lemhi Pass.

CLUI photo

### Lemhi Pass

Heading south from Lost Trail Pass, the Divide follows the crest of the Beaverhead Mountains for 50 miles, with peaks rising to more than 10,000 feet, and little more than some trails through them, until the Divide drops to an elevation of 7,373 feet, at Lemhi Pass. The pass was used by Shoshone traveling on horseback as far back as the late 1700s, but became famous after it was used by the Corps of Discovery in 1805, otherwise known as the Lewis and Clark Expedition.

In August, 1805, scouting ahead of the rest of group, Meriwether Lewis and three others crossed the Continental Divide for the first time, here. Lewis then returned to the expedition's camp on the east side of the Divide, 30 miles back, to meet with the rest of the group, who were slowly dragging their canoes and gear up the last dribbling bits of remaining river.



The actual site of Camp Fortunate is now under the waters of the Clark Canyon Reservoir, which flooded the valley in 1964, when the Bureau of Reclamation completed the Clark Canyon Dam to control flooding and to provide water to irrigation projects downstream.

CLUI photo



## CONTINENTAL DIVIDE

They called the camp they established 30 miles east of the Divide Camp Fortunate; it was the furthest point up the Missouri watershed they could get with their boats. The Corps of Discovery called this Jefferson's River. It is now called the Beaverhead, and a battery of interpretive plaques overlooks the site.

On August 23, 1805, the Corps left Camp Fortunate and headed towards Lemhi Pass, traveling with Sacajawea and other Shoshone, leaving their canoes behind. The canoes were filled with rocks, sunk in a nearby pond, and were recovered when William Clark returned heading eastward a year later. They soon arrived at the pass, two weeks after the first visit by Meriwether Lewis, and called it Portage Hill, as they had hoped that the Salmon River, at the base of the pass on the other side of the Divide, would carry them by boat to the Pacific Ocean. The river was found to be too small and too full of rapids, but, led by Shoshone, Salish, and Nez Perce tribal members, the expedition finally found navigable water, and trees big enough to build canoes, weeks later at the Clearwater River in northern Idaho, which eventually carried them to the Columbia River, and the Pacific.

Lemhi Pass was the highest point they would cross on their western trip, and it is where they left the United States, land recently acquired by the Louisiana Purchase, and entered the northwestern territory still claimed by the British. Half a mile south of the pass is the Sacajawea Memorial Area, created in 1932 through the efforts of Laura Tolman Scott, of the Daughters of the American Revolution, to honor Sacajawea's role in guiding the team westward.

Located at the remote and seldom visited interpretive area is the Most Distant Fountain, which for years was assumed to be the source of the Missouri River, as identified by Meriwether Lewis. It is one of a few springs in the area that create small streams here on the eastern side of the Divide, that join the tributaries that flow into the Beaverhead River, which officially begins, now, where it trickles out of the base of the Clark Canyon Dam.

From there it meanders relentlessly over the next 50 miles until it joins the Big Hole River to form the Jefferson River, which meanders over another 50 miles until, at Three Forks, the Jefferson River joins the Madison River and the Gallatin River to form the Missouri. The Missouri, of course, merges into the Mississippi River at St. Louis, where the Corps of Discovery began its journey, up the Missouri into the Louisiana Purchase, and on which they returned, a year later, flowing back down the Atlantic side of the Divide.



Abandoned mine shaft on the Continental Divide, near Bannock Pass. CLUI photo

### Bannock Pass

Bannock Pass is a more modern road over the Continental Divide, 13 miles south of Lemhi Pass. Much of the even grading of the otherwise remote dirt road is from the former Gilmore and Pittsburgh Railroad roadbed, which was built through the pass in 1910 to service mines in Gilmore, Idaho, and an expected boom in population that did not arise.

It ran between Salmon, Idaho and Armstead, Montana, where it connected to another rail line that went to Butte. It operated until 1939, when it was demolished, and its tracks were removed, leaving this automobile road to connect the two valleys on either side of the Divide.

Though Salmon is still a regional population center, Gilmore is a ghost town, and Armstead is under the waters of the Clark Canyon Reservoir. Abandoned mines and a collapsed railroad tunnel remain at the top of the Divide near Bannock Pass, as well as a microwave repeater site, now owned by American Tower, like so many mountain-top communication sites around the country, in use, and not.



Interstate 15, Union Pacific Railroad, and old Highway 91 at Monida Pass. CLUI photo

### Monida Pass to Yellowstone

After Bannock Pass, the Divide curves eastward at the southern end of the Bitterroot Range with no major crossings until it is overtopped by Interstate 15, for the third and last time, at Monida Pass, where the Union Pacific Railroad also goes through the pass, next to the interstate. The railroad line generally follows the interstate, north to Butte, and south to Pocatello, and Utah. It more closely follows Old Highway 91, which at times, like at Monida Pass, is nearly abandoned in favor of the interstate.

The Divide is also, still, the state line between Montana and Idaho, and the pass, and nearby small community of a half dozen people, gets its name—Monida—by combining portions of the words Montana and Idaho.

From Monida, the Divide continues eastward, through a scrapyard next to the highway, then along the remote ridgeline for more than 50 miles. It hits pavement again at Targhee Pass, on Highway 20, just a few miles west of West Yellowstone, the entrance to Yellowstone National Park. The Divide leaves the road and meanders southeast for another 20 miles, carrying the state line with it, until it hits the north/south line of Wyoming's western edge, already two miles into Yellowstone National Park.

# CONTINENTAL DIVIDE

## PART 2: WYOMING



Isa Lake, in Yellowstone National Park, is divided by the Divide, and the road.  
CLUI photo

### Dividing Attractions in Yellowstone Park

The Continental Divide enters the great rectangular state of Wyoming near its northwestern corner, in Yellowstone National Park. The Divide meanders around in the southwest corner of the park, steering clear of Old Faithful, which is on the east side of the Divide. The residue from the famous fountain drains into the Firehole River, which drains into the Madison River, which drains into the Missouri River, then on to the Atlantic Ocean, via the Mississippi. Most of the other water-based attractions in the park also drain into the Atlantic via tributaries to the Missouri.

One exception is Isa Lake, which sits directly on the Divide, and is an unusual body of water. It is located at Craig Pass, where the road crosses the Continental Divide in the park for the first of three times. Historically, with spring runoff, the “lake,” a pond really, grows, and spills over its shores down both sides of the Divide.

Making it more complicated, the west goes east and the east side goes west: The west end flows into Spring Creek, which drains into the Firehole River, and thus into the Atlantic (eastern) drainage. The east end overflows into a drainage ditch along the road, which drains into DeLacy Creek, which ultimately drains into the Columbia River and into the Pacific Ocean.

Isa Lake was targeted as an attraction by Hiram Chittenden, the Army Corps engineer who planned much of the 140-mile Grand Loop Road, which opened in 1891, connecting the attractions in Yellowstone Park.

Though some have called it the only natural lake in the world that drains into two oceans, its status as a natural lake is challenged by the substantial road engineering that has altered its form and its drainage behavior. Apparently, too, the hydrology of the area has changed so that the lake often doesn't fill up with enough water to drain in either direction.

Five miles away, the Grand Loop Road crosses the Continental Divide again, and seven miles more down the road, south of West Thumb, the road crosses the Divide again, for the last time in the park.

Despite Yellowstone's two million visitors a year, on 310 miles of roads and in nearly 2,000 buildings, the southeastern side of

Yellowstone Park is remote. A few miles east of where the Continental Divide leaves the park is an area that is 21.7 miles from a road of any kind, and is considered the most remote place in the lower 48, by some ways of measuring.

The region also has a remote site known as the Parting of the Waters, where Two Ocean Creek emerges from the mountains and drains into both the Atlantic and Pacific (through Atlantic Creek and Pacific Creek), thus dividing the Divide along its two mile course.



Togwotee Pass.

CLUI photo

### Three Waters Mountain and the Wind River Range

The Continental Divide is next crossed by a highway at Togwotee Pass, 20 miles south of Yellowstone Park, and 20 miles east from the entrance of Grand Teton National Park. The road, US Highway 26, is the second highest paved crossing of the Divide in Wyoming, 9,658 feet above sea level.

South of the pass is Three Waters Mountain, so called because waters flow down its flank into tributaries for three of the major river basins that cover much of the continent: the Columbia River, which drains into the Pacific Ocean at the Oregon/Washington state line; the Colorado River, which drains into the Pacific at the Gulf of California, south of the California/Arizona state line; and the Mississippi River, via the Missouri, which drains into the Gulf of Mexico in Louisiana.

Three Waters Mountain is in the remote mountains of the Wind River Range. There are just a few trails and small dirt roads through the range, which, is otherwise a mountainous barrier for 130 miles between paved roads. The east side of the range is mostly the Wind River Indian Reservation, a sovereign nation of the Eastern Shoshone, established in 1868, and covering 3,400 square miles—about the same size as Yellowstone National Park.

Sacajawea, the famed Shoshone Indian so helpful to Lewis and Clark, has a memorial in the cemetery at Fort Washakie, on the reservation. She was born near the region of today's Salmon, Idaho, through which she guided the Corps of Discovery, after they crossed the Divide together at Lemhi Pass in 1805.

Some believe she died in her twenties, in 1812, at a fur trading post in what is now North Dakota, near Lake Sakakawea, a massive reservoir on the Missouri River built in the early 1950s, that bears her name (and which flooded several settlements, native and otherwise). Others claim she married into the Comanche Tribe, and lived into her seventies, mostly in Wyoming, until 1884. Some interpretive



## CONTINENTAL DIVIDE

plaques at the memorial claim that she is buried here. Either way, wherever her body is, her spirit, and the American myths her legacy embodies, resides in the mountains of the Continental Divide.



Historic trail marker at the old South Pass.

CLUI photo

### South Pass

After more than 50 peaks over 13,000 feet high, the Wind River Range peters out at its southern end near Lander, eventually reaching a level of 7,550 feet, where a pass over the Continental Divide became a historic throughway known as South Pass.

The pass was a pinch point for westward migrations, where the California Trail, the Mormon Trail, the Oregon Trail, and the Pony Express trail converged. The South Pass was used as an immigrant trail as early as the 1820s, but it was Charles Fremont who publicized it in the account of his expedition in 1842, citing it as one of the easiest ascents over the Divide, which led to many thousands using it over the following decades.

The original, historic South Pass is a dirt road a couple miles south of where the modern highway crosses the Divide, scattered with a few interpretive plaques and monuments, but rarely visited. For today's travelers over the pass, on Highway 28, there is a roadside rest at the pass.

Gold mining developed in the region in the 1860s, and continued sporadically through the 1930s. The Carissa Mine and Mill was the largest of the mining facilities in the region. It closed for the last time in 1949, and in 2003 it was acquired by the State of Wyoming to be preserved as an historic site. The mill is located in South Pass City, located in a gulch along Willow Creek, one of two towns that still exist in the region, left from the mining period. South Pass City had a peak population of as many as 3,000 people in the late 1860s, when it was likely the second largest city in Wyoming. It is now the state's largest historic site. The town has a handful of private homes and around a dozen residents, in addition to the preserved structures owned by the State.

A few miles away, in the gulch along Rock Creek, is Atlantic City, less preserved, but more active. The local population of around 100 people live creatively amidst the remains of the old mining town, operating a few bars and B&Bs for tourists. Like many scrappy former mining towns in the west, it is a spirited place.

Atlantic City had another boom when US Steel opened a modern iron mine nearby in 1962, and operated it until 1983, employing as many as 500 people. Over those 20 years, US Steel shipped concentrated iron ore to the Geneva Steel Mill south of Salt Lake

City, more than 200 miles away, by rail, forming an open pit that is now filled with water, next to the highway, as well as sprawling waste piles and a recontoured landscape.

To get the ore to Utah required building 80 miles of new track to connect the mine to the existing rails at Rock Springs. The railway US Steel built, in 1962, went through the historic pass at South Pass, and was the last railway to be built over the Continental Divide. The tracks were removed after the mine closed in 1983, though the roadbed remains, next to the old immigrant trail.



Snow fencing in the Great Divide Basin.

CLUI photo

### Great Divide Basin

South of South Pass the Continental Divide divides, circling an arid basin where drainage goes inward and evaporates, instead of flowing to the ocean—what geomorphologists call an endorheic basin. The Great Divide Basin, as it is known, is 80 miles wide, second only to the Great Basin, which covers much of Utah and Nevada.

Though nearly empty of population, the Great Divide Basin is an area of oil and gas extraction, with a little uranium mining, and ranching. The Bridger Coal Company operates a large strip mine along the Divide's southwestern edge, as well as an underground mine. Both supply the Jim Bridger Power Plant, less than five miles from the Divide, and one of the largest coal-fired power plants in the nation.

Not far from the plant, Interstate 80 crosses the southern edge of the Great Divide Basin. It does so again 50 miles east, near Rawlins. The Union Pacific Railway crosses the Divide here too, twice (into and out of the Basin), next to the interstate. This is the path that the first transcontinental railway took westward, to meet its eastbound counterpart at Promontory, Utah in 1869, 250 miles west of here.

The only other active mainline tracks crossing the Divide between here and the Canadian border is the BNSF line at Marias Pass, next to Glacier National Park in Montana. And south of here are just three more mainline tracks crossing the Divide before the Mexican border.

Interstate 80 is the most direct route between New York and San Francisco, and alongside the tracks and the interstate over the Divide are important utility corridors, connecting east and west. These include fiber optic communication lines, operated by the Level 3 Company, and natural gas lines run by the Enterprise Products Company. There are also some microwave relays, still used for communications by some companies, like the railway.

## CONTINENTAL DIVIDE



Battle Pass, marking the Continental Divide in the Sierra Madre of southern Wyoming. CLUI photo

### The Sierra Madre Range and Battle Pass

South of Rawlins the split in the Continental Divide around the Basin reforms into a single line heading southeast towards Colorado. It enters the Sierra Madre Range near Bridger Pass, once part of the Overland Trail, until the nearby transcontinental railway made it obsolete in 1869.

Highway 70, known as the Battle Highway, is the only paved road through the Sierra Madre Range. It connects the town of Baggs to Encampment, 50 miles away, and goes through Battle Pass along the way, at the crest of the Continental Divide. Though it's a remote region, and not on its way anywhere for most people, interpretive signage is heavy along the road, mostly credited to the Medicine Bow National Forest. The signs are helpful, especially as it's often hard to see much in the forest, because of the trees.

One sign explains about the "tie hacks" who lived in these mountains in the 1880s to the 1920s, felling trees that would be floated downstream in the spring to Union Pacific's transcontinental railway, for use as railroad ties across the otherwise treeless plains of Wyoming. Another sign is about Jim Bridger, the famed mountain man and guide, who traveled through these parts in the 1820s and '30s, and whose name appears throughout the region, on topography from Bridger Pass to the Bridger Mountains, and constructions from Fort Bridger to the Bridger Power Plant.



A sign along Highway 70 explains how the Ferris Haggarty Tramway carried ore from the Rudefeha Mine to the smelter in Encampment, 16 miles away, over the top of the Continental Divide, on what was maybe the longest aerial tramway in the world, at the time. CLUI photo

Approaching the Divide from the west, a sign explains about the Rudefeha Mine, which was the largest of the copper mines in the area. Though it operated for just ten years, between 1898 and 1908, the mine had a profound impact on the region.

The trees thin out at the top of Battle Pass, offering views down both sides of the Continental Divide. At nearly 10,000 feet, this is the highest major pass over the Divide in Wyoming, and the southernmost pass in the state, just a few miles from Colorado.

It is downhill from there, to the town of Encampment, on the eastern side of the Divide. The largest attraction in this small community of 450 people is the Grand Encampment Museum and Interpretive Center. With all its reconstructed and relocated out buildings, they say it's the second largest museum in Wyoming, after the State Museum in Cheyenne.

Among the displays is a reproduction of part of the aerial tram that once carried ore those 16 miles over the Divide to the smelter in town. There were 370 of these towers supporting the looped cable that held 840 buckets, each capable of carrying 700 pounds of ore. All of this, and it operated for less than five years before the mine went out of business and closed.

The tram was among the first major projects of the Riblet Tramway Company of Spokane, a company that would go on to become one of the largest chairlift companies in the nation, helping some old Rocky Mountain mining towns find new life as ski resorts, and where, in some cases, trams now lift people to the top of the Continental Divide.

## PART 3: COLORADO



One of two Rabbit Ears Passes on the Continental Divide in northern Colorado. CLUI photo

### Rabbit Ears and other Northern Colorado Passes

Entering the top of Colorado from Wyoming—moving from one rectangular state to another—the Continental Divide stays above 10,000 feet, and passes through mountaintops exceeding 12,000 feet, until dropping to 9,426 feet at Rabbit Ears Pass.

The pass has the northernmost east/west highway in the state, US Highway 40, one of 15 paved highways or roads that pass over the



## CONTINENTAL DIVIDE

Continental Divide in Colorado. To the west is Steamboat Springs, and to the east is Rocky Mountain National Park.

Rabbit Ears Pass gets its name from a nearby rock formation, named Rabbit Ears Peak by early trappers. As with rabbit's ears, there are two Rabbit Ears Passes. A mile north of the current highway pass is an earlier road, improved in 1919, with a monument noting its passage over the Divide, at 9,680 feet. After a mile down its eastern slope, the pavement ends where the road is barricaded with a dirt mound, as it is now closed to traffic.

A few miles east of Rabbit Ears Pass, Highway 40 meets Highway 14, where the road crosses the Continental Divide again. The pass is called Muddy Pass, but it is unmarked. The next pass over the Divide is Willow Creek Pass on US Highway 125, 25 miles east, connecting the towns of Walden and Granby.



Continental Divide at La Poudre Pass: The highest pond at the headwaters of the Colorado River, on the left, and the Grand Ditch, flowing the opposite direction, on the right. CLUI photo

### La Poudre Pass and the Grand Ditch

La Poudre Pass is a remote area at the northwest corner of Rocky Mountain National Park, at the dead end of a ten-mile long dirt road from Highway 14. From the end of the road you can walk in to the park, and there are no rangers here to charge admission. Though it is unmarked, you pass over the Continental Divide in less than a mile, and arrive at a view looking southwest, over the headwaters of the Colorado River.

There is a small pond there that could be considered the ultimate source of the great river, that drains much of the west slope of the Rockies, and the southwestern USA. Hikers can observe the pond from a road that runs along the edge of a canal known as the Grand Ditch, a 14-mile long conduit that collects water from the western slope, that would otherwise flow into the Colorado River, and moves it to the eastern slope, through the ditch.

The diverted water crosses the Divide at La Poudre Pass, then flows into the Long Draw Reservoir. From there it is meted out in a measured fashion, under the dam, into Cache La Poudre Creek, for use on the plains of the eastern slope, around Fort Collins, Thornton, and Greeley.

The Grand Ditch has existed in some form since 1890, but didn't reach its full length until the 1930s, when the Long Draw Reservoir

was constructed. It is owned by the Water Supply and Storage Company of Fort Collins, which had to pay the Park Service \$9 million for damages to the environment when the channel collapsed in 2003.

Around 20,000 acre-feet of water flows through the ditch annually, an amount estimated as 20-40% of the runoff from its source, the Never Summer Mountains, which the ditch partially wraps around. The flow is measured at a gauging station, equipped with telemetry.

As is common in ditches, aqueducts, rivers and streams, the water flows through a Parshall Flume, a box of known dimensions, often constructed in concrete, so that the flow can be calculated by measuring the water's depth at a fixed point, using automatic sensors which transmit the information electronically.

According to the USGS, the official federal mapping agency, the Continental Divide crosses the channel just a few feet upstream from the gauging station. But given the engineering of the hydrologic divide here, their maps may need to be adjusted.



Milner Pass.

CLUI photo

### Milner Pass and Rocky Mountain National Park

Milner Pass, inside Rocky Mountain National Park, is the next pass south down the Divide from La Poudre Pass, and though it is just four miles away, it would take hours to drive from one to the other. Milner is along US Highway 34, known as the Trail Ridge Road, which is the highest paved through-road in the nation. It reaches a peak of 12,183 feet a few miles east of Milner Pass.

The road was constructed from 1926 to 1932, and is closed for the winter when it is covered in drifts up to 35 feet deep. There is a visitor center along the road between the pass and the high point. It's at an elevation of 11,796 feet.

The highest paved road in the country, incidentally, dead-ends at a parking lot at the summit of Mount Evans, at 14,130 feet. It is 60 miles south of here, and five miles east of the Continental Divide.

## CONTINENTAL DIVIDE

### DIVIDED WE STAND BIG BASINS AS LAW OF THE LAND

Watersheds are perhaps the most geographically fundamental divisions of the landscape. While tectonics gives rise to mountains, it is erosion by water that shapes the land. Everything that grows on the ground, from trees to farms, and houses to cities, does so in response to this shedding of water.

Every river and stream has a watershed—the area where a drop of water falling on the ground finds its way into its channel. These basins are distinct, by definition, and where one ends, another begins, immediately next to it. And so it goes, and flows, from small stream basins to larger river basins, to the ocean. How you enumerate or describe these individual basins is just a matter of scale.

At the largest scale, the contiguous 48 United States could be described as having five primary watersheds, separated by five dividing lines, located where the edges of the basins meet. While they have been modified by humans in major ways, like everything else on the earth, these basins remain in essence the most basic architecture of the continent. They also suggest an alternate way of dividing the landscape into governing units, according to the physical laws of the land.

#### GREAT DIVIDE

Generally referred to as the Continental Divide, this is the line dividing the watersheds of the Pacific Ocean and the Atlantic Ocean, which follows the Rockies from Canada to Mexico, and extends to the top of Alaska and to the bottom of South America. Since all of the water sloughing off the landmass of the lower 48 states goes into either the Atlantic or the Pacific, this line is the most basic, and binary, divide.

#### GREAT BASIN

Located in an arid portion of the western United States, the Great Basin is the exception, as it doesn't drain anywhere, except into itself. It covers much of Nevada, nearly half of Utah, and some of Oregon, Idaho, Wyoming, and California. The shape of the basin has been altered by the hands of man, by things like the Owens Valley Aqueduct, which moves water out of the basin, into the Pacific Ocean, via Los Angeles. The shape of the basin has not been redrawn to reflect these alterations.

#### Triple Divide Peak

This mountain top in Glacier National Park is at the intersection of the Continental Divide and the Laurentian Divide, and has three streams draining its slopes, each entering a different continental watershed: Atlantic Creek, which eventually drains into the Atlantic via the Mississippi River; Pacific Creek, which eventually drains into the Pacific via the Columbia River; and Hudson Bay Creek, which as the name implies, flows into Hudson Bay, in the Canadian north.

#### Mouth of the Columbia River

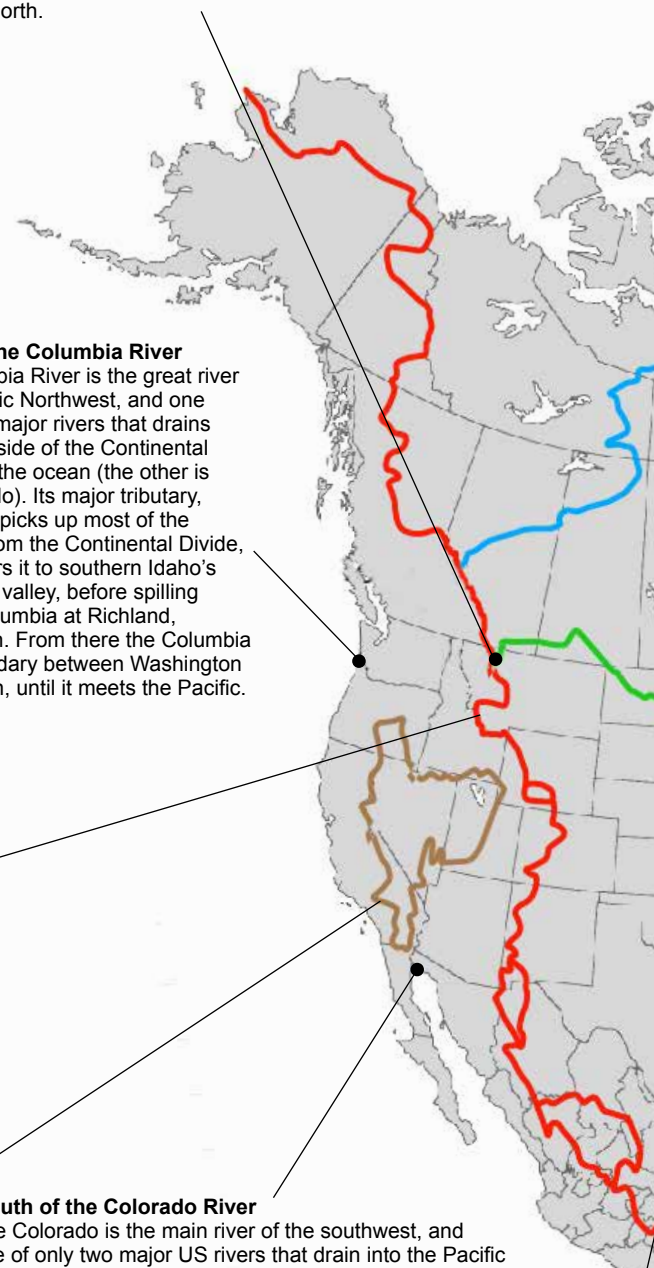
The Columbia River is the great river of the Pacific Northwest, and one of just two major rivers that drains the Pacific side of the Continental Divide into the ocean (the other is the Colorado). Its major tributary, the Snake, picks up most of the drainage from the Continental Divide, then delivers it to southern Idaho's agricultural valley, before spilling into the Columbia at Richland, Washington. From there the Columbia is the boundary between Washington and Oregon, until it meets the Pacific.

#### Mouth of the Colorado River

The Colorado is the main river of the southwest, and one of only two major US rivers that drain into the Pacific Ocean. It starts in the Rockies of northern Colorado, and flows into Utah, where it is joined by the Green River coming out of western Wyoming. The Colorado goes on through Lake Powell, the Grand Canyon, Lake Mead, then into the Gulf of Mexico, in Mexico, if there is any water left in it, which there often is not.

#### Mouth of the Rio Grande

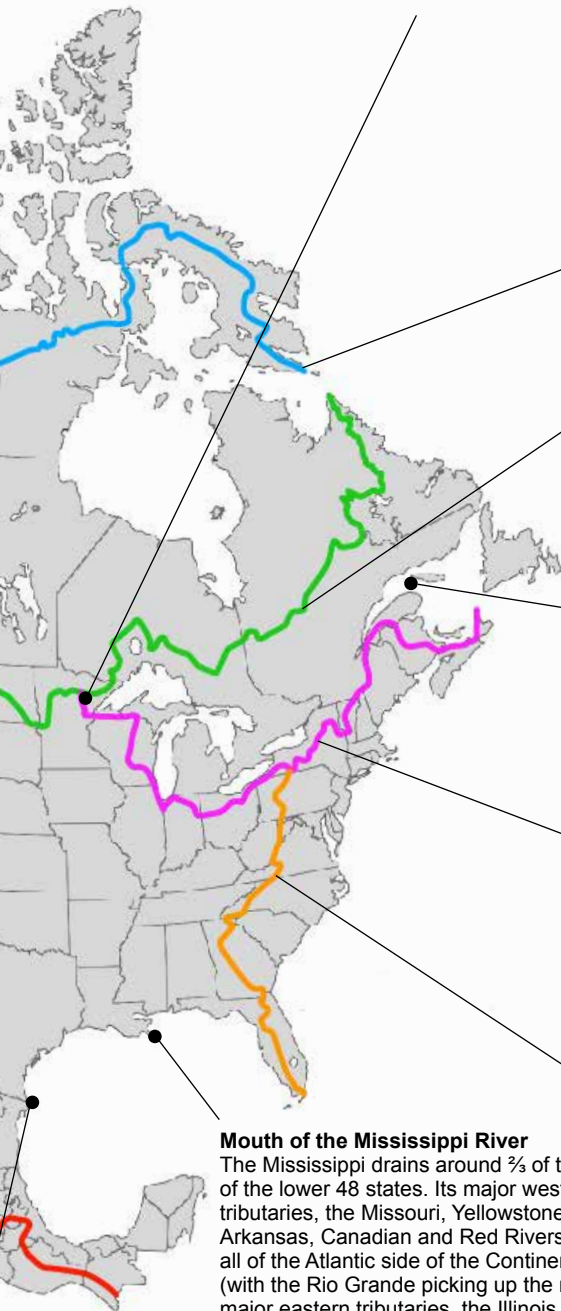
The Rio Grande starts in southern New Mexico, then forms the border between Texas and Mexico, then flows to the Atlantic at the Gulf of Mexico.





### Hill of Three Waters

Three watersheds diverge from a point in northern Minnesota known by Chippewa Indians as the Hill of Three Waters. From here water flows either north to Hudson Bay, or east through the St. Lawrence, or south to the Gulf of Mexico. However, the site is also the location of the Hull Rust Mahoning iron mine, so the Hill of Three Waters is now a pit, and the drainage patterns altered. Called the Grand Canyon of the North, this mine was the largest single source of iron for American steel mills for much of the first half of the 20th Century.



### ARCTIC DIVIDE

Located entirely in Canada, the Arctic Divide is the boundary between basins that drain into Hudson Bay (and thus into the northern Atlantic), and the Arctic Ocean, which is one of the five major oceans of the world (along with the Pacific, Atlantic, Indian Ocean, and Antarctic Ocean). While the lower 48 is unaffected by this divide, the northeastern part of Alaska drains into the Arctic Ocean, and not into the Atlantic or the Pacific—the only part of the USA to do so.

### LAURENTIAN DIVIDE

North of the Laurentian Divide, water falls into Hudson Bay, which flows out the Labrador Sea. South of it drains more directly into the Atlantic Ocean. A small portion of northwest Montana drains on the north side of the line, from Triple Divide Peak, as does much of northeast North Dakota and northern Minnesota. The Labrador Sea is technically part of the Atlantic Ocean, so this divide is of lesser order than the Great Divide, as is the case with the other divides too.

### Mouth of the St. Lawrence River

The St. Lawrence basin begins in the streams of the Masabi Range of northern Minnesota, near the Hill of Three Waters and the iron mines, then flows into Lake Superior at Duluth. The water drains through the interconnected Great Lakes, then becomes the St. Lawrence River in the Thousand Island area at the east end of Lake Ontario, and forms the border between New York and Canada. Much of the River is more like a freshwater floodway, wide, low and slow, controlled by dams and the engineered Seaway, until widening into a gulf past Quebec City, and merging into the Atlantic.

### ST. LAWRENCE DIVIDE

Water on the north side of the St. Lawrence Divide drains into the St. Lawrence River, either directly or through the Great Lakes. South of the divide the water drains more directly into the Atlantic at the Gulf of Mexico, or off the eastern seaboard.

### Mouth of the Mississippi River

The Mississippi drains around  $\frac{1}{3}$  of the landmass of the lower 48 states. Its major western tributaries, the Missouri, Yellowstone, Platte, Arkansas, Canadian and Red Rivers, drain nearly all of the Atlantic side of the Continental Divide (with the Rio Grande picking up the rest). Its major eastern tributaries, the Illinois, Ohio, and Tennessee Rivers, drain much of the Midwest and northeast, even into New York state. The main channel of the river extends to within 100 miles of the Canadian border with Minnesota, and enters the Atlantic south of New Orleans, 2,350 miles from its source.

### EASTERN DIVIDE

A high point in the woods near Gold, Pennsylvania, is the intersection of the St. Lawrence Divide and the Eastern Divide. Northward water flows into the Great Lakes and into the Atlantic via the St. Lawrence River. East of the Eastern Divide, water flows into the Atlantic seaboard, mostly via numerous relatively short rivers draining the east side of the Appalachians. West of the Eastern Divide water flows into the Gulf of Mexico, via rivers such as the Chattahoochee, Ohio, Tennessee, and Mississippi.

in Colorado, and drains  
tal Divide's Atlantic side,  
Texas and Mexico, all the  
Mexico.



The east portal of the Alva Tunnel, emerging out from under Rocky Mountain National Park. CLUI photo

## The Alva Tunnel Under Rocky Mountain National Park

Highway 34 is not the only impressive engineering feat inside Rocky Mountain National Park. A 13-mile long ten-foot wide water tunnel runs under the park, from one end to the other, crossing 3,700 feet under the Continental Divide near Andrews Pass.

It is the fulcrum of a network of trans-basin, trans-divide reservoirs and pipelines known as the Colorado-Big Thompson project, built by the U.S. Bureau of Reclamation, and completed in 1947, at a cost of \$160 million. The system involves a number of reservoirs, pipelines, and pumping stations on the western slope to collect water that would otherwise flow into the Colorado River, and away to places like California. These include the Willow Creek Reservoir and the Windy Gap Reservoir, which deliver captured water to Lake Granby, the largest of the reservoirs in the system, via pipelines and canals.

The Farr Pumping Station lifts water out of Lake Granby up a hundred feet more in elevation to the Shadow Mountain Reservoir and Grand Lake. The water is siphoned out of the lake at the western portal of the Alva B. Adams Tunnel, where it flows under the park, and over the Divide.

Meanwhile the Colorado River itself flows through the same system of reservoirs, but in the opposite direction. It enters the Shadow Mountain Reservoir as a somewhat wild stream, emerging from its headwaters at La Poudre Pass, 20 miles north. At the Shadow Mountain Reservoir, its waters become part of a captured hydraulic infrastructure, and a fully controlled resource, all the way to Mexico, where whatever is left dribbles into the Pacific.

At Grand Lake, the collected Colorado River water enters the Adams Tunnel through an underwater tube, and runs as a straight line for 13.1 miles under Rocky Mountain National Park, to the east portal, which is 109 feet lower in elevation from the west portal, allowing the water to flow by gravity. It gets from one end to the other in around two hours.

When the tunnel opened in 1947, it was the longest irrigation water tunnel in the nation. Today the annual 220,000 acre-feet of water it delivers is consumed by a variety of end users, mostly urban.

The water enters a pipeline after passing through the tunnel, and heads to a string of downstream reservoirs, including Lake Estes, a reservoir in Estes Park, made by damming the Big Thompson River. From there, Colorado River water, now joined with the eastern slope's Big Thompson River water, flows off to other reservoirs that store water to be used by the booming population in cities north of Denver.



Pipeline emerging from the ground then entering the Moffat Water Tunnel, next to the west portal of the Moffat Train Tunnel. CLUI photo

## Rollins Pass and the Moffat Tunnel

25 miles south down the Divide from the Alva Tunnel is Rollins Pass, where a railroad was built over the Divide starting in 1903. With the pass at 11,677 feet, it was the highest non-cog railway in the nation. Much of the route was covered with wooden snowsheds, but snow removal was always a problem.

The route over the pass, sometimes called Hell Hill, was part of the Moffat Road, and it was meant to last just until a tunnel could be built at a much lower elevation, away from the snowdrifts, and without all the curves and the four percent grades. Finally this happened, in 1928, when the Moffat Tunnel opened, and this 23-mile section over the pass was made obsolete.

The tracks were pulled up around 1936, and over time the trestles and three tunnels on the route collapsed. The 170-foot long Needle's Eye Tunnel, near the crest of the Pass, remained somewhat intact, and was visited recreationally by motorists, bikers, and hikers. It was closed off in 1990, after a visitor was injured in a rock fall in the tunnel, and since that time the route has been blocked.

The Moffat Tunnel's east portal is at the base of the old railway route over Rollins Pass, which crosses over the Divide 2,440 feet above the tunnel's elevation. Work on the Moffat Tunnel started in 1924, and it took four years to drill and blast the 24-foot high, 18-foot wide hole, 6.2 miles through the mountains. It is actively used for freight trains by Union Pacific, and is the fourth longest mainline railway tunnel in the USA.

The west portal is at Winter Park, a ski resort, developed by the city of Denver, and the largest municipal ski development in the nation. It opened in 1939, with its first ski lift, built by the WPA, and grew quickly into a major ski resort, owned by Denver's parks department until the city sold it to a private company in 2002. A weekend "ski train," which started in 1940, still connects the slopes to downtown Denver, 65 miles away by train.



## CONTINENTAL DIVIDE

Next to the train's tunnel is the Pioneer Bore, a ten-foot diameter pilot tunnel that runs parallel and 75 feet south of the main tunnel, which has been used as a water supply tunnel for the city of Denver, starting in 1936. Known as the Moffat Water Tunnel, this water comes through a large system of pipelines and reservoirs that collect water on the west side of the Divide, and deliver it to the populous east side, via the Moffat Tunnel.

Denver Water, as the city's main water supply company is called, operates four collection systems to capture water for the city, three of which collect water from the western slope of the Continental Divide, using the watersheds of the Fraser, Williams Fork, and Blue Rivers.

Denver Water's Moffat Collection System has one lobe on the east side of the Divide, and another on the west side, with the Moffat Tunnel between them. The western side collects water from Fraser River tributaries through a number of aqueducts, tunnels, and existing stream channels.

Each of the two underground tunnels, the Vasquez Tunnel and the Gumlick Tunnel, cross the Continental Divide, bringing water from the Williams Fork River watershed to the Moffat Collection System. By the time this water enters the Moffat Water Tunnel, it has crossed the Continental Divide three times, back and forth.

At the east portal of the Moffat Tunnel, the water emerges as a canal that joins Boulder Creek, which flows alongside the tracks for around 15 miles, before spilling into the Gross Reservoir, six miles southwest of Boulder. Efforts are underway to enlarge this reservoir, by raising the dam by more than 100 feet.



Berthoud Pass Ditch, taking water from the west side to the east side of the Divide, heading under the parking lot at the old ski hill. CLUI photo

### Berthoud Pass

The next pass on the Divide south of the Moffat Tunnel is Berthoud Pass, which is crossed by Highway 40. A plaque dated 1929 says the pass was discovered and surveyed by Captain E.L. Berthoud in 1861, aided by Jim Bridger. A toll road opened in 1874, and an improved highway opened in 1923.

With an average of 30 feet of snowfall per year, and as much as 60, the Colorado Department of Transportation employs a number of methods to minimize avalanche risk at the pass, including automated propane-fueled concussive blast cannons that explode gas in drilled holes, shaking the earth itself to knock down looming snowdrifts.

The pass was best known as a ski attraction, and was one of the earliest ski hills developed in the state. Before the lifts came, people used their own cars to drop skiers off at the top of the Divide, taking turns to pick them up at the bottom of the run and drive them back up again.

While a private resort near Colorado Springs installed a rope tow in 1936, it's possible that Berthoud Pass became the first public ski area in the state when it installed one a year later. A lodge was built after World War Two, when the Forest Service issued a permit for the ski hill to operate on their land. One of the first double chairlifts in the state was installed here in 1947, and lifts operated on both sides of the road, up and down the Divide. The operation continued for five decades, a small but friendly and reasonably priced skiing option, less than 60 miles from Denver.

The ski hill closed in 2002, citing financial reasons, lawsuits, and the expense of improving water collection and sewage treatment facilities. The lifts were taken down in 2003, and the lodge was demolished by the Forest Service in 2005, replaced with a functional warming hut, as the site is still used by self-serve backcountry skiers and snowboarders.

There is an electronics telemetry site on the hilltop above the pass, known as the Mines Peak Electronic Site. It has been used as a microwave relay site to convey communications across the nation since 1959, and has a heavily reinforced AT&T microwave relay tower, built in the 1970s. There is also weather monitoring equipment at the site.

Also at the pass is the Berthoud Pass Ditch, one of a few dozen trans-basin water collection ditches that move water over the Continental Divide. Originally an irrigation ditch, dating back to 1902, in the 1980s it was purchased by the eastern slope cities of Northglenn and Golden, which each receive approximately half its yield of 500 to 1,000-acre feet per year.

The 3.5-mile long ditch captures water from the headwaters of the Fraser River, on the western slope, then enters the pass from the north. It goes underneath the parking lot of the former ski operation, and picks up a bit more parking lot drainage there too. The water emerges again as a stream from under the southern end of the parking lot, and heads downslope to join the headwaters of the West Fork of Clear Creek, which follows Highway 40 to Interstate 70, and down towards Denver.



A cyclist hauling their bike over the crest of snowed-in Jones Pass, where two underground tunnels cross the Divide, more than 2,000 feet below. CLUI photo

## CONTINENTAL DIVIDE

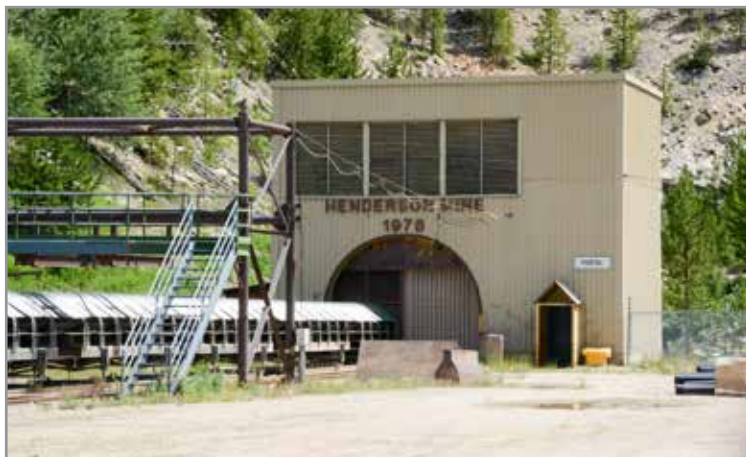
### Jones Pass and the Vasquez and Gumlick Tunnels

The 3.5-mile long Vasquez Tunnel passes invisibly under the Divide near Vasquez Peak, four miles down the Divide from Berthoud Pass. It meets the three-mile long Gumlick Tunnel, which passes invisibly under the Divide near Jones Pass, at a point next to Clear Creek.

The Vasquez and Gumlick Tunnels flow by gravity, with the upstream end around 100 feet higher than their downstream end. They are seven feet in diameter, with a flat bottom.

The meeting point is contained in a small maintenance facility operated by Denver Water. The Gumlick was originally built as the Jones Pass Tunnel in 1940, and drained into Clear Creek. In 1958, when the Vasquez Tunnel was finished, the tunnels were connected here, enabling the water to flow on to the Moffat Tunnel, crossing the Divide for the third and last time.

At 12,454 feet above sea level, Jones Pass is more than 2,000 feet above the Gumlick Tunnel, when it passes under the Divide. The pass usually has snow into August, which does not stop energetic cyclists and hikers.



The Henderson Mine conveyor belt emerging from its ten mile long journey under Jones Pass, and over the Continental Divide. CLUI photo

### Henderson Mine Tunnel

There is another tunnel crossing the Divide invisibly under Jones Pass, too, the Henderson Mine Tunnel. This tunnel originates at the Henderson Mine, immediately next to the Gumlick/Vasquez tunnel connection point. It is the largest molybdenum mine in the nation, and has produced more than a billion pounds of the material from this site.

At the mine, the rock-bearing ore is blasted out of the living rock, and is crushed down to soccer ball sized or smaller chunks, that dump onto a conveyor belt. This all takes place half a mile underground, with little to see on the surface except huge vents, the elevator headframe, and other support structures.

The conveyor belt enters a tunnel inside the mine that travels under the Divide, then exits next to the Williams Fork River on the western slope, ten miles later. The conveyor belt was installed in 2000, replacing an automated rail car system that had operated in the tunnel for a few decades. It is the longest conveyor belt tunnel in the country.

The conveyor runs for another five miles from the west portal to the mill, crossing over the Williams Fork River and a dirt road, and passing the East Branch Reservoir, which is used as a source of water for the mill.

The mill crushes the rock into powder and uses flotation and other methods to produce concentrated forms of molybdenum. The material is shipped from here to a finishing plant in Iowa, and to other processors, who use it in lubricants and metals.

Waste material from the mill, including tailings (leftover unused parts of the rock) flow in a slurry further downslope from the plant, into a two-mile long impoundment reservoir.

The Henderson Mine and Mill is one of two major molybdenum operations on the Continental Divide, both of which are operated by Climax Molybdenum, part of the Freeport-McMoRan mining company, based in Phoenix, Arizona.

The mine, at the other end of the tunnel from the mill, opened in 1976, expanding deeper into an underground ore body that had been mined for decades before that. The old mining area, referred to as the URAD mine site, closed in 1974, after 48 million pounds of molybdenum was produced by companies that were absorbed into Climax Molybdenum.

Since then, URAD has become the largest mine reclamation and remediation project in the state, addressing groundwater and other contamination issues. A wastewater treatment plant still operates next to the primary mine portal.



The west portal of the Johnson and Eisenhower Tunnels, carrying Interstate 70 over/under the Divide. CLUI photo

### Interstate 70

Six miles southbound down the Continental Divide from the Henderson Mine Tunnel is another set of tunnels through the Divide that is much more visible and familiar to people: the Johnson and Eisenhower Tunnels, carrying Interstate 70 over and under the Divide.

The Eisenhower Tunnel, now the westbound lane, was built first, opening in 1973. Six years later the Johnson Tunnel opened next to it, and the highway was divided. The tunnels are just under two miles long, and cross 1,470 feet underneath the Divide. At more than 11,000 feet in elevation, it is the highest point on the Interstate Highway System, and they are the highest vehicular tunnels in the nation as well.

The tunnels also carry water over the Continental Divide, from the western slope to the eastern slope. A series of infiltration points collect water from above the western portal into an underground tank, which is connected to a channel that runs into the tunnel.



## CONTINENTAL DIVIDE

The rights to much of this water were claimed, when the tunnels were proposed, by the Adolph Coors Company, which sought more sources of water for its primary brewery in Golden, on the eastern slope.

The water joins with surface drainage around the tunnel portals, including from the roadway drains and tunnel seepage. Some of this water is held at the tunnel for cleaning and firefighting use by the Department of Transportation, but most of it is treated in a treatment plant inside the east portal building, and discharged. The water flows out of the tunnel into a small pond next to the highway, then joins Clear Creek, a once wild creek, now pushed to the side of Interstate 70, which uses the valley carved by the creek, to get to Denver.



Loveland Pass.

CLUI photo

### Loveland Pass

Next to the interstate is the Loveland Ski Area, one of the closest ski areas to Denver, with chairlifts that approach the Continental Divide above the east portal of the highway tunnel. The ski area is accessed from the Highway 6 exit off the interstate. Before the tunnels were bored for the interstate, traffic on this busy route west of Denver had to cross the Divide on Highway 6, and go over Loveland Pass.

It is one of the highest passes that is kept clear of snow year-round by the Department of Transportation, as trucks with hazardous cargo, including gasoline tankers, are not permitted in the tunnels on Interstate 70, and have to take this curvy loop between the west and east portals of the Eisenhower and Johnson Tunnels. The pass also offers convenient access to the snowy Divide, more than two miles above sea level, with back country skiing most months of the year, and less than an hour from Denver.



The east portal of the Roberts Tunnel, flowing into the North Fork of the South Platte River.

CLUI photo

### Roberts Tunnel

The next major crossing of the Continental Divide is ten miles south of Loveland Pass, near Santa Fe Peak. This crossing is another tunnel, the Roberts Tunnel, one of the largest and longest water tunnels in the world, crossing more than 4,000 feet below the top of the Divide.

In the 1950s, Denver Water captured the Blue River watershed, which flows out of the former mining town of Breckenridge, and built the Dillon Reservoir and Roberts Tunnel to deliver it to Denver. The Dillon Reservoir is the largest reservoir for the City of Denver. Construction started in the 1950s, before agreements were even reached. The reservoir began filling in 1963, after the town of Dillon was moved.

The ten-foot diameter Roberts Tunnel begins at its west portal, underwater in the reservoir, controlled by a valve facility on a peninsula. It then runs for 23.3 miles in a nearly straight line to its east portal, near the town of Grant.

The bored tunnel, with an exterior diameter of nearly 16 feet, flows by gravity. At its east portal, 175 feet lower in elevation than its west portal, it emerges from underground just below the grade of the adjacent highway, with a small control building on top of it.

It crosses under the highway, and spills into the North Fork of the South Platte River. From there the river flows into reservoirs feeding the needs of Denver.



The Hoosier Pass Tunnel, emerging from under the Continental Divide. CLUI photo

### Hoosier Pass and Hoosier Tunnel

Hoosier Pass, on Route 9 south of Breckenridge, marks a transition for urban trans-divide watershed extensions, from Denver and its extensive suburbs and northern cities, to the urban trans-divide watershed extensions of Colorado Springs, and the eastern slope's southern cities.

While Denver captured some of the Blue River and took it over the Divide through the Roberts Tunnel, Colorado Springs takes some of the Blue River and takes it over the Divide in the Hoosier Tunnel.

The combination area at the north portal of the tunnel, on the west side of the Divide, connects to other tunnels and aqueducts in the Blue River Diversion Project, including the Quandary Tunnel and

## CONTINENTAL DIVIDE

the McCullough Tunnel, which capture water from the western side of the Blue River watershed. From there the 1.5-mile long, 10-foot diameter Hoosier Tunnel runs under the Divide, flowing by gravity, and opens into a spillway on the southern side, flowing into the Montgomery Reservoir.

The tunnel was completed in 1951, and the reservoir in 1957. From there the water flows out from under the dam into the Middle Fork of the South Platte River. At the town of Fairplay, water is removed from the river and goes to Colorado Springs via the 30-inch Montgomery Pipeline.

Hoosier Pass was the site of the Hoosier Ditch, which was the first recorded trans-divide water diversion in the state. It consisted of two ditches, collecting water from the west side of the Divide, and converging on the pass, where it drained into the Middle Fork of the South Platte River.

The ditch was first recorded in 1860, to supply water for the placer mining operations downriver, and was further enhanced in 1929. The city of Colorado Springs has since purchased the water appropriation, and diverts the water through the Hoosier Tunnel.



This public park, full of interpretive signs, is across from the entrance of the Climax Mine, located directly on the Divide, at Fremont Pass, elevation 11,318 feet. CLUI photo

### Climax Mine

From Hoosier Pass, the Continental Divide heads west, following the mountains north of Leadville. Six miles west of Hoosier Pass, the Divide enters the altered landscape of the Climax Mine. This was the largest molybdenum mine in the world, and was the origin of the company that is now called Climax Molybdenum. Climax Molybdenum operates this site as well as the Henderson underground mine, which has replaced this as the largest molybdenum mine in the nation, in output.

The mine at Climax is bigger in surface area, and is directly on the Divide. After becoming a surface mine in the 1960s, it has physically altered the topography by reshaping mountains, digging pits, and piling tailings, thus changing the course of the Divide, in ways that have not really been studied or recorded on maps.

The main mine entrance is on Highway 91, at Fremont Pass, directly on the Divide. The pass was named after the explorer John Fremont, as a plaque on a rock, installed by the local chapter of the Daughters of the American Revolution in 1930, states.

Climax got its name from railroad engineers who built a line to the top of the pass—the climax—in the late 1880s, connecting it to the boomtown of Leadville in the valley below. The mine operated mostly as an underground operation, starting in 1915. By 1926, three fourths of all the molybdenum in the world come from here.

Block-cave mining started in 1927, an excavation technique that was pioneered at the mine. The process uses explosives to cause controlled cave-ins in massive vertical cavernous voids. Under its own weight, the broken material spills into pre-constructed funnels and is hauled off over time by train cars that line up under the funnels in a tunnel below. This technique enabled production to increase dramatically, and by 1957, Climax claimed to be the largest underground mine in the world.

In World War Two, molybdenum was considered an important strategic resource, as it was used to make hardened steel for everything from aircraft engines to armor plating. Most of the nation's supply at that time came from this mine.

A company town, built here in 1936, had as many as 2,000 people in the 1950s. In the 1960s, as open pit mining expanded, the town was in the way, and was removed, and a popular skiing operation was closed. Many of the town's buildings, and people, moved to Leadville, joining the rest of the workforce, which surpassed 3,000 employees by 1979.

By then a new, more advanced underground operation had opened, the Henderson Mine, up the Divide, and 1970s environmental laws were having an effect on operations here. In 1982 mining operations here decreased to a trickle, then stopped altogether a few years later.

Though open pit mining started up again in 2012, the emphasis now is mostly about remediation, reclamation, mitigation, and erasure—as much as that might be possible.

Covering a wide area on the Divide, the Climax Mine is at the headwaters of a few river drainages. However, most of the mine's wastes have been placed in one of them, the Ten Mile Creek drainage, which flows directly into the Dillon Reservoir, Denver's largest drinking water reservoir, ten miles from the last of the mine's tailings dams.



The remains of several historic mining towns existed along Ten Mile Creek, including Kokomo, a town which had 12 hotels and 20 saloons in the late 1870s. A monument for the "highest Masonic lodge in the USA" was erected overlooking the tailings which now cover it, and these other historic sites as well. CLUI photo



## CONTINENTAL DIVIDE

More than half a billion tons of tailings have been impounded in basins constructed along the drainage of the creek, creating new land masses of waste material that cover around six square miles. State Highway 91 has been moved five times over the years to make room for new tailing ponds.

The acidic mining waste water is treated with lime to help precipitate out heavy metals, before the water flows out the end of the last impoundment dam into the creek. Interceptor canals also catch water on slopes before it drains into the tailings ponds, diverting it downstream around the tailings impoundments.

In addition to all the material that is moved from one side of the Divide to the other at the mine, water has been diverted too. A major source of water for the mine and reclamation efforts comes from the Arkansas Well and its reservoir, located below Fremont Pass.

The water is removed from the headwaters of the Arkansas River, which flows down the eastern slope, and is pumped over the Divide to be consumed by the mine, and flows down the western slope, through Ten Mile Creek.

This may be the only instance, on the entire Continental Divide, where water is taken from the eastern slope, and delivered to the west through a pipeline or tunnel. (The Vasquez Tunnel sort of does this too, but its waters originate from the west, through the Gumlick Tunnel, and travel back to the east slope through the Moffat Tunnel.) In this case though, since the drainage from Ten Mile Creek goes into the Dillon Reservoir, which drains into the Roberts Tunnel as part of Denver's water supply, this water finds its way back to the east slope too, eventually.



Tennessee Pass.

CLUI photo

### Tennessee Pass

Six miles further down the Continental Divide from the Climax Mine is Tennessee Pass, an important pass, historically. The area was explored by John C. Fremont and Kit Carson in 1845, as the nearby state historic plaque attests. Also at the pass is the Ewing Ditch, which was among the first transcontinental water diversions on record, and may be the oldest one still in use. Constructed in 1880, it extends for a mile up the side of Piney Gulch, capturing drainage that would otherwise go into the Colorado River, and moving it over the Divide where it drains into the Arkansas River watershed.

Around a thousand acre-feet of water pass through the ditch annually, measured by a flow gauge on the Divide. It has been owned by water managers for the city of Pueblo since the 1950s, and helps furnish water to that community, south of Colorado Springs.

Two miles west from the pass another water ditch extends northward from the Divide for a few miles, to collect drainage from the western slope. The ditch provides more than 2,500 acre-feet of water a year to the city of Pueblo, which is measured by a flow gauge at the pass. Known as the Wurtz Ditch, it was built in 1929, purchased by Pueblo city water managers in 1938, and extended in the 1950s. It is one of around 40 trans-divide ditches and tunnels carrying water from the western slope to the eastern slope.

Tennessee Pass is mostly remembered as an important railway route over the Divide. A narrow gauge railway was built over the pass from Leadville in 1881. At that time Leadville had a population of around 30,000, and was among the largest cities between St. Louis and San Francisco. A few years later a tunnel was bored through the mountain, and the rails were converted to standard gauge. The line connected to Aspen, and was a busy route between Denver and the West for a few decades.

A new and larger tunnel opened next to the old one in 1945, though traffic was already diminishing, favoring the shorter route through the Moffat Tunnel, which opened in 1928. The last train through Tennessee Pass came through in 1997, and the tracks have been quiet ever since.

In 2012, part of the older train tunnel collapsed, creating a sinkhole in the highway above it. That tunnel was sealed off. The 1945 tunnel remains open, and the route has recently been considered as a potential backup for transcontinental freight—if the Moffat Tunnel were to close, Union Pacific would have to reroute traffic out of the state into Wyoming.

During World War Two, the Army's 10th Mountain Division trained in the mountains around Tennessee Pass, as part of its preparations for alpine warfare in Europe. Based out of Camp Hale, five miles north of the pass, the area continued to be used for cold weather and high altitude military training after the war.

From 1959 to 1965 the CIA trained Tibetan Freedom Fighting troops there. In 1966 Camp Hale was closed and turned over to the Forest Service, and its remaining buildings were removed.



The Homestake Tunnel, emerging from under the Continental Divide, before draining into Turquoise Lake.

CLUI photo

### Homestake Tunnel

Ten miles further down the Continental Divide from Tennessee Pass, the Divide is crossed by the Homestake Tunnel, another water tunnel taking water from the west, to the east. The tunnel is five miles long, and connects Homestake Reservoir to Turquoise Lake.

## CONTINENTAL DIVIDE

The Homestake Reservoir is fed by the Missouri Tunnel, which is part of the Homestake Collection System, built by the front range cities of Colorado Springs and Aurora, in the 1960s. The tunnel originates through a portal at the bottom of the reservoir.

After crossing under the Divide, the Homestake Tunnel emerges from under the mountains into a concrete channel. From there the water continues flowing towards Turquoise Lake, another reservoir, a few hundred yards further away.



The Busk-Ivanhoe Tunnel, a former rail tunnel converted to a car tunnel, now just carries water, in a pipe over the Continental Divide. CLUI photo

### Hagerman Pass Tunnels

Another six miles down the Divide from the Homestake Tunnel is Hagerman Pass, a remote track over the Divide, under which three trans-divide tunnels pass, the Boustead, Ivanhoe/Carleton, and Hagerman Tunnels.

The Hagerman Tunnel was a 2,150-foot long railroad tunnel constructed in 1887, to serve local mining towns. It was soon abandoned after being replaced by the 9,300-foot long Busk-Ivanhoe Tunnel, built in 1893 along the same line, 575 feet lower in elevation and with fewer grades.

The Colorado Midland Railroad, which built the Busk-Ivanhoe Tunnel, went bankrupt. In 1922 the tunnel was turned into an automobile tunnel, and renamed the Carlton Tunnel, with State Highway 104 using it and the old railroad grade, until 1942, when the road was abandoned. The tunnel is now used to carry water over the Divide, in a concrete tube, from the Ivanhoe Reservoir, on the western slope, to Busk Creek, outside the tunnel's east portal. From there it flows into Turquoise Lake, and is allocated for use by the cities of Pueblo and Aurora, Colorado.



The Boustead Tunnel, emerging out from under the Divide, flows into Turquoise Lake. CLUI photo

### Boustead Tunnel and the Fryingpan-Arkansas Project

The third tunnel crossing the Divide under Hagerman Pass is the Boustead Tunnel, which opened in 1972, carrying water under the mountains for 5.5 miles, from the Fryingpan River to Turquoise Lake, where it emerges through the tunnel's east portal. The tunnel is part of the Fryingpan-Arkansas Project, a large-scale water capture and storage project, under construction from 1964 to 1981, by the Bureau of Reclamation.

The project is similar to the Colorado-Big Thompson Project, which provided trans-divide water to eastern slope communities north of Denver, though in this case it serves cities on the southern front range, including Colorado Springs, Pueblo, and La Junta.

A total of five reservoirs, 22 tunnels, and 87 miles of conduits are part of the system, on both sides of the Divide. But the Boustead Tunnel is the system's main link over the Divide itself. The tunnel carries around 70,000-acre feet per year, which spills into a channel and flows towards Turquoise Lake.

Turquoise Lake, a few miles west of Leadville, is a large reservoir constructed in the late 1960s as part of the Fryingpan-Arkansas Project. The water from the Boustead Tunnel enters the lake's western end, across from where the Homestake Tunnel drains into the lake. The reservoir was formed by building the Sugar Loaf Dam, and flooded many old mines and a few old mining towns.

At the base of the dam the water enters the Mount Elbert Conduit, an 11-mile long covered channel, buried just beneath the surface, that flows through the headwaters of the Arkansas River to the Mount Elbert Forebay, at the base of Mount Elbert, the highest mountain in the state, just east of the Divide.

The forebay drains into a tube that descends down the slope to a power plant on the edge of the Twin Lakes. The power plant and the forebay were constructed as part of the Fryingpan-Arkansas Project. When not generating power, water is pumped back up to the forebay from the power plant.

The Twin Lakes used to be two small ponds along Lake Creek, before the Twin Lakes Dam was built for the Fryingpan-Arkansas Project, which flooded the area and serves as a reservoir for the pumped storage project, and other end users of the water. These include the cities of the eastern slope, but also agricultural users down the arid watershed of the Arkansas River, which flows past Pueblo, through Wichita, Kansas and Tulsa, Oklahoma, then across the state of Arkansas, where it meets the Mississippi.



Independence Pass.

CLUI photo



## CONTINENTAL DIVIDE

### Independence Pass

Ten miles west of Twin Lakes, up Lake Creek, Highway 82 climbs up to Independence Pass, which is the second highest paved crossing of the Continental Divide. The pass, ten miles south down the Divide from Hagerman Pass, is a busy road crossing of the Divide. The highway continues west to Aspen, and is active with biking and tourists.

In 1882, a toll road was built over the pass, though traffic dropped off when the railroads got to Aspen a few years later. In the 1920s, the state of Colorado started maintaining the road as State Highway 82. The modern highway is closed for half the year because of snow, though as an old toll road it was kept open year-round.

Early use was spurred by the mining town of Independence, located a few miles west of the pass, and by the proximity of the boomtowns of Leadville and Aspen. The town of Independence and other historic sites and overlooks along the road are maintained by the Aspen-based Independence Pass Foundation, and the volunteer group Friends of Independence Pass.



The east portal of the Twin Lakes Tunnel.

CLUI photo

### Twin Lakes Tunnel

Two miles south of Independence Pass, another water tunnel sneaks invisibly under the Continental Divide. This is the Twin Lakes Tunnel, which begins on the west side of the Divide at the Grizzly Reservoir and dam.

The caretakers live in a remote home next to the reservoir, and drive through the narrow four-mile long tunnel, when it has low water, to get to Leadville. It's a long way around, otherwise, especially when Independence Pass and the surrounding area is snowed in for the winter.

The tunnel emerges from the other side of the Divide at its eastern portal. It is said to be as straight as a rifle barrel, and that you can see one end all the way to the other—a pinprick of light 4 miles away.

The tunnel was built in the 1930s, and around 40,000 acre-feet per year flow through the tunnel as measured by the Parshall Flume at the east portal. It is owned by the Twin Lakes Reservoir and Canal Company, whose shareholders are the city of Colorado Springs, the Pueblo Board of Water Works, the city of Aurora, and other eastern slope communities. The water flows into Lake Creek and to the Twin Lakes Reservoir.



The museum at Pitkin, a town on the west side of the Divide, has artifacts and displays about the long-abandoned Alpine Tunnel, six miles to the east. CLUI photo

### University Peaks and Alpine Tunnel

From Independence Pass south, the Divide runs west of the Arkansas River, and goes through a remote, lofty phase, passing through Mt. Harvard (14,414 feet), Mt. Yale (14,194 feet), and Mt. Princeton (14,197 feet). Only one maintained road passes through this 30-mile stretch, at Cottonwood Pass, a remote, meandering, dirt road.

This part of the Divide is also crossed by an abandoned railway tunnel, east of the old railway and mining town of Pitkin. This was the Alpine Tunnel, a 1,772 feet long tunnel topping the Divide, built for a narrow gauge rail line that ran from Denver to Gunnison. It opened in 1882, and was the first tunnel crossing of the Divide in the state. It was abandoned in 1910.

Both ends of the tunnel have been blocked by collapse and landslides. Volunteers have preserved some of the remains at the west portal, including part of a turntable, telegraph office, and station platform—despite the fact that the road to it is often impassable, covered by landslides.



The gift shop at Monarch Crest.

CLUI photo

### Monarch Pass

Southbound, the Divide is crossed by pavement again at Monarch Pass, for the first time since Independence Pass. Highway 50, a major highway that runs across the southern half of the state, goes over the pass, between Salida and Gunnison. Monarch Pass is one of only two sites directly on the Continental Divide with retail opportunities.

## CONTINENTAL DIVIDE

The Monarch Crest gift shop and visitor center has operated here since 1954, though the old log cabin style building burned down in 1988, and was replaced with a larger and more hardy 8,000-square foot structure.

The building was made in a modular fashion, using a cluster of ten concrete squares, topped by concrete domes, then covered by eight feet of earth. Inside is a snack bar and gift shop, often staffed by the owner. The building is on land leased to the concession by the National Forest.

There is also a nook for Continental Divide Trail hikers, who can pick up packages mailed to them here, repack with supplies, and charge cell phones. A relief map shows them where they stand in the state on their long journey one way or the other. The bathrooms for the gift shop and snack bar are on the eastern side of the Divide, and the sewage treatment and septic is on the Pacific side.

Above the parking lot is Monarch Ridge, a point on the Divide 700 feet higher than the pass. The concession company built an aerial tram up to the ridge in 1966. Though there are other trams and lifts at ski hills on the Divide, this is the only purely scenic tram on the Divide, and operates in the summer, instead of the winter. The tram was made by the Heron Engineering Company of Denver, which makes chairlifts for ski operations around the state. The four-person fiberglass cars were made by the Atlas Engineering Company in Salt Lake City.

The 1,440-foot long diagonal trip to the top takes just a few minutes, and offers fine views of the pass and the nearby Monarch Ski Area. The hilltop terminal building has a 30-ton concrete counter-weight on its back side, which holds up the tram cable, and provides even tension on the line.

On top of the tram building is an observation level, ringed by an outdoor deck providing views in all directions, that extend for 150 miles on clear days. Inside are interpretive overlooks that point out surrounding topographic features.

Outside are a variety of electronic transmission and communication facilities, including an AT&T microwave tower, and an automatic weather station, operated by the FAA. Wind gusts of close to 150 miles an hour have been recorded here, and snow levels average 350 inches a year—30 feet.



A Parshall flume measuring the flow of the Tabor Ditch at Spring Creek Pass, one of the 40 or so active diversions of water from the west side of the Continental Divide to the east side. CLUI photo

### Headwaters Hill and Spring Creek Pass

South from Monarch Pass, the Continental Divide heads southwest through remote mountains for more than 50 miles, crossed only by one paved road, Highway 114, south of Gunnison. The next paved road is Highway 149, which crosses the Divide at Spring Creek Pass. On the way, ten miles south of Monarch Pass, the Divide comes to a peak known as Headwaters Hill. This marks a point on the Divide where the drainage eastward transitions from the Arkansas River, which drains into the Mississippi, to the Rio Grande, which forms the border with Mexico, and drains into the Gulf near Brownsville, Texas. Westward from Headwaters Hill, drainage remains to the Pacific Ocean through the Colorado River drainage (via the Gunnison).

On the western side of Spring Creek Pass is the scenic valley of the Lake Fork River, which flows into the Gunnison north of Lake City. A few miles before the pass, the Slumgullion Earthflow Overlook reminds travelers of the fluidity of even these massive Rocky Mountains. 850 years ago a massive slide, the Slumgullion Earthflow, dammed the Lake Fork River and created Lake San Cristobal, forming the second largest natural lake in the state. The hillside is still moving, they say, at a rate of around 20 feet per year.

At Spring Creek Pass there is a small trans-divide water diversion ditch, collecting water for around a half a mile in the forest on the western slope. Known as the Tabor Ditch, it was constructed around 1910 to capture water for irrigation downstream. It is now owned by the Colorado Division of Wildlife, which uses it to help compensate for other water diversions in the watershed. The ditch diverts between 500 and 1,550 acre-feet per year.



The grand display about the Continental Divide, at Wolf Creek Pass. CLUI photo

### Wolf Creek Pass

After heading southwest through the spine of the San Juan Mountains, the Continental Divide doubles back, eastward, as if it were repelled by the mining district of Silverton. It snakes around the San Juans until dropping down to 10,800 feet at Wolf Creek Pass.

Wolf Creek Pass is on Highway 160, which runs across the bottom of the state from one end to the other. A nice view of the highway through the pass and of the ski runs of the Wolf Creek Ski Area can be had from the Lobo Overlook, on the Divide north of the pass. There is also a busy telemetry tower at the Lobo Overlook, amid the spruce trees killed by beetles.



Down below, at the pass on the highway, is one of the grandest interpretive panels on the Divide. It depicts and describes the Continental Divide, and how it “sends water to every part of the Continent.” The sign proclaims “With a foot on each side of the bronze line below, you are symbolically straddling the spine of the Western hemisphere.”

Behind the sign is the Treasure Pass Diversion Ditch, which captures water from the western slope and carries it over the Divide. The ditch was built in 1922, to help irrigate the San Luis Valley, on the eastern slope. It's a small ditch, diverting around 125 acre feet a year, as measured by a Parshall flume, on its way out of the pass. It is the last of a half dozen small trans-divide ditches along the Divide between here and Spring Creek Pass, that supplement the flow of the upper Rio Grande. And it's the last of the 40 or so large and small trans-divide water diversions within Colorado, the state with the most, by far.

Southbound, Wolf Creek Pass is the last time pavement crosses the Divide in Colorado.



The access hatch to the Azotea Tunnel, as it leaves the Oso Diversion Dam, taking Colorado River water south into New Mexico and to the Rio Grande, crossing the Continental Divide along the way. CLUI photo

## Azotea Tunnel

The Oso Diversion Dam is two and a half miles west of the Continental Divide, and two and a half miles north of the New Mexico state line. It is the origin of the Azotea Tunnel, which takes water from the western slope in Colorado, and delivers it to the eastern slope in New Mexico. The Oso Dam is the collection point for 15 miles of tunnels which collect water from streams on the western side of the Divide and bring it to Oso. It is part of the U.S. Bureau of Reclamation's San Juan-Chama Project, moving water from the San Juan River to the Chama River, to help with irrigation in northern New Mexico, but also to supply more water to New Mexican cities and towns, primarily Albuquerque and Santa Fe.

Constructed in 1970, the Azotea Tunnel originates at the diversion dam and runs south, underground, for more than 12 miles, crossing under the Divide in New Mexico, before discharging water previously destined for the Colorado River, into the Rio Grande's watershed. It is the only trans-state, trans-divide tunnel along the Divide.

## PART 4: NEW MEXICO



The Azotea Tunnel spills into Willow Creek, which drains into the Heron Reservoir, next to an abandoned marina. From there its water flows through two more reservoirs before joining the Rio Grande. CLUI photo

## Azotea Tunnel to the Rio Grande

The Azotea Tunnel leaves the Ojo Diversion Dam in Colorado, charged full of water from the Colorado's San Juan Mountains, on the western side of the Divide, and crosses into New Mexico. A mile after crossing the state line, it crosses the Continental Divide, invisibly, underground. At its southern end, after 13 miles underground, it becomes an open channel, on land controlled by the Jicarilla Apache.

The water flows through the engineered channel of Willow Creek for several miles into Heron Lake, which was built in the late 1960s to hold the imported water as part of the Bureau of Reclamation's San Juan-Chama Project, which delivers around 100,000 acre-feet per year through the Azotea Tunnel. One acre-foot is 325,857 gallons.

The water leaves the system through a spillway at the base of the dam, where it flows into the Chama River. In just a few hundred yards, the river enters another reservoir, El Vado Lake. The lake was constructed in 1935, as part of an earlier Bureau of Reclamation Project.

El Vado Dam, which holds back the lake, is unusual as it uses steel plates to reduce seepage across the 175-foot long face of the dam. The collected water leaves through a tunnel at the base of the dam, then continues its course downstream through the Chama River for several miles, then enters the Abiquiu Reservoir.

The Abiquiu Reservoir was built by the Army Corps of Engineers in 1963, primarily for flood control, originally. In the 1970s, with the new water coming into the system from the other side of the Continental Divide through the San Juan-Chama Project, downstream cities, including Albuquerque, successfully petitioned to have more water stored in the reservoir.

In the 1980s, the dam was raised another 13 feet. The water leaves the reservoir through a tunnel at the base of the dam, and continues downstream as the Chama River, once again. It joins the Rio Grande at Española, 25 miles away. The Rio Grande is used as the primary water source for most of the population and agriculture in the state.

## CONTINENTAL DIVIDE



Several roads cross the Continental Divide in the flatter parts of New Mexico, without much fanfare. CLUI photo

### The Subtle Passes of Northwest New Mexico

The Continental Divide crosses Highway 64 just a few miles from where the Azotea Tunnel passes invisibly under the same road. In much of New Mexico, the Divide is long and low, not flanked by steep drops, as it is for much of the Rockies. In New Mexico, it is often hard to tell where the Divide lies.

South of Highway 64, the Divide runs through the Jicarilla Apache Reservation for most of the next 40 miles, and is crossed by Highway 595 a few times, unmarked and likely unknown to most travelers, who are few, as the road peters out into a dirt track.

The Divide is marked with a state “point of interest” sign where it crosses the busier State Highway 44/550, west of Cuba. Though the pass is unnamed, and the rise is slight, it is not insignificant. In addition to a cell tower, there is also a steerable camera mounted on a pole to monitor the highway.

The Divide crosses through the Chaco Hills, between Grants and Cuba, 20 miles east of Chaco Canyon. On the road the Divide is unmarked and unnoticed.



The haul road bridge, which connects the two parts of the El Segundo mine, travels over the highway that divides it, on the Continental Divide. CLUI photo

### El Segundo Mine

On Highway 509, south of Whitehorse, on either side of the road is the El Segundo Coal Mine, operated by Peabody Energy. It is located directly on the Divide. A haul road over the highway unites the two halves of the mine, and adds another layer to this undercutting and surmounting of the Divide.

This mine covers 5,344 acres, and has around 270 employees. It is one of three mines operated by Peabody in the Southwest. The company is more active in the Midwest and in the Powder River Basin of Wyoming, where it operates the largest coal mine in the nation. The coal leaves the mine by a dedicated railway, which crosses the Divide, south of the mine. The mine produces over five million tons of coal a year, which is shipped by rail to power plants in the Southwest, including the Escalante Generating Station, 20 miles south of the mine.



Borrego Pass Trading Post.

CLUI photo

### Borrego Pass

Ten miles southwest of the mine, the Continental Divide crosses a road again at Borrego Pass, a community centered around the Borrego Pass Trading Post, a traditional Navajo Trading Post, established in 1927, and run by white missionaries—in this case, Mormons. There once were around 400 such trading posts in the region, though few operate anymore, and this one was for sale in 2019.



One of the gift shops at the settlement of Continental Divide, New Mexico.

CLUI photo

### Town of Continental Divide

Another 20 miles southwest, the Continental Divide leaves the remote Indian lands of northwest New Mexico to cross Interstate 40 at a community called Continental Divide. Nowhere is the Continental Divide more celebrated, signified, and visited (intentionally or not), then here.



## CONTINENTAL DIVIDE

The town of Continental Divide is located at exit 47 of Interstate 40, 47 miles from Arizona, 108 miles from Albuquerque, and between exit 44 (Coolidge) and exit 53 (Thoreau).

Signs in the middle of the interstate mark the Divide at 7,275 feet. On the service road, it is marked with the usual terse state of New Mexico historic roadside sign, one on each side of the interstate. Over the years it has been called Campbell Pass, Gonzales, and Summit. But the local post office makes it official: this is Continental Divide, zip code 87312.

Though the route was used by Indians, wagons, and emigrants, the trail was fixed when the railroad chose this low pass over the Divide for a line connecting Albuquerque to Southern California, in 1880. It remains one of the principal transcontinental routes for the BNSF. Starting in 1926 this was Route 66, and the remnants of the pre-interstate roadside abound. Two, and sometimes three, gift shops offer Indian souvenirs, as it is near the Navajo Nation, and Indian lands are checkerboarded around railroad land, state land, and forest land.



Highway 53 crossing the Divide next to Bandera Crater, on the edge of the valley of lava known as El Malpais. CLUI photo

### The Malpais

South of the interstate, the Continental Divide travels through the Zuni Mountains in the Cibola National Forest, to the base of an old volcano called Bandera Crater. The crater is one of several in this area that created the massive volcanic flow known as the Malpais Lava Beds, as if the lava flowed out of a crack in the Continental Divide, and flowed towards the eastern drainage before freezing solid, 10,000 years ago.

The lava fields cover a hundred square miles, and in places are nearly impossible to walk on. The region was considered as a place to test the first atomic bomb, but the Jornada del Muerto was selected instead, and El Malpais is now a National Monument.

At Bandera Crater, the lava field is wide and deep, but has paths cut through it. At one point there is a stairwell leading into the ground, ending in an ice cave with a foetid pool. The area around the crater is privately owned, and the family that owned it developed it into a tourist attraction in the 1940s, with a small museum, gift shop, and campground.

Next to Bandera Crater Highway, 53 crosses the Divide, heading west, while the Divide heads southwest, meandering around forested cinder cones for 20 more miles.



According to the USGS, Pie Town, New Mexico is 1.5 miles west of the Continental Divide, but close enough to be an important stop on the Continental Divide Trail. CLUI photo

### Pie Town

The Continental Divide crosses Highway 60 at an unnamed and subtle pass a mile and a half east of Pie Town. The Divide passes within a mile of a radio astronomy antenna, one of ten similar antennas that form the Very Long Baseline Array (VLBA), which is the largest dedicated full-time astronomical instrument in the world.

The VLBA is often upstaged by the Very Large Array (VLA), which is another 30 miles east of here. Though the VLA is large, with 27 antennas in a system that is 20 miles across, the VLBA is more than continental in size, with antennas spread across the USA, and from the Virgin Islands to Hawaii. Both the VLA and the VLBA are managed by an operations center in Socorro, New Mexico. Their proximity to the Divide is coincidental.

The nearby town of Pie Town apparently did get its name by serving pies to travelers, something it still does, including to the occasional Continental Divide Trail hikers who stop in town on their 3,100-mile journey along the Divide.

Another 20 miles west on Highway 60 is Quemado, where the Dia Art Foundation has an office for visitors to *Lightning Field*, a kind of meteorological minimalist landscape sculpture it owns, by Walter DeMaria, that covers nearly a square mile with a grid of 400 steel poles. The sculpture itself is northeast of Pie Town, six miles from the Continental Divide.



Interpretive sign at the Aldo Leopold Vista Picnic Area, looking eastward at the Gila Wilderness. CLUI photo

## CONTINENTAL DIVIDE

### Aldo Leopold Wilderness

The Divide wraps around the west end of the Plains of San Augustin, a flat, empty, and arid valley whose isolation was the primary reason for locating the VLA on its eastern edge. Then the Divide heads south into the remote mountains of Gila National Forest.

The Gila National Forest covers 3.3 million acres, and varies in altitude from 4,500 feet to 11,000 feet. Though much of it is forested, it is desert-like, too, and is often steep, crumbly, and desiccated.

750,000 acres of the forest are designated as the Gila Wilderness, which was the nation's first official "wilderness" area. It was established by the urging and efforts of the naturalist and writer Aldo Leopold, who served as a forest ranger in the area for periods between 1909 and 1924, often spending weeks alone with his horse. He was a founder of the Wilderness Society, which believed in the need to preserve places where the land is affected primarily by the forces of nature. He once wrote, "Of what avail are forty freedoms without a blank spot on the map?" Leopold was most famous for the collection of nature essays published in *A Sand Country Almanac*, which came out in 1949, a few months after he died. A portion of the Gila Wilderness was renamed the Aldo Leopold Wilderness in his honor.

The Federal Wilderness Act was passed in 1964, preserving more than 9 million acres of federal land, much of it along the Continental Divide. It now covers more than 109 million acres, in 750 places, including already established National Parks. The act defines wilderness as "an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain." Mechanized modes of travel are prohibited in most official wilderness areas, even bicycles, as well as other machines, like chainsaws and drones, if used by the public.

The Continental Divide travels through the Aldo Leopold Wilderness, on the east side of the National Forest, and enters civilization again on Highway 35, 20 miles north of Silver City.



The Continental Divide goes through the Tyrone Mine somewhere, but who knows where. CLUI photo

### Tyrone Mine

North of Silver City, the Divide goes through the community of Pinos Altos, the first of several mining areas along the Divide in southern New Mexico. Not much mining goes on in Pinos Altos anymore. It's primarily a mountain community with inexpensive real estate and tourism.

The Divide then goes over Highway 180, just west of Silver City. With a population of 10,000, the old mining town of Silver City is the largest city for miles. It still has two large copper mines nearby, as well as major mine reclamation projects.

A few miles southwest of Silver City, the Continental Divide enters Freeport-McMoRan's Tyrone Operations. This has been an active open pit copper mine since 1967, one of two in the area (the other is the Chino operation, ten miles east of Silver City).

It's hard to say for sure what happens to the Continental Divide here, though USGS maps still place it on the contours around the mine site, as it appeared in the 1980s, when the last map was drawn. The map places the Divide on the road to the main entrance to the mine, then it goes south into the mining area, meandering around the south side of the operation.

Around the south side of the mound is the Tyrone Reclamation Information Center. Though unmaintained, it still provides an overview of the operations there. Mining here started a hundred years ago, as an underground operation. The town of Tyrone was built in 1915 by the Phelps Dodge Corporation to house workers for the mine.

The town was designed by noted Gothic and Spanish colonial revival architect Bertram Goodhue, and soon became a very grand ghost town, in 1921, when the underground mine closed. The town crumbled romantically until the 1960s, when the mine opened up again as an open pit operation, and the townsite, now in the way, was demolished.

The mine has operated continuously since the open pit operation started in 1967. Phelps Dodge was acquired by the other big Arizona-based mining company, Freeport-McMoRan, in 2007. Since 1992, copper has been processed by a solution extraction and electrowinning method, generating around 100 million pounds of copper annually. Freeport-McMoRan also owns Climax Molybdenum, which operates two major mines on the Continental Divide in Colorado. The company is thus the single largest sculptor of the landscape along the Divide.

A few miles south of the mine the Divide crosses the highway to Lordsburg, at 6,355 feet above sea level, and getting lower. It's downhill from here. Next to the road there is a newly graded and marked trail site for the Continental Divide Trail. The trail and the true Divide often stray from one another, as the trail stays on public land as much as possible. From this point south, the trail remains in the hills southwest towards Lordsburg, while the actual Continental Divide follows the original drainage divide to the southeast, out of the mountains and into the desert. Mexico is just 50 linear miles away.



The Divide is as flat as it gets on Interstate 10.

CLUI photo



## CONTINENTAL DIVIDE

### Interstate 10

According to the USGS, the Continental Divide crosses Interstate 10 27 miles west of Deming, and 33 miles east of Lordsburg, at a point near the base of the eastbound off-ramp of exit 55. The highway department, however, marks the Divide with a road sign two miles west. But it seems to matter less by this point. It's pretty flat, either way.

The Southern Pacific Railroad first came through here in the 1880s. The interstate followed the route 80 years later. It is one of the busiest mainlines for freight across the Divide, and across the nation, connecting Los Angeles to Texas, New Orleans, and Florida. The right of way is also used by pipelines and communications lines. The Continental Divide, meanwhile, meanders south, towards distant hills.



The private road over San Luis Pass, the southernmost pass over the Continental Divide, is just a few miles north of the Mexican Border, at the bottom of the Bootheel. CLUI photo

### The Bootheel

Southbound, the Divide crosses Highway 146 a few miles north of Hachita, then crosses Highway 9, west of Hachita. It crosses Highway 9 a second time where the Continental Divide meets the Continental Divide Trail. From that point the trail and the Divide travel together for a few miles, northwest, through the Coyote Hills, though in opposite directions: Soon the Divide meanders south again, heading towards Mexico, and the trail continues northbound, towards Lordsburg, and Canada. Southbound they will not meet again.

The Divide then crosses Highway 9 for the third and last time, the last time the Divide will cross pavement in the USA. From here the Divide enters the Bootheel—a rectangular tab on the southwestern corner of New Mexico, with Mexico on the east and south sides, and Arizona to the west.

The Divide turns south, and stays along the crest of the Animas Mountains, with the Animas Valley on the west side, and the Playas Valley on the east side. This is nearly all private land, mostly large private ranches, zealously posted and gated, and crawling with Border Patrol officers.

The road down the Animas Valley dead-ends at the gone ghost town of Cloverdale, five miles before the border. The road down the Playas Valley passes the former company town of Playas, and dead-ends at the site of a former copper smelter.

Playas was an isolated company town built in the 1970s, to house workers at a nearby and even more isolated copper smelter. Now gated and closed to the public, it had more than 270 houses, several

apartment buildings, a bowling alley, company store, and other amenities to support a population of more than 1,000. After the smelter shut down in 1999, the residents left. In 2004, the town was turned into a security forces training facility, operated by New Mexico Institute of Mining and Technology, a state school in Socorro, and supported primarily by federal funds. Now called the Playas Training and Research Center, it is a busy site for training paramilitary forces.

The original residents of Playas worked at Phelps Dodge's Hidalgo Smelter, ten miles further down the road. The company opened the copper smelter here in 1971, to process copper from the mines near Silver City, which came by rail through Lordsburg. The remote site was chosen as the process was dirty, emissive, and used toxic materials. The smelter closed in 1999, and has mostly been torn down. Its 600-foot tall stack was toppled in 2007. Remediation efforts, including addressing soil and groundwater contamination, continue.

Highway 81, south of Hachita, approaches the Playas Valley obliquely, from the northeast, through a pass known as Hatchet Gap. Near the Gap is a kiosk for hikers on the Continental Divide Trail, located at the closest paved road to the southern origin/terminus of the trail.

Most people who hike the entire 3,100-mile long trail, do so from south to north, starting in May and arriving at the other end in September. This avoids the summer heat of the southern part, and gives time for the snow to melt from the peaks of the north.

Southbound hikers start in June, and end up here in October. There is no official way to track how many through-hikers actually make it every year, but a few hundred is possibly likely, with the vast majority going northbound. The trail starts on the border at the Crazy Cook Monument, at the end of a very bumpy and remote road.

South of Hatchet Gap, and just two miles from the border, Highway 81 meets the road to San Luis Pass, a dirt road that goes over the Divide, four miles north of the border. It once was a county road, and the only connection between the Animas and Playas Valleys, but is now controlled by the landowners, the Diamond A Ranch, which keep it closed and off limits to the public, rendering the last pass over the Divide unpassable.

In two miles Highway 81 meets the Antelope Wells port of entry, the only border crossing in the Bootheel of New Mexico. This is the very end of the nation, and the Continental Divide. Or the beginning, if you are going the other way. ♦



The Mexico/US border station, at the bottom of the Bootheel.

CLUI photo

## TLEP CIRCLES SALTON SEA SCANS BOTTOM FOR COMING ATTRACTIONS



TLEP at the harbor of the former Salton Sea Test Base. Lukas Marxt and Steve Badgett spent several days sonar scanning the target areas offshore, searching for evidence of test bombs dropped in the sea, including Manhattan Project prototypes from early 1945. CLUI photo

THE TERMINAL LAKE EXPLORATION PLATFORM (TLEP) spent a few months on the Salton Sea in 2019, serving as a roving base for a number of independent research projects, and exploring the margins of this increasingly remarkable salty lake in the southeastern corner of California.

Skipped by its builders and designers, Chris Taylor and Steve Badgett, the TLEP was on the water in the spring, based out of the state's visitor center and campground, at North Shore. The deployment to the sea was supported by its inclusion in the art biennale, Desert X.

Desert X 2019 included a string of commissioned outdoor artworks, mostly clustered around Palm Springs. Visitors connecting the art dots on the map were drawn slowly southeast along Highway 111, eventually leaving gated communities and golf courses behind them at Coachella, to get to the last bits and pieces at the Salton Sea. The last of these bits, and the furthest out, was the TLEP, not even quite on the land, but moored offshore, disembarked from the end of the string of art, to image and orbit the sea, at the end of the drainage, and the bottom of the bowl.

From February into April, the platform migrated to different points around the Salton Sea, eventually circling it in a counter-clockwise direction, occasionally shuttling back and forth across the sea, depending on weather conditions.

TLEP is an aluminum structure on inflated pontoons, that can be assembled on shore in a few days. Its 420-square foot lower deck is designed to house a few people for several days, and is powered by batteries and propelled by an electric motor. Its roof and upper deck provide shade, and space for a large photovoltaic array that keeps its electrical systems charged.

The structure is a human habitat, somewhere between a ship and a dock, a kind of situational blind, capable of repositioning itself to different observation locations. When it moves, it does so slowly, at a walking pace, rather than hurrying to shrink space and time. In this way too it is responsive to conditions of wind, weather, and climate. Rather than surmounting these forces, it immerses its users in the local environs.

TLEP was developed initially for the Center for Land Use Interpretation to use on the Great Salt Lake, as the Great Salt Lake Exploration Platform (GSLEP). Over a few years of seasonal deployments on the Great Salt Lake, the platform brought a variety of users, including students, teachers, and practitioners in fields like art, architecture, and landscape, face to face with the lake, absorbing this unique, remote, and entirely altered environment in ways that are rarely experienced.

The deployment to the Salton Sea is part of a broadening of its scope, and a rechristening as TLEP, an acronym which can alternately be read as "Terminal Lake Ex Platform," where the open-ended "Ex" allows for all of those great words that start with "ex" to be explored and examined (exhibit, exploit, extreme, extrapolate, extract, extraneous...) without favoring or limiting it to any one in particular. An excellent concept, perhaps.

The TLEP is heading into the broader West, into other terminal lakes at the bottom of what are known as endorheic basins, places with no drainage to the ocean. Isolated, discrete islands of water on the land. These internal margins are the first to dissolve into a dessiccationscape, by the continuing reduction of water resources, an outcome of human-induced alterations to the local and planetary environment. Few terminal lakes, though, are as altered as the Salton Sea.

The Salton Sea itself, as most people are aware by now, is the product of a man-made accident, where an irrigation canal was overwhelmed by the Colorado River in 1905, causing this arid and below sea level valley to be flooded, forming a 35-mile long lake. Railways, roads, buildings, a salt factory, telephone poles, agricultural fields, and Indian reservation land were buried by water.

Over the years the Salton Sea grew, as it became a sink for the disposal of agricultural wastewater and runoff for one of the most productive industrial agricultural area in the nation, the Imperial Valley, at its southern shore. The Whitewater River, entering the sea at its northern shore, drains the Palm Springs and Coachella region, an urban area with a population of 500,000 people, and more than 100 golf courses.

Added to this nutrient rich soup over the preceding century are thousands of military practice bombs, several crashed airplanes, sunk boats, unspecified dumpings, and the many shoreline developments from the 1920s to 1960s that were swallowed up as the sea grew steadily, like a blob. In the 1940s, the Navy built a seaplane practice base and brought other small crafts from the Pacific—with barnacles attached. Now the entire bottom of the sea and everything in it is covered in a crust of barnacles.



## SEEING THE SALTON SEA



At the south end of the Sea, TLEP crew came ashore via the canoe to explore Mullet Island, for many years the only island in the sea, and now connected to the shore by a muddy peninsula. The island is covered in bird guano, and contains the foundations of a resort/gallery/marina/bar known as Hell's Kitchen, dating from the 1920s.

CLUI photo

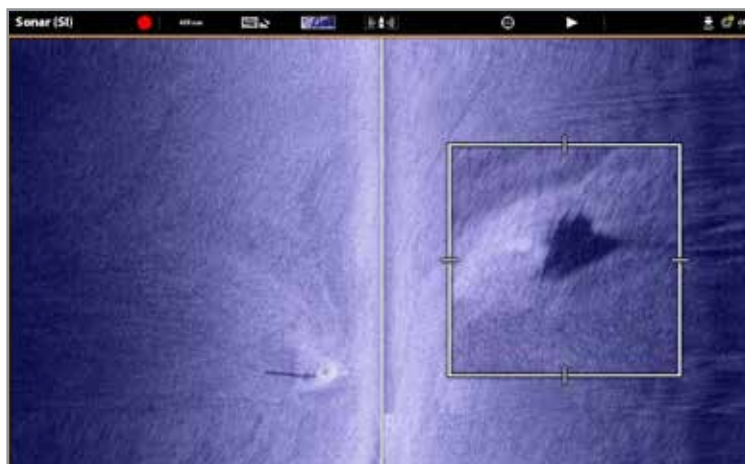
Imported alien fish, migratory and nesting birds, and swarms of flying bugs have boomed and busted in the sea, in various ways. Overstuffed with nutrients and invasive organisms, accelerated cycles of generation and destruction, as each induced overabundance of life is followed by suffocation and collapse. Over and over, faster and faster, with unattenuated explosions and implosions of ecological stability. These convulsions culminated in recent years with the last gasps of the remaining tilapia that suffocate in the summer when algae blooms soak up all the oxygen in the water, and a crusty dead fish beachscape forms along the shore.

All of this, however, is coming to an end, if it hasn't already, and in fact has started to reverse. Salinity has increased, so that the tilapia and many other organisms are nearly gone, and flooding has been stopped by legislation. As of the first of January, 2018, water is no longer dumped into the sea. Instead it is treated, reused, or sent to San Diego. So now the sea is shrinking, and getting saltier, evaporating at a rate of around one or two feet a year.

Since the sea is only 40 feet deep at its deepest point, it could be gone in as little as 20 years. This, however, is unlikely, as things will get so bad before that, that something will be done. The exposure of the shore and sediments, picked up by the wind, is likely to produce toxic dust storms that will make Owens Lake look like a walk in a park, some say. And unlike Owens Lake, there are many more people downwind here than at Owens Lake.

What, exactly, will be done is very much up in the air. Proposals, including building aqueducts to bring water from the Pacific Ocean, are being considered. But for now, at the moment, and for the foreseeable future, what has been underwater for the last century, is now, slowly, being exposed. What we thought was maybe gone forever, forgotten, and away, is coming back into the world—encrusted in barnacles. ♦

*One of the functions of the TLEP as it traveled around the Salton Sea was to scan the bottom using sonar, to see what there is to see, a kind of “coming attractions” from a submerged landscape frozen in time. In this way the TLEP was a flatbed scanner, hovering over the underwater ground, like a surveillance aircraft flying at a fixed altitude through aqueous air, over a future landscape, immersed in amniotic fluid, as yet unborn.*



What was revealed by the scans is hard to tell. The sonar recorded circular fields of tilapia nests, some telephone poles, tree trunks, and lots of indistinct forms. Interpretation of these images and artifacts is ongoing.

CLUI photo



The TLEP had a removable screen so that it could present its sonar scans to visitors on the shore. It also travelled the sea at night, projecting the scans live to whoever was watching.

CLUI photo



An evening of Salton Sea films was also presented for an audience on the shore at the State Park, featuring a reel of trailers of some of the many films shot at the sea, including: *The Bad Batch* (2016), *Future World* (2018), *The Monster that Challenged the World* (1957), *Little Birds* (2011), *Dead Sea* (2014), *Bombay Beach* (2011), *Salton Sea* (2002), and *Plagues and Pleasures of the Salton Sea*, Chris Metzler's 2004 documentary narrated by John Waters.

CLUI photo

## WENDOVER REPORT

FROM THE CLUI OUTPOST IN THE BONNEVILLE BASIN



Group visiting the CLUI in Wendover.

CLUI photo

THE CENTER'S OUTPOST AT WENDOVER, Utah, on the shores of the Bonneville Basin, saw its usual stream of visitors, known and unknown, passing through, signing the guest books or not, as well as some long-term projects progressing in different ways.

The Orientation Building remains open 24-7-365, with access information posted at the door. The Exhibit Hall across from it is no longer open all the time, as it is slowly having some new exhibits installed, after being “gutted” by the Center for Art+Environment (in truth, the CLUI donated its Wendover Residence Program material to the CA+E archives, whose registrars came to collect it. Some of this material may find its way into exhibits at CA+E's parent organization, the Nevada Museum of Art).

Other recidivists include: the “towering” artist Rob Ray, who serviced the radio receiving tower at the Orientation Building and the visual observation tower at Main Base, and worked on the aural broadcasting sound tower at South Base; the 13 Black Cats crew, who came to shoot their film *Straight Flush* (which is screening at the Museum of Modern Art in New York in February) in the CLUI Special Projects space (one of the old barracks buildings); William Lamson's *Mineralogy* installation continues to salinify nicely, and was visited by many of the groups passing through CLUI Wendover.

CLUI personnel worked on video shoots and other documentation projects for future programming at and about the region. Classes coming through and staying for a bit included Land Arts of the American West from Texas Tech, which spent a week at CLUI working on creative projects in the region; Aurora Tang's field class with Ian James from Otis College of Art and Design visited Wendover, as did her field class with Alexander Robinson from the University of Southern California; and Hikmet Loe's class from Westminster College made its annual pilgrimage west from Salt Lake City. ♦

## CLUI VISITORS AND VISITATIONS

WHILE MOST VISITORS TO CLUI do so through virtual means (through our website and publications), some people do visit us in the physical world as well, still. In addition to people coming through CLUI Wendover—a most “physical” place indeed—people come in a steady stream through CLUI Los Angeles, the organization's main office on the edge of downtown Culver City, which has a visitor center and bookshop, and features a few exhibits produced by the CLUI every year. Outside of the regular public hours (Friday-Sunday, 12-5pm), classes, groups, and researchers from out of town make appointments to meet with our staff, or see exhibits. Groups that stopped by in 2019 included graduate classes from UC Berkeley; University of Melbourne; UTS School of Architecture, Sydney; Kansas State; Texas Tech; and a group from MassMoCA. From the Los Angeles area, classes from Otis College of Art and Design, ArtCenter, Claremont College, CalArts, the Mountain School, and the Southland Institute stopped by for talks. CLUI program managers were invited to speak at other places too, including Harvard University. ♦

## THE COAST REALTY ARCHIVE

A NEW LOOK AT OLD LOS ANGELES



The Sturges House, designed by Frank Lloyd Wright at 449 Skyewiay Road in Brentwood—for sale in 1963 for \$55,000. Coast Realty Archive image

THE CLUI HAS ACQUIRED A collection of over 15,000 old real estate listings, from Coast Realty, a local realtor that closed shop several years ago. The listings date from the 1950s through the 1960s, and depict a Los Angeles of another time, booming with postwar development and possibility. Whether commercial or residential, each listing has a photograph of the structure, taken from the street, creating a unique block by block photographic survey of the westside of Los Angeles, decades before Google Street View. Over the coming years, the Center will be sorting the archive, creating a finding aid, and digitizing the images to make them available for the public to view. ♦

CLUI Corps: Matthew Coolidge, Sarah Simons, Aurora Tang, Ben Loescher, George Budd, Steve Badgett, Oswaldo Gonzalez, Rob Ray, Tellef Tellefson, Igor Vamos, Jim Fox, Nico Young.

Newsletter Editors: Matthew Coolidge, Sarah Simons, Aurora Tang.



## BOOK REVIEWS

## BOOKS NEW TO THE SHELVES OF THE CLUI LIBRARY

**Garage**, by Olivia Erlanger and Luis Ortega Goveia, 2018

A playful and insightful study of the garage, “an architectural technology devised to protect machines,” that evolved into a “polyvalent space,” where obsessions and creativity can be explored, without damaging the finish. Silicon Valley was born here, as some garages claim, as well as suburban angst-driven garage bands. And so many known and unknown things between, and beyond. It’s fun even to just think about what garages are, and can be.

**Bulldozer: Demolition and Clearance of the Postwar Landscape**, by Francesca Russello Ammon, 2016

When considering the clearance of the postwar landscape, it’s tempting to stray from the path of the bulldozer—that piece of heavy machinery with the flat plow on the front, and tank-like treads for wheels—into that of loaders, backhoes, graders, scrapers, power shovels, tractors, and other forms of yellow-painted earthmovers, but in general, the author stays on track. The bulldozer, of course, is the most iconic of these land-forming machines, and its role as cultural notion and symbol is also addressed, at length.

**The Spoils Of Dust: Reinventing the Lake that Made Los Angeles**, by Alexander Robinson, 2018

An encyclopedic view of the contemporary conditions at one of the most conceptually and visually astounding places in the USA, Owens Lake. Robinson, a landscape architecture professor at USC, delves deep into shallow flooding, moat and row, and other dust control measures. He provides a wealth of contexts, from land art to bird migrations, to help us understand the perceptual phenomenology, politics, and mechanics of this compelling place, where more than a billion dollars has been spent for it to not be a lake.

**A Ditch in Time: The City, the West, and Water**, by Patricia Nelson Limerick, 2012

The venerable director of the Center of the American West published this singular overall view of Denver’s water infrastructure, especially the politics, people, proponents, and opponents, historically and to the present. Denver has built some of the largest water projects in the nation, even spanning the Continental Divide (through tunnels underneath Rocky Mountain National Park, and such). The network of dams and reservoirs, fed by tunnels and ditches (canals that capture streamflow and move it elsewhere by gravity), stepping into the heights behind the Front Range, is staggering.

**After Promontory: One Hundred and Fifty Years of Transcontinental Railroad**, edited by the Center for Railroad Photography and Art, 2019

This is the big book of the exhibit of the same name, which is still on the road (next stop: San Mateo History Museum, Redwood City, California). The book has essays that provide new takes on the history and significance of railways, but it’s really about the photos, from the historic landscape classics of Carleton Watkins to the contemporary landscape classics of Mark Ruwedel, all with a railroad running through it. Brought to us by the academic railfans at the Center for Railroad Photography and Art, a nonprofit in Madison, Wisconsin.

**Machine Landscapes: Architectures of the Post-Anthropocene**, edited by Liam Young, January 2019

Architectural Design Magazine, a book-sized design and technology bi-monthly journal, often has dramatic issues that focus on landscape and architecture, arranged around a theme by a guest editor. This edition was edited by speculative architect and Sci-Arc professor Liam Young, and explores the presently future spaces of datacenters, automated fulfillment centers, driverless cars, Chinese bitcoin mines, spacejunk, cyber-windfarms, creepy AI spaces and other extrapolations of the present, as algorithmically predicted, likely.

**The King and Queen of Malibu: The True Story of the Battle for Paradise**, by David K. Randall, 2017

Newlyweds Frederick and May Rindge left Boston in 1887 and moved to Los Angeles, using Frederick’s inherited fortune to make a bigger one in real estate and other businesses. Among the things they acquired was 13,000 acres of remote

land on the shores north of Santa Monica, where they built their beachside mansion. Frederick Rindge died in 1905, and May held on to Malibu’s entirety for decades more, fighting off public roads, and manipulative encroachments, with scandalous vigor. She died in 1941, and the postwar boom finally blasted through the gates she so stubbornly held shut, enabling the enclave of private beachfront exclusivity as we know it today to develop. In LA, it’s all about the real estate.

**The Nevada Test Site**, by Emmet Gowin, 2019

Black and white aerial photos with strong shadows and oblique views bring out the contrast and reveal the textures of this transformed landscape, where the eminent photographer, Emmet Gowin, flew for a few flights, with his camera, in a helicopter, in 1996 and 1997. This was the time between the end of large-scale underground nuclear testing, and the beginning of the site’s post 9/11 retasking as the Nevada National Security Site. This was the same time the CLUI was on the ground there (perhaps a bit too much) working on our *Guide to America’s Proving Ground*. Now we know who that guy buzzing around over our heads was.

**Lake Bonneville/Lake Lahontan**, by Michael Light, 2019

This book of photos, at 16½ inches tall, 10½ inches wide, and one inch thick, is small and light, by Michael Light standards, but it enables you to flip it around, and around, as you must, since on one cover it is called *Michael Light Lake Lahontan*, and the other *Michael Light Lake Bonneville*. Either way, opening it up, you get 21x16½ inch photos of one or the other place, showing Light’s characteristic dramatic high contrast, horizon-less, low altitude obliques of squiggly lines, mostly tire tracks and road patterns, shot from his plane with a big camera. In the middle of the book is a nearly blank map of this historic emptiness, and if you flip that over you get an essay about the emptiness by William L. Fox. Flanking this, in the body of the book, are upside down to one another poem/essays by Charles Hood, and Leah Ollman. You move this book as much as it moves you.

**Lookout America! The Secret Hollywood Studio at the Heart of the Cold War**, by Kevin Hamilton and Ned O’Gorman, 2019

Finally a book comes out about Lookout Mountain, the Air Force’s secret movie studio just above the Sunset Strip, where hundreds of movies that never saw the light of day were made, and where the hundreds more that did, blew people’s minds (including Pete Kuran’s, who made a film about the Atomic Cinematographers who were based out of here). After Lookout Mountain closed, the building became a privately owned Laurel Canyon pleasure palace with a dozen spa-sized bathtubs. The book is more about the films produced here, and the programs they depict, than the place, which is perhaps as it should be.

**Homewreckers: How a Gang of Wall Street Kingpins, Hedge Fund Magnates, Crooked Banks, and Vulture Capitalists Suckered Millions Out of Their Homes and Demolished the American Dream**, by Aaron Glantz, 2019

That pretty much sums it up.

**Water Gold Soil: The American River**, by Sayler and Morris, 2019

This heavily designed book, with trickles of embossed gold ink in heavy earth-toned paper, follows the journey of water from the headwaters of the American River, whose South Fork runs through the site of Sutter’s Mill, the point of origin of the Gold Rush, through the Folsom Dam, and into the canals of Big Ag in the Central Valley. Interspersed are images of the plotting hands of cartographers of the 1950s, working the waterworks out. It’s an aesthetic, apostrophic postscript to some chapter of *Cadillac Desert*, complete with a backwards-looking foreword by Elizabeth Kolbert.

**Michael Heizer: The Once and Future Monuments**, by William L. Fox, 2019

Despite its simplicity and literally monolithic qualities, Michael Heizer’s sculpture continues to elicit an interpretive stream. No doubt much of the interest in him is because he has been building Complex City, the largest sculpture in the world, by some ways of measuring, for 50 years, letting only a few in to see it. Among them has been the author, William L. Fox, the director of the Center for Art + Environment, who likely burns whatever is left of his “City” bridges in this book. (And whether we will forgive Fox for his claim of directing the “world’s only art research institute devoted to the study of human’s creative interactions with their natural, built, and virtual environments,” we shall see.)

# UNITED STATES FREQUENCY ALLOCATIONS

## THE RADIO SPECTRUM

| RADIO SERVICES COLOR LEGEND |  |  |
|-----------------------------|--|--|
|                             |  |  |
|                             |  |  |
|                             |  |  |
|                             |  |  |
|                             |  |  |
|                             |  |  |
|                             |  |  |
|                             |  |  |
|                             |  |  |
|                             |  |  |

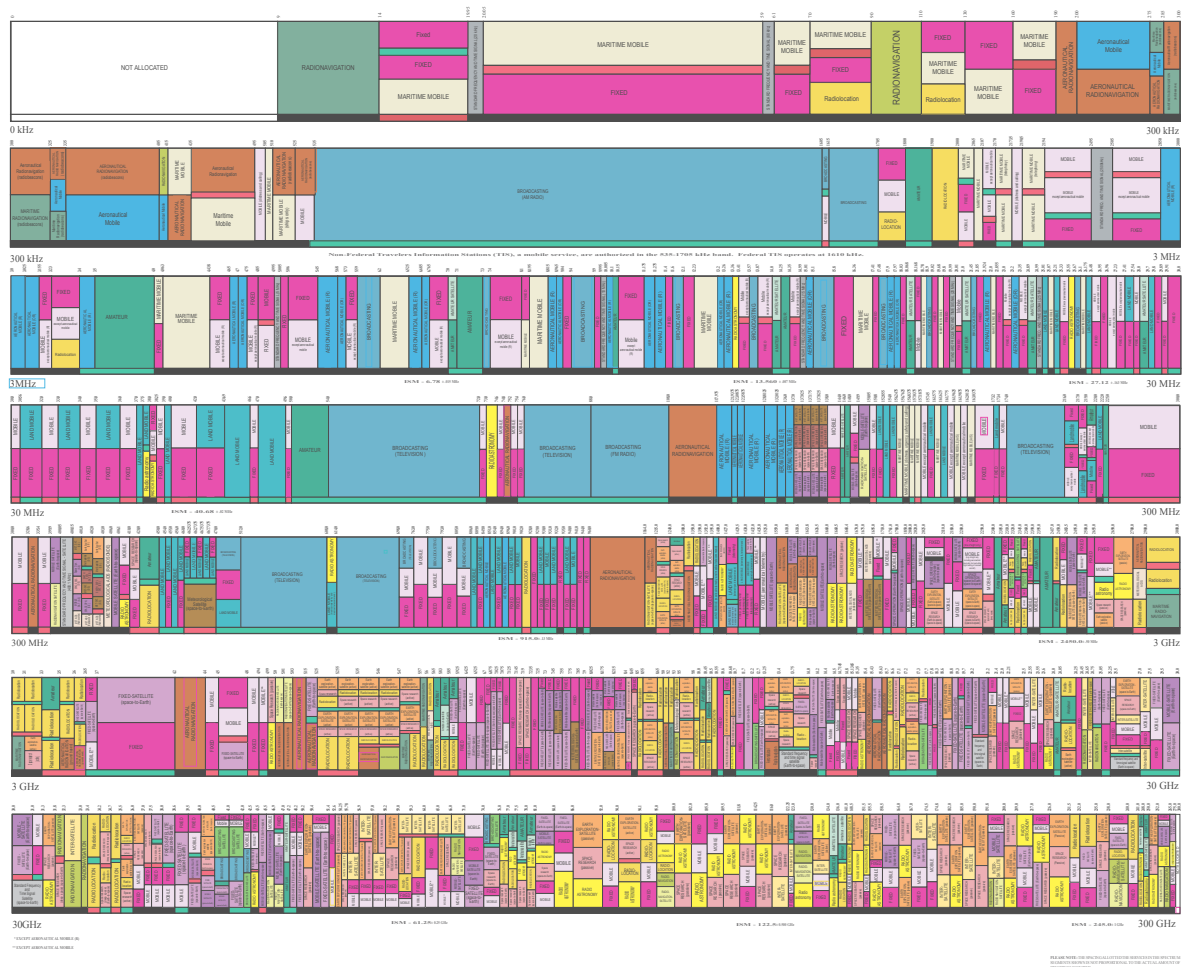
| ACTIVITY CODE |  |  |
|---------------|--|--|
|               |  |  |
|               |  |  |

| ALLOCATION USAGE DESIGNATION |         |                                     |
|------------------------------|---------|-------------------------------------|
| Service                      | Example | Designation                         |
| Primary                      | Fixed   | Capital Letter                      |
| Secondary                    | Mobile  | 1st Capital with lower case letters |

This chart is a graphic representation of the United States Frequency Allocation Table (USFAT) and is not a legal document. It is intended for informational purposes only. The USFAT is a legal document that is published by the Federal Communications Commission (FCC) and is subject to change. The USFAT is a legal document that is published by the Federal Communications Commission (FCC) and is subject to change. The USFAT is a legal document that is published by the Federal Communications Commission (FCC) and is subject to change.

U.S. DEPARTMENT OF COMMERCE  
National Telecommunications and Information Administration  
Office of Spectrum Management  
JANUARY 2016



Download this handsome chart for free at [www.ntia.doc.gov](http://www.ntia.doc.gov)



THE CENTER FOR LAND USE INTERPRETATION  
9331 Venice Blvd.  
Culver City, CA 90232  
[www.clui.org](http://www.clui.org) [clui@clui.org](mailto:clui@clui.org)