



2020 REPORT CARD FOR
COLORADO'S
INFRASTRUCTURE



Colorado Section of the American Society of Civil Engineers
INFRASTRUCTUREREPORTCARD.ORG/COLORADO





COVER PHOTO:
CITY PARK LAKE AERIAL DRONE SUMMER GREEN LANDSCAPE IN THE ROCKY MOUNTAIN CITY - GREEN SUMMER CITYSCAPE
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EXECUTIVE SUMMARY

Colorado's population is expected to grow from 5 million in 2010 to a projected 6 million in the 2020 U.S. Census. Colorado's population explosion begs many questions: How will all of these people move around? Will they have adequate drinking water and electricity? What types of facilities will be available for their recreation? How suitable are the school buildings? Every day, civil engineers focus on these types of infrastructure questions.

For the first time in a decade, local engineers with the Colorado Section of the American Society of Civil Engineers (ASCE) have conducted an exhaustive evaluation of Colorado's infrastructure, based on publicly available databases, analysis, and conversations with state and local agencies. Citizens of Colorado benefit from an objective review undertaken by dozens of experts in their respective fields. The 2020 Colorado Infrastructure Report Card represents the third evaluation performed by the Colorado Section of ASCE and focuses on 14 categories of infrastructure.

In 2020, the overall GPA for Colorado's infrastructure is a C-. When compared with the 2010 grades, five categories saw improvements, two categories got worse, and three stayed the same. Four additional categories were included in the 2020 Report Card were not included in 2010. Although the overall GPA has gone from a C in 2010 to a C- in 2020, significant progress was made in several areas, including:

- Colorado policymakers have doubled down on renewable energy production with passage of legislation requiring social cost of carbon evaluations and increased oversight of utility resource decisions. Utilities have pursued aggressive adoption of renewables, but have also invested heavily in new transmission capacity, battery storage and advanced metering technologies that will make the grid more resilient.
- Colorado transit has made consistent strides over the years, despite funding shortfalls. Sixty out of the sixty-four counties in Colorado provide some type of transit for their residents and visitors. Public transit options for outdoor recreationists and tourists along the western I-70 corridor such as Snowstang have been rapidly expanding as their popularity grows.
- Despite an ever-increasing gap in funding, Colorado's roads have kept up with maintenance and improvements at an above-average rate compared to the nation.
- Similar to roads, Colorado's bridges have seen better maintenance and improvements than the national average. Colorado has become a leader in bridge innovation, implementing designs such as concrete box-girder bridge and utilizing the accelerated bridge construction (ABC) method of sliding bridges into place to reduce impact to the public and use funds efficiently.

These are commendable improvements, but significant work remains. Colorado hasn't raised its gas and diesel taxes in 30 years. This means our state's Department of Transportation is relying on a stagnant source of revenue, a challenge akin to asking someone to live off their 1991 salary in 2020.

The state and localities alike have stretched limited infrastructure dollars as far as they can. Meanwhile, our population is growing and our existing assets are aging. Immediate action is needed to maintain Coloradans' high quality of life, keep our state economically competitive, and prepare us for future challenges and opportunities.

SOLUTIONS TO RAISE THE GRADE

While significant improvements headline this positive story, many challenges remain as addressed in our four Key Solutions to Raise the Grade:

1. Prioritizing infrastructure during state and local budget discussions and in elections can help connect disparate parts of the state, strengthen the economy, and alleviate challenges associated with a quickly growing population. Investment in road and rail will support Colorado's key industries of agriculture, mining, and manufacturing, as well as allow residents better access to jobs, schools, and healthcare services. Infrastructure investment cannot go to metropolitan Colorado alone. Adequate support must also be provided to low-income communities to improve schools and water access and promote a high quality of life. Legislators should work to put together an inclusive infrastructure connectivity plan that identifies all regions of the state and prioritizes low-income areas.

2. Robust transit and multi-modal prioritizing in planning and funding is needed to create viable transportation alternatives to help combat congestion and pollution, especially in metropolitan areas. Providing increased funding for the Regional Transportation District and other transit agencies so that they can provide adequate service to customers is a good first step. Transportation planning should focus on increased mobility across a multi-modal system and be positioned to capitalize on innovations such as real-time alerts, on-demand service, and eventually, self-driving vehicles.

3. Colorado has unique infrastructure funding obstacles in the forms of TABOR and the Gallagher Amendment. One of the results of these measures working together is that voters have a decisive role in infrastructure funding needs being met. Public education on these needs and related legislation should be undertaken consistently and with the goal of a mutual trust of the government and public meeting each other's needs regarding infrastructure projects. Local jurisdictions have seen success in this matter through specific funding allocations being cited in legislation and referenda, as well as public education throughout and following an infrastructure project.

4. The Colorado State Legislature should work towards increase funding for the Building Excellent Schools Today (BEST) competitive grant program. The BEST Program provides support to public schools looking to invest in their capital construction needs. Additional funding could come in part from re-allocating Amendment 64 special sales tax revenue that is currently going to the General and other funds as well as increasing revenue from School Trust Lands.

The answer begins with engagement and we hope the 2020 Infrastructure Report card will help by increasing awareness of infrastructure needs to help focus valuable resources on improving infrastructure to support Colorado's economy and quality of life.

ABOUT THE INFRASTRUCTURE REPORT CARD

GRADING CRITERIA

ASCE-CO's 2019 Report Card Committee is a group of dedicated civil and environmental engineers from Colorado, who volunteered their time to collect and analyze data, prepare, review, and revise each section, and develop the final Report Card. The committee worked with ASCE's Committee on America's Infrastructure and ASCE Infrastructure Initiative staff to provide Colorado with a snapshot of the state of our infrastructure, as it relates to us at home, and on a national basis.



The Report Card Sections are analyzed based on the following eight criteria:

CAPACITY Does the infrastructure's capacity meet current and future demands?

CONDITION What is the infrastructure's existing and near-future physical condition?

FUNDING What is the current level of funding from all levels of government for the infrastructure category as compared to the estimated funding need?

FUTURE NEED What is the cost to improve the infrastructure? Will future funding prospects address the need?

OPERATION AND MAINTENANCE What is the owners' ability to operate and maintain the infrastructure properly? Is the infrastructure in compliance with government regulations?

PUBLIC SAFETY To what extent is the public's safety jeopardized by the condition of the infrastructure and what could be the consequences of failure?

RESILIENCE What is the infrastructure system's capability to prevent or protect against significant multi-hazard threats and incidents? How able is it to quickly recover and reconstitute critical services with minimum consequences for public safety and health, the economy, and national security?

INNOVATION What new and innovative techniques, materials, technologies, and delivery methods are being implemented to improve the infrastructure?



COMPARISON OF 2014 AND 2020 GRADES

COLORADO			
Category	2014	TREND	2020
Aviation	B	↔	B
Bridges	C-	↑	C+
Dam	C+	↔	C+
Drinking Water	C-	↔	C-
Energy	D	↑	C+
Hazardous Waste	N/A	N/A	C-
Levees	N/A	N/A	D+
Parks	N/A	N/A	C
Rail	N/A	N/A	B-
Roads	D	↑	C-
Schools	D	↑	D+
Solid Waste	B-	↓	C-
Transit	D+	↑	C-
Wastewater	C	↓	C-



2020 REPORT CARD FOR COLORADO'S INFRASTRUCTURE



 AVIATION  B

 PARKS  C

 BRIDGES  C+

 RAIL  B-

 DAMS  C+

 ROADS  C-

 DRINKING WATER  C-

 SCHOOLS  D+

 ENERGY  C+

 SOLID WASTE  C-

 HAZARDOUS WASTE  C-

 TRANSIT  C-

 LEVEES  D+

 WASTEWATER  C-



GRADING SCALE



EXCEPTIONAL: FIT FOR THE FUTURE

The infrastructure in the system or network is generally in excellent condition, typically new or recently rehabilitated, and meets capacity needs for the future. A few elements show signs of general deterioration that require attention. Facilities meet modern standards for functionality and are resilient to withstand most disasters and severe weather events.



GOOD: ADEQUATE FOR NOW

The infrastructure in the system or network is in good to excellent condition; some elements show signs of general deterioration that require attention. A few elements exhibit significant deficiencies. Safe and reliable with minimal capacity issues and minimal risk.



MEDIOCRE: REQUIRES ATTENTION

The infrastructure in the system or network is in fair to good condition; it shows general signs of deterioration and requires attention. Some elements exhibit significant deficiencies in conditions and functionality, with increasing vulnerability to risk.



POOR: AT RISK

The infrastructure is in poor to fair condition and mostly below standard, with many elements approaching the end of their service life. A large portion of the system exhibits significant deterioration. Condition and capacity are of significant concern with strong risk of failure.



FAILING/CRITICAL: UNFIT FOR PURPOSE

The infrastructure in the system is in unacceptable condition with widespread advanced signs of deterioration. Many of the components of the system exhibit signs of imminent failure.



AVIATION



DENVER INTERNATIONAL AIRPORT
SOURCE: BIGSTOCKPHOTO.COM



AVIATION GRADE: B

EXECUTIVE SUMMARY

There are 74 public use airports in Colorado listed in the National Plan of Integrated Airport Systems, nine of which classified for commercial service. Runway pavement condition is good; in 2018, the area-weighted pavement condition index for major and intermediate airport primary runways met the state's goal. The 2018 runway pavement condition index remained essentially unchanged from the 2014 inventory, which indicates Colorado's airport pavements have been adequately maintained the past four years. The largest airport in Colorado is Denver International Airport (DEN), which is the fifth busiest airport in the country and 18th in the world. In 2018, DEN served a record 64.5 million passengers. DEN airport has adequate capacity and room to expand. Smaller commercial airports across the state also collectively experienced an average 5% increase in passenger traffic the past five years. In general, communities across the state have adequate access to airports, but some smaller communities are struggling to modernize their facilities to take advantage of the latest technologies.

INTRODUCTION

Colorado's aviation infrastructure has remained in good condition through the last decade. While the state has experienced a surge in population and infrastructure use, Colorado's airports have been able to keep up with the demand. While Colorado had 77 public use airports in 2008, according to the National Plan of Integrated Airport Systems (NPIAS), for Fiscal Years 2019 to 2023 the number was reduced to 74. The NPIAS identifies airports in the national airport system, the roles the airports serve, and the type of development eligible for federal funding through the Airport Improvement Program (AIP). In addition to the airports included in NPIAS, Colorado also has 27 publicly owned non-NPIAS airports and nine privately owned airports open to public use.

Table 1 shows Colorado's NPIAS airports and their classifications:

- **COMMERCIAL SERVICE AIRPORTS:** Publicly-owned airports that receive a minimum of 2,500 scheduled passenger service enplanements each calendar year. All nine of Colorado's Commercial Service Airports are designated as primary.
- **RELIEVER AIRPORTS:** Publicly or privately-owned FAA-designated airports that relieve congestion at Commercial Service Airports and provide improved general aviation access. Reliever airports are classified as nonprimary.
- **GENERAL AVIATION AIRPORTS:** Public use airports that do not have scheduled service or have less than 2,500 annual passenger enplanements and are considered nonprimary.

TABLE 1: AIRPORTS FOR FISCAL YEARS 2019-2023 (NPIAS)

CATEGORY	NUMBER OF AIRPORTS	CLASSIFICATION
Commercial	1	Large Hub
Commercial	1	Small Hub
Commercial	7	Non-Hub
General Aviation	11	Basic
General Aviation	21	Local
General Aviation	6	Regional
General Aviation	2	National
Total Colorado NPIAS Airports	49	—

Colorado's aviation services support approximately \$36.7 billion in overall annual economic output through a wide range of services, including commercial air transportation, emergency medical evacuation, flight training, and more. Most of Colorado's aviation infrastructure is supported by the Division of Aeronautics in the Colorado Department of Transportation (CDOT) and with the help of the Colorado Aeronautical Board. While each individual airport runs on separate business models, the Division of Aeronautics supports operations through oversight and regulations, advocacy, and some investments to the infrastructure.

CAPACITY

Denver International Airport (DEN) is the predominant aviation gateway for Colorado. In 2018, DEN served approximately 64.5 million passengers according to their operations report, making DEN the fifth busiest airport in the country and 18th in the world. DEN, which is owned, operated, and maintained by the City and County of Denver, expects continued growth and has room to expand on its 53 square miles of land.

DEN is not only seeing increases in passenger activity, but cargo as well. In 2017, DEN moved over 580 million pounds of cargo and in 2018, the number increased to 685 million. Current trends for 2019 project further growth given a 20 million-pound increase from April 2018 to April 2019.

Besides DEN, other Colorado commercial airports include Colorado Springs Municipal, Grand Junction Regional, Durango-La Plata County, Eagle County Regional, Gunnison-Crested Butte Regional, Aspen-Pitkin County, Pueblo Memorial, Cortez Municipal, San Luis Valley Regional, Telluride Regional, Yampa Valley, and Montrose Regional. These airports collectively experienced an average 5% increase in passenger traffic the past five years.

It is likely the Grand Junction Regional Airport will need to increase its capacity in response the upcoming relocation of the Bureau of Land Management (BLM) headquarters from Washington D.C. to Grand Junction. Although only 27 new BLM employees are projected to move to Grand Junction, the demands on the airport will expand due to increased business travel and increased economic development as a byproduct of the relocation.

The economy and population in Colorado are expected to continue to grow, albeit at a slower pace. The aviation infrastructure in the state is expected to accommodate this growth with the help of the Strategic Plan, the Colorado Aviation System Plan, and other programs established by the CDOT Division of Aeronautics. The Division is currently preparing a new 2019 Colorado Aviation System Plan (CASP), which will serve as a guide for federal, state and local airport improvement funding and priorities. The 2019 CASP is expected to be finalized in April 2020.

CONDITION, OPERATION AND MAINTENANCE

The current and near-future condition of Colorado's airports is generally good. The massive investment to create, maintain, and expand Colorado's airports, especially DEN, is generally viewed as a significant contributor to the economic growth that Colorado has experienced in the past decade.

The Pavement Condition Index (PCI) is the primary measure of airfield pavement quality. CDOT collects systematic inventories of statewide airport PCI inspections every four years. CDOT classifies airports as major, intermediate, and minor based on the level and type of aircraft traffic. In 2018, the area-weighted PCI for major and intermediate airport primary runways were 78 and 75, respectively, which met the State's goal of a PCI greater than 75 for primary runways. These values were essentially unchanged from the previous system inventory in 2014, which indicates Colorado's airport pavements have been adequately maintained over the past four years. For example, DEN used a recent PCI study of their airfield pavements that recommended specific repairs (e.g. crack sealing, grinding, joint sealing, slab replacement) to schedule and prioritize funding for maintenance.

In 2018, DEN began a \$1.8 billion contract to renovate the Great Hall in the airport's 1.5 million square foot main terminal. The project was intended to enhance security, provide a more flexible and open check-in space, and add new dining and shopping options. The renovation was funded through a public-private partnership (P3) contract between the City and County of Denver and the developer, Great Hall Partners. The City and County of Denver terminated the contract with Great Hall Partners in August 2019 amid a series of delays and disputes involving safety concerns, investigations into the quality of the existing concrete, permit issues, and an increase in renovation costs. The airport plans to resume construction of the Phase I of the project with a new designer and contractor, no longer in a P3 contract. The dispute highlights the need for airports to understand the risks of unconventional contracting methods and to understand impact of large-scale renovation projects on the traveling public.

FUNDING AND FUTURE NEED

There are three major sources of funding for airport development: airport cash flow, revenue and general obligation bonds, and federal/state/local grants. Within the federal grants program are the federal Airport Improvement Program (AIP) and Passenger Facility Charges (PFCs). The Congressionally-approved AIP provides funding for large scale projects at Colorado's airports that are part of the NPIAS system. Given the lack of predictability in the AIP due to previous short-term extensions of the Federal Aviation Administration (FAA) by Congress, it can be difficult for airports to plan for major capital improvements. However, Congress passed a five-year reauthorization of the FAA in late 2018, which provides longer-term funding certainty for airports across the state. In 2018, \$3.18 billion was made available for AIP grants across the country.

Another source of revenue for airport infrastructure is the passenger facility charge (PFC). The PFC program allows the collection of fees – federally capped at no more than \$4.50 – for every enplaned passenger at commercial airports. The projected PFC revenue for all airports in the U.S. is \$3.5 billion. There is currently no publicly available PFC reports by airport. However, DEN's 2018 PFC rate was \$4.50 and the airport served 64.5 million passengers last year. It can be inferred that DEN's 2018 PFC revenue was approximately \$290 million.

At a state level, Colorado collects taxes on aviation fuel sold within the state and redistributes the tax revenue through aviation fuel tax disbursements and the Colorado Discretionary Aviation Grant (CDAG) Program. In 2018, the CDOT Division of Aeronautics distributed approximately 65% of the fuel tax revenue, or \$17.4 million, in the form of aviation fuel tax disbursements back to the airports that collected the taxes. The fuel tax disbursements must be used on airports for aviation purposes, such as operations and maintenance. The remaining 35% of the tax revenue was used to fund the Division's operations, numerous statewide initiatives, and the CDAG Program, which is managed by the Colorado Aeronautical Board. In 2019, \$5.78 million in CDAG grants were awarded to fund projects that included pavement maintenance, safety enhancements, and airport improvements.

PUBLIC SAFETY AND RESILIENCY

Airports are critical for moving goods and people during disasters and often serve as a gateway for supplies. However, they are linked with other forms of transportation, operating most efficiently as an interconnected network. When evaluating public safety and resilience related to disaster recovery, airport accessibility is important. The goal is to provide an airport system that is easily accessible from both the ground and the air. Colorado is a state with a large geographical area with varying population density; however, Colorado's airports are geographically well-positioned to respond to an emergency that requires the rapid movement of goods and people as shown in the airport accessibility data in Table 2. Colorado's airports also support a number of other emergency services, including air ambulance/ medical evacuation and aerial wildland firefighting.

TABLE 2: COLORADO AIRPORT ACCESSIBILITY

ACCESSIBILITY	PERCENT OF COLORADO'S POPULATION IN RANGE	PERCENT OF COLORADO'S LAND AREA IN RANGE
90-minute or less drive to a commercial airport	98	77
30-minute or less drive to a system airport	94	54
30-minute or less drive to an airport capable of supporting the King Air emergency aircraft	91	37

INNOVATION

The FAA is currently implementing its NextGen initiative throughout the country, which is intended to modernize the U.S. Air Traffic Control System by shifting control from ground-based radar to satellite-based navigation. In Colorado, NextGen aims to move air traffic more efficiently through the airspace in the Denver metroplex into and out of Denver International Airport, Rocky Mountain Metropolitan Airport, and Centennial Airport. The FAA projects the new Metroplex flight paths, with smoother approaches than the current stair step descents, will save more than \$1.8 million in fuel and reduce carbon emissions by 5,000 metric tons per year. NextGen was implemented into DEN in 2013 and was upgraded in October 2018. As with any new technology, some pitfalls are expected. Currently, the biggest concern to deploy this technology is that while the major airports in the state will be able to implement this technology, the smaller rural and general airports will struggle to jump onboard. The strong divide that exists in Colorado between rural and urban will be more evidenced when these smaller airports will not have the capacity to have the systems installed or maintained properly. Currently, the Division of Aeronautics is not expecting the smaller airports or aircrafts to be ready for the January 1, 2020 deadline as established by the FAA.

Unmanned Aerial Systems, commonly known as drones, are also one of the technologies that the Division of Aeronautics at CDOT is looking into. While no major airport has reported concerns with drone flights, concerns from associations and stakeholders around the state have arisen about the broad-sweeping applications.



AVIATION



RECOMMENDATIONS TO RAISE THE GRADE

- **Raise state funding for aviation commensurate with its economic benefit to the state.**
- **Congress should uncap Passenger Facility Charges at commercial service airports.**
- **The trends toward a regional aviation footprint with a larger, combined entity rather than multiple small communities should be embraced. This model allows for greater combined economic gain and decreases maintenance strain on financially strapped communities. This would be especially important to allow for the roll out of newer technology and FAA requirements to be broadly available.**
- **Continue to fund and maintain airport pavement, the most essential infrastructure in the aviation system. Capitalize on opportunities to perform preventative maintenance before full rehabilitation is required.**
- **Update airport condition assessments statewide, including pavement, terminal, and layout condition studies.**



AVIATION



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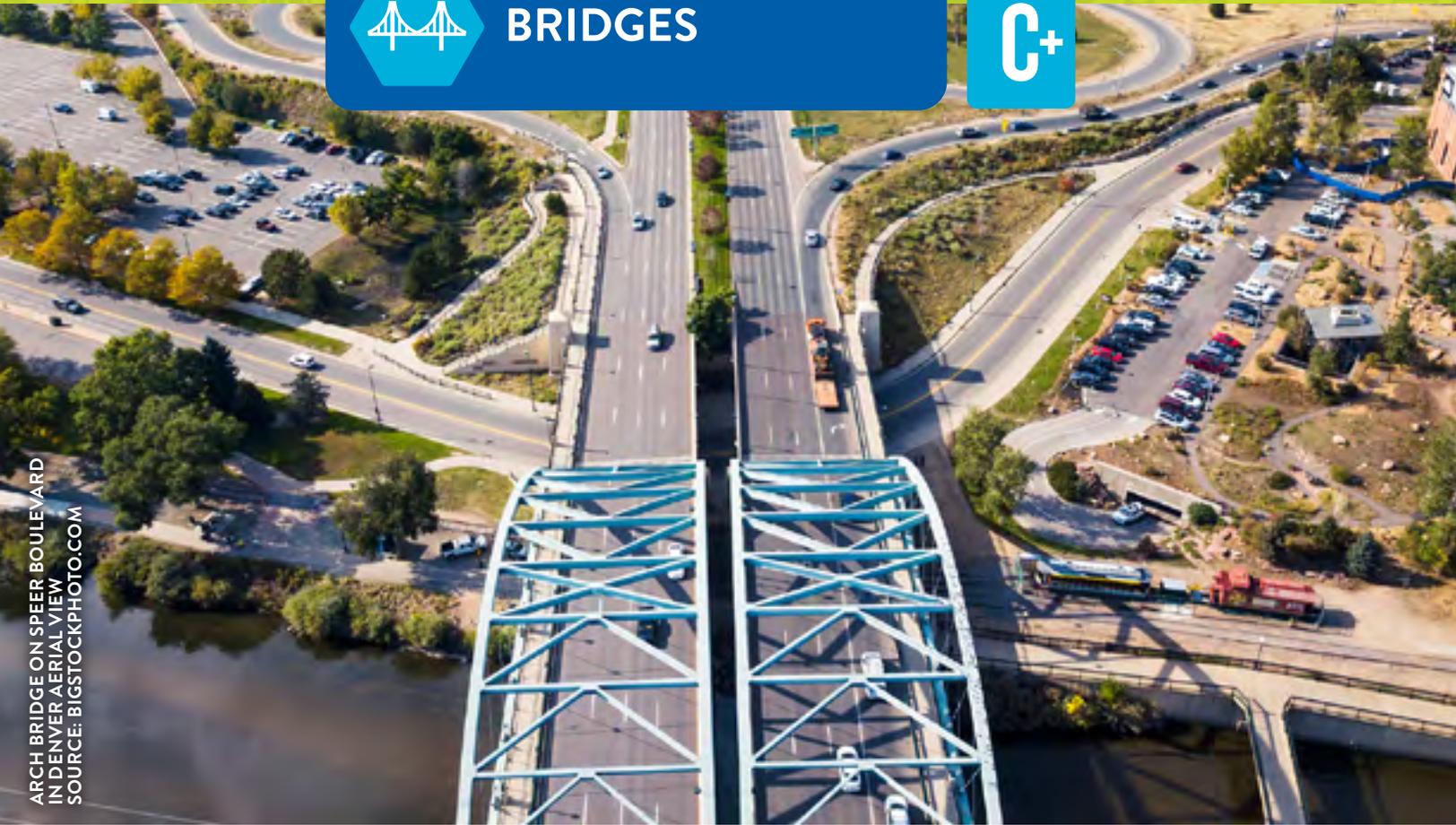
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BRIDGES



ARCH BRIDGE ON SPEER BOULEVARD
IN DENVER AERIAL VIEW
SOURCE: BIGSTOCKPHOTO.COM



BRIDGES

GRADE: C+

EXECUTIVE SUMMARY

Colorado boasts a wide variety of landscapes—including rivers, ravines, and mountainous terrain—and bridges are critical to ensuring access to all parts of the state. The overall condition of Colorado’s bridges is above average. Of Colorado’s 8,786 bridges, 5.4% are rated structurally deficient (SD) (4.1% by deck area). Bridges that are rated as SD are not unsafe, but they do require significant maintenance, rehabilitation, or replacement due to one of the key elements (deck, superstructure, or substructure) being rated as “poor” condition. This is better than the national average of 8.4% of SD bridges. However, the Colorado Department of Transportation still faces significant challenges, with a budget shortfall of \$136 million per year over the next 10 years. Looking ahead, the state needs to raise its gas tax, support tolls and public-private partnerships, and encourage emerging technologies and transit options to reduce the impact on bridge structures.

CONDITION AND CAPACITY

Of Colorado's 8,786 bridges, 473 (5.4%) are considered SD, with 51 (10.8%) of them located on the Interstate Highway System. This is significantly better than the national average of 8.4% of bridges rated as SD in 2018. When comparing urban vs. rural bridges in Colorado, 3.3% of urban bridges are rated SD, whereas 6.4% of rural bridges are rated SD, showing that there are fewer of the more heavily-trafficked, urban bridges rated SD.

FIGURE 1: NUMBER OF STRUCTURALLY DEFICIENT BRIDGES IN COLORADO



As bridges greatly vary in size, the percentage of deck area that belongs to structurally deficient bridges and the number of daily crossings on these bridges are other useful indicators of the overall risk to the public. Of all the bridges in Colorado, 4.1% of the total deck area belongs to structurally deficient bridges, and of Coloradans' estimated 71 million daily bridge crossings, over 2.5 million (3.6%) are over bridges rated as SD.

Bridges can also be posted for load or clearance restrictions. Posted bridges can dramatically increase driving time for larger vehicles such as school buses, ambulances, and delivery trucks, as well as increase the potential for bridge damage when the postings are not followed. In 2016, 10.1% of the bridges across the U.S. were load restricted. In Colorado, 4.9% of the bridges are load restricted, 19.8% have 16.5-foot clearance postings, and 1.7% have 14.5-foot clearance postings.

The overall condition of Colorado's bridges is above average, with the state ranking better than the national average in the number of bridges rated SD, area of bridges rated SD, average age of bridge, and number of load restricted bridges (see Table 1 below). For reference, Colorado ranks number 34 in the nation (50 is best) in the percentage of bridges rated SD. However, Colorado ranked 38th in 2017; the total number of bridges rated SD increased from 448 in 2017 to 473 in 2018, indicating a recent downward trend in the overall condition of bridges. Over the next decade, as the average age of bridges in CO hits their typical design life of 50 years and the population continues to grow, this downward trend is expected to continue.

TABLE 1: COLORADO BRIDGES VS. NATIONAL AVERAGE

	# SD [%]	Area SD [%]	Age [Yrs]	LOAD RESTRICTED [%]
National*	9.1%	6.3%	43	10.1%
Colorado	5.4%	4.1%	40	4.9%

*National average data from 2017 National Report Card

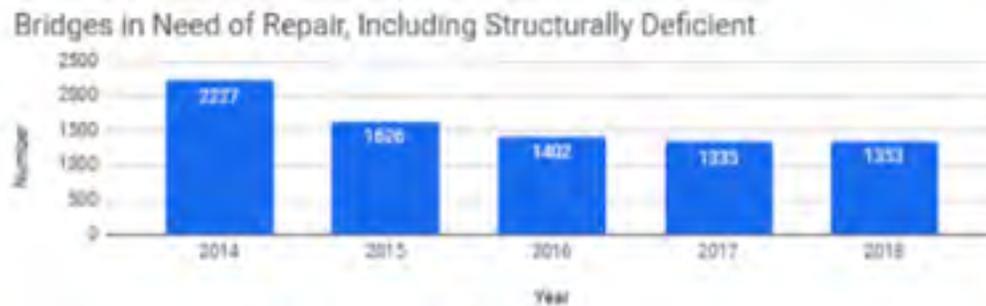
FUNDING & FUTURE NEED

The volume of vehicles crossing a bridge is one of the primary factors that causes deterioration of bridge components and leads to structural deficiency. With the projected Colorado population increase, the SD rate is not expected to decrease and may increase unless future funding accounts for the increased traffic and deterioration. Currently, 1,353 bridges (15.4%) require repairs, with an estimated cost of over \$680 million. Although the number is down from 2014 (2,227; 25.6%), it has been consistent since 2016. Of the 1,353 bridges requiring repair, 326 (24%) of them will require total replacement. These 326 bridges are crossed 2.1 million times each day and will cost \$300 million to replace.

The total cost to sustain 95% of Colorado's bridges rated structurally sufficient is estimated to be \$1.95 billion over 10 years, assuming no additional investment for CDOT's risk-mitigation targets. The total cost to achieve CDOT's vision (95% structurally sufficient and mitigation of bridge risks) over the next 10 years is estimated at \$2.89 billion, with the current projected budgets falling short by \$136 million per year, or \$1.36 billion, over 10 years.

One of the ways Colorado is attempting to address this issue is by moving towards toll projects to generate revenue and public-private partnerships (PPP) to help fill in the funding gaps. Toll projects are essentially a form of tax on drivers and PPPs are used to get more projects going with less state funding by providing private financing, but may cost more in the long run. That said, new project procurement methods need to be carefully considered, as they may come with increased financial risks and potential public disapproval. For example, the financially responsible party for the recent collapse of Highway 36 between Boulder and Denver is still being investigated. See the *Roads* chapter for more information about public spending on highways, including bridges.

FIGURE 2: COLORADO BRIDGES IN NEED OF REPAIR, INCLUDING STRUCTURALLY DEFICIENT



Bridges are one of CDOT's "big three" asset categories that together make up approximately half the department's annual budget. In 2009, the Colorado legislature passed two bills to help fund transportation projects. Senate Bill 09-108, the Funding Advancements for Surface Transportation and Economic Recovery Act (FASTER), generates additional revenue through several vehicle registration fees and fines, with the goal of quickly generating funding for state roads and bridges that lack sufficient funding for repairs and safety improvements. This bill also created the Colorado Bridge Enterprise (CBE), which operates as a government-owned business within CDOT with the purpose of financing, repairing, reconstructing, and replacing designated bridges as defined by the bill. Senate Bill 228 funds strategic transportation projects through five years of CO General Fund transfers, originally projected to be \$200 million per year. However, the first year of this funding was received in 2016, and the amounts to be transferred going forward remain uncertain.

These bills were helpful, but not long-term solutions to addressing Colorado's bridge funding gap. Currently, over 60% of CDOT's funds come from the combination of federal and state gas taxes. As a result, the current debates around raising the gas tax are critical.

OPERATION AND MAINTENANCE

CDOT's Asset Management program was implemented to strategically and efficiently improve and maintain the entire transportation system. The program aims to determine the work required to properly maintain the state's bridge and roadway assets, the factors that contribute to deteriorating infrastructure conditions, and the critical infrastructure fixes. Maintaining roads and bridges that are in poor condition can be more expensive than doing the same for assets in better condition, so identifying assets in need of maintenance and repair can save money over the infrastructure's lifecycle.

The two main factors impacting bridge conditions and maintenance efforts are exposure to the elements and growth in vehicle miles traveled (VMT), typically due to population growth. From 2000 to 2016, the annual VMT in Colorado went from 42 billion miles to 52 billion miles, an increase of 25%. Examples of maintenance projects include repairing spalled concrete in columns, patching potholes in the deck, replacing the deck, and repairing deck expansion joints.

The CDOT maintenance program assigns a letter grade to evaluate the overall level of maintenance service. CDOT's aspirational target is to achieve a B on their own grading scale, which was estimated in 2017 to cost \$4.33 billion over 10 years, but projected O&M budgets forecast a \$143 million annual deficit. In 2016, CDOT achieved a C+, and it was estimated to cost \$3.88 billion over 10 years just to maintain this grade, with a \$98.1 million annual deficit.



POUDRE RIVER AND NEWLY CONSTRUCTED WHITEWATER PARK IN DOWNTOWN OF FORT COLLINS, COLORADO, FALL SCENERY WITH A LOW WATER FLOW
SOURCE: BIGSTOCKPHOTO.COM

RESILIENCE

Of particular concern from a resilience standpoint are three main environmental hazards: freeze-thaw, rockfalls, and scour.

These hazards increase the rate of deterioration of Colorado's bridges, and are difficult to protect against. One of the best ways to mitigate freeze-thaw damage is to increase concrete durability and longevity through the use of emerging concrete technologies, such as ultra-high performance concrete (UHPC) or additives like colloidal silica. For rockfall and scour, inspection programs are in place to categorize the risk and hazards for each.

PUBLIC SAFETY & INNOVATION

One of the best ways to innovate and improve the overall condition of the state's bridges is to become an innovator and leader in the realm of new material technologies. To do this, CDOT needs to make research into developing concrete technologies a priority, promote the consideration of these materials for the total life-cycle cost of a project, and encourage the use of these materials during the bidding and awarding phase of projects. These materials will add durability, strength, resilience, and life extension to the structures. Examples include UHPC, high-performance steel, concrete additives, and composites. With a majority of the bridges in Colorado being comprised of concrete, UHPC is particularly promising, as it can be used in either rehabilitations or new construction to significantly extend the lifespan, lower the life-cycle cost, and speed the construction of bridges.

So far, Colorado has relied on innovation in building and repairing bridges. Despite some states' hesitancy, Colorado has become a leader in concrete box-girder bridges, as evidenced by the Glenwood Canyon bridges and the Santa Fe over I-25 bridge. Additionally, multiple bridges have aimed to reduce impact on the public during construction by utilizing the accelerated bridge construction (ABC) method of sliding bridges into place. Examples of these include US 34 in Wray, Pecos over I-25, and the W-line bridge. CDOT is also looking into concrete and paving technology to increase durability and reduce overall life-cycle costs, such as using colloidal silica additives in concrete and using a poly-concrete wearing surface instead of traditional asphalt.

That said, Colorado still has room to improve its bridge infrastructure, such as reducing direct impact on bridge structures, improving repair and maintenance of current bridges, implementing new technologies.

To reduce the direct impact on bridge structures, CDOT is attempting to leverage emerging technologies like connected and autonomous vehicles. The future impact of these technologies is not certain, as the total VMT could either increase or decrease with the use of autonomous vehicles, but it is anticipated that general accidents and collisions with bridge structures will decrease, reducing collision-related repair.



RECOMMENDATIONS TO RAISE THE GRADE

- **Increase funding from all levels of government by pushing for increased national transportation legislation to reduce SD, raise overall condition, and prepare for future deterioration.**
- **Evaluate increased usage of PPP to procure funding for larger projects.**
- **Put durability and triple bottom line life-cycle cost assessment as a top priority in new projects, not just immediate construction-cost low-bidder.**
- **Raise the state and national gas tax, which is deposited into the Highway Users Tax Fund (HUTF), or change to a road-usage charge (RUC). Due to increased fuel economy standards (54 mpg by 2025) and the increase in electric vehicles, an RUC is preferred for long-term viability. Ensure this tax is tied to inflation.**
- **Make bridge repair and construction a top priority in CDOT's yearly budget.**
- **Promote the use of embedded sensors for real-time feedback and monitoring to better assess which bridges need to be addressed first.**



DEFINITIONS

Structurally Deficient—Bridges that require significant maintenance, rehabilitation, or replacement. These bridges must be inspected at least every year since critical load-carrying elements were found to be in poor condition due to deterioration or damage.

Load Restricted—As part of a bridge’s regular inspection, it may be determined that the bridge can only carry traffic up to a certain weight or speed, requiring the posting of a load restriction.

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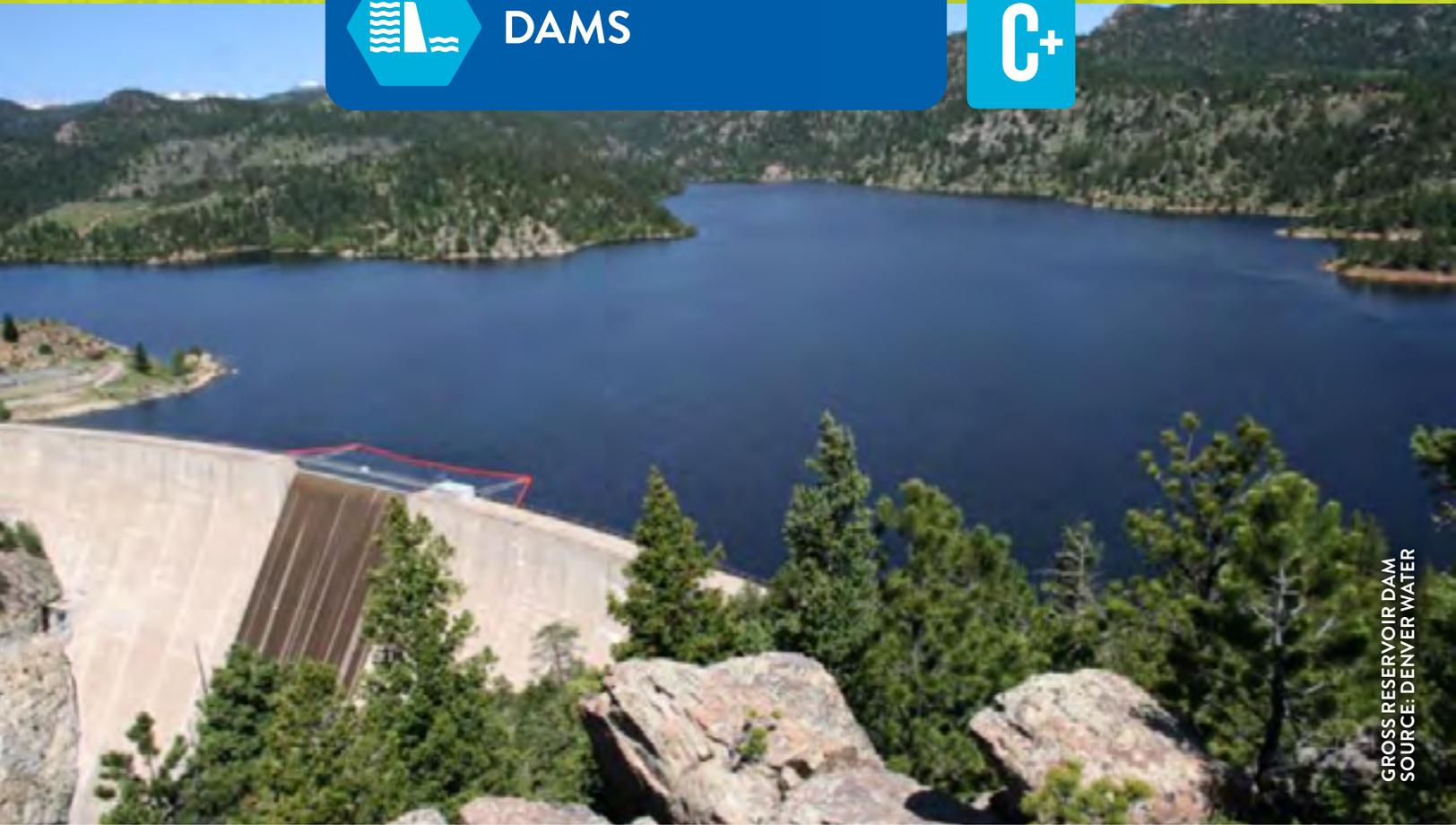
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DAMS



GROSS RESERVOIR DAM
SOURCE: DENVER WATER



DAMS
GRADE: C+

EXECUTIVE SUMMARY

Colorado's dams help ensure adequate water supply for urban and rural areas as well as provide flood protection, irrigation, hydropower, and recreation benefits. Colorado's dam database shows Colorado is home to 431 high hazard dams. High hazard dams are defined as dams whose failure or mis-operation is likely to result in the loss of human life. Fortunately, progress has been made in recent years toward addressing dam safety in Colorado. For example, the number and quality of Emergency Action Plans (EAPs) have significantly increased; today, approximately 98% of high hazard potential dams now have an EAP. A visionary plan to address the state's widening water supply-demand gap is in the beginning phases of implementation. Nevertheless, major obstacles remain. Most dams in Colorado are privately-owned, and the cost associated with dam operation and maintenance remains a challenge for all dam owners. Some financial support is available for local government and private projects through the Colorado Water Conservation Board, but more is needed to combat the impacts of age and a changing climate.

CAPACITY & CONDITION

Dams in Colorado help to provide a reliable source of water. Colorado’s population relies on dams to capture and store spring runoff from winter snowpack to provide a year-round water source. Dams ensure adequate water supply for urban and rural areas while also providing for flood protection, irrigation, hydropower, and recreation.

Dams are typically designed for a 50-year lifespan. While regular maintenance and periodic rehabilitation can extend the typical design life of a dam, the average age of dams in Colorado is currently approximately 74 years old. Documented dam construction started in Colorado in the 1860s and largely continued until the 1990s. A significant decrease in the rate of dam construction has occurred since the 1990s as shown in Figure 1. Therefore, Colorado’s water storage capacity has remained relatively unchanged for the past 30 years. The Colorado Water Plan (CWP), published in 2015, identifies a “gap” in storage of approximately 400,000 acre-feet. This “gap” considers needs of population growth, recreation, agricultural uses, and more. Significant new dam construction projects will be needed to fill this gap.

Colorado’s current reservoir storage capacity is approximately 7.5 million acre-feet, as depicted in Figure 2. Approximately 4.2 million acre-feet of the state’s total storage is contained within federally owned reservoirs. Within 113 federally owned facilities, just 6% of the dams in Colorado’s portfolio store almost 60% of the state’s water.

FIGURE 1: COLORADO’S DAM CONSTRUCTION AND RESERVOIR STORAGE VOLUME OVER TIME

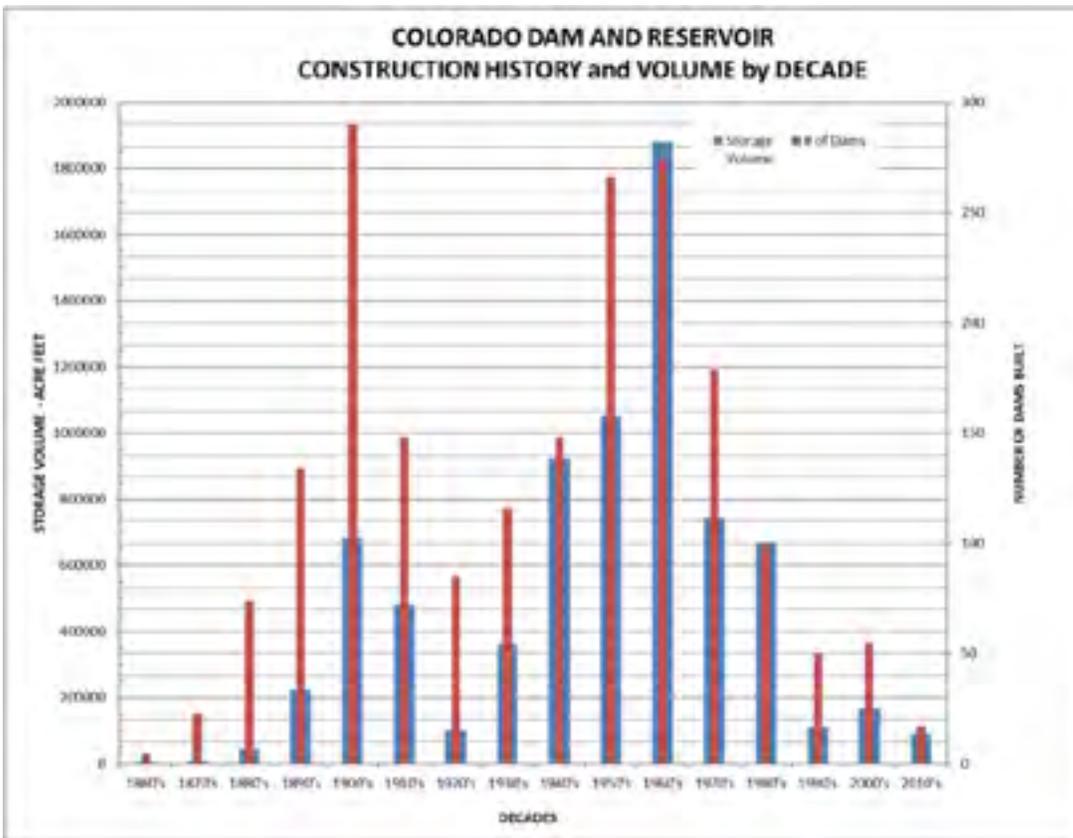
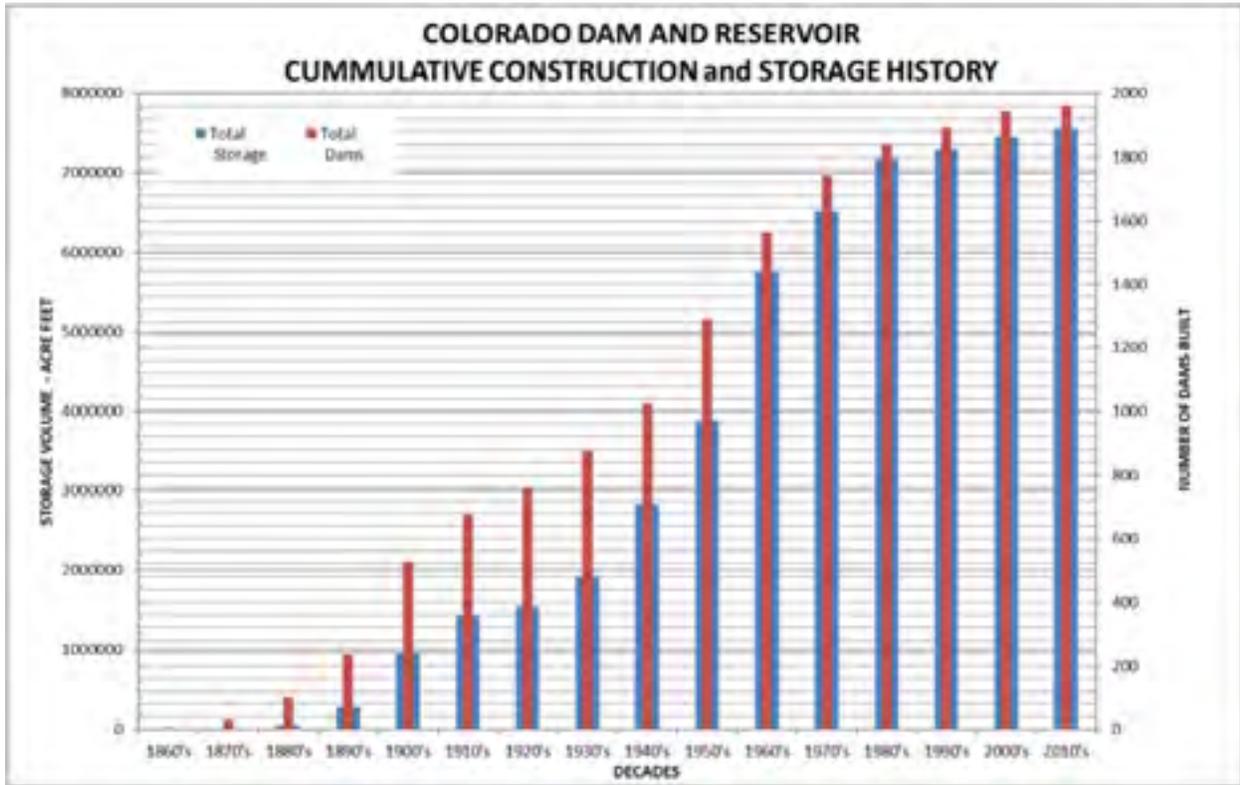


FIGURE 2: COLORADO'S CUMULATIVE DAM CONSTRUCTION AND RESERVOIR STORAGE VOLUME

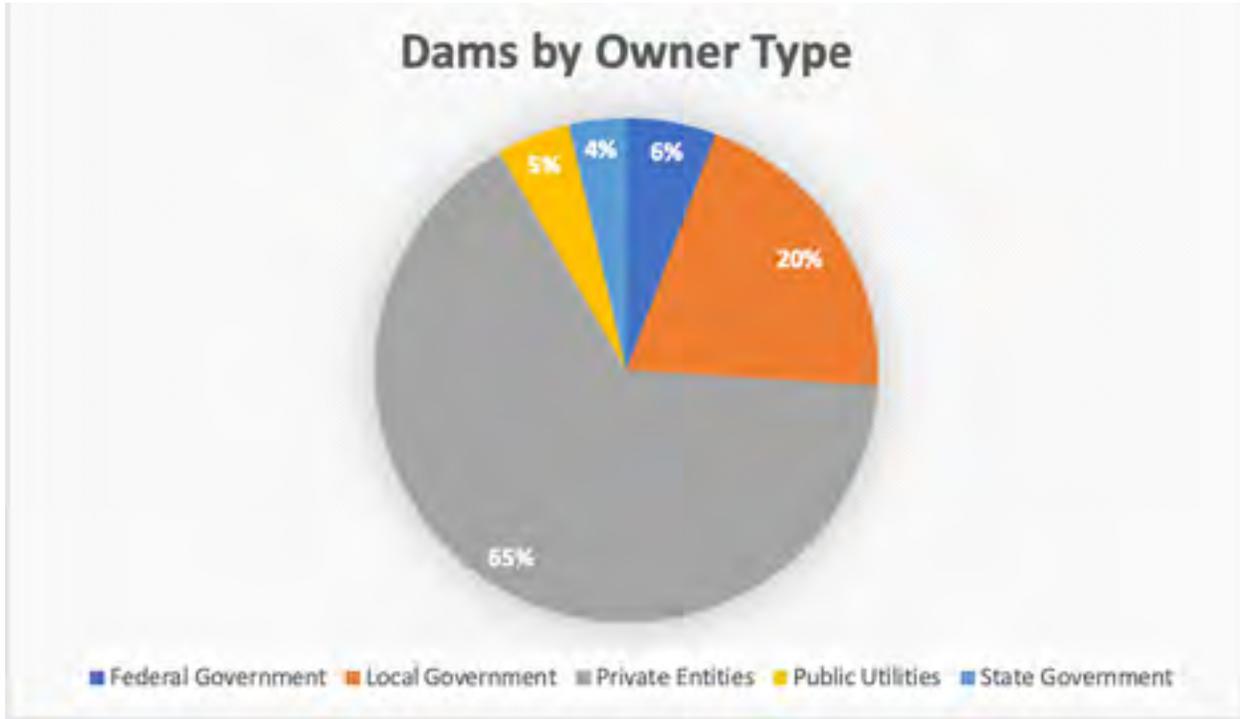


The storage of water for beneficial use comes with risk. The risk profile for dams is, in part, determined by the consequences that would be experienced should failure occur. *High* hazard dams are defined as dams whose failure or mis-operation is likely to result in the loss of human life. *Significant* hazard dams are defined as dams whose failure or mis-operation is likely to result in property damage and economic impacts. *Low* hazard dams are defined as those whose failure or mis-operation is likely to result in neither loss of life nor significant economic loss. In addition, Colorado has a fourth classification of dams called No Public Hazard (NPH). Similar to Low hazard dams, NPH dams are defined as those whose failure or mis operation is likely not to result in loss of life or even minimal property damage.

Colorado provides information on their portfolio of dams to the U.S. Army Corps of Engineers (USACE), National Inventory of Dams (NID), and publicly accessible platforms such as the Colorado Information Marketplace (CIM). The CIM dataset is updated daily, while the NID dataset is updated every two years. A query of the latest CIM dataset shows that Colorado currently has 431 high hazard dams, 303 significant hazard dams, 1,028 low hazard dams, and 201 NPH dams.

The state has multiple types of dam owners. Approximately 113 dams are federally owned, 397 dams are owned by local governments, 1,288 dams are privately owned, 93 dams are owned by public utilities, and 72 dams are state-owned. Most of the dams that are privately owned in Colorado are intended for agricultural purposes. See Figure 3 below for a visual representation of dams by owner type in Colorado.

FIGURE 3: COLORADO DAMS BY OWNER TYPE



As a prime example of the condition and capacity of Colorado dams to support large-scale events, according to the CWP, the 2013 Colorado floods resulted in loss of life, businesses, and damage to homes and transportation infrastructure with an estimated economic loss of \$2.9 billion. Over the course of the five-day event, many of the Front Range reservoirs went from near empty to near full or even spilling. Although predominantly water supply reservoirs, in this late season event, the reservoirs provided an important flood protection benefit. Eleven low hazard dams failed, and 29 dams sustained damage due to the extreme precipitation. To ensure safety of other affected dams, Colorado Dam Safety staff developed an impromptu emergency inspection program by utilizing 115 volunteer professional engineers to conduct inspections of 207 dams in a period of two weeks once the rains subsided.

In addition to flood protection, some of Colorado’s dams are used for hydroelectric generation by providing a reliable, renewable energy source. Approximately 4% of Colorado’s electricity, 1162 megawatts (MW), is generated by hydropower dams. According to the U.S. Energy Information Administration, the median percentage of state hydroelectric generation as a percent of the total state electric generation is approximately 2%. Therefore, Colorado generates greater hydroelectricity than the median amount for U.S. states.

OPERATIONS & MAINTENANCE, FUNDING, AND FUTURE NEED

Estimates of the total cost to rehabilitate the state's non-federal dams is approximately \$1.6 billion, according to the Association of State Dam Safety Officials (ASDSO). Only one-tenth of one percent of the state's budget goes toward natural resources including loans for water projects according to the CWP. It is estimated that \$20 billion is needed in the areas of water supply, water infrastructure, recreation, and the environment in Colorado over the next 30 years. The CWP has set an objective to gain 400,000 acre-feet of additional water storage capacity to manage and share conserved water by 2050. This objective requires an 80% success rate of planned storage capacity projects.

Generally, funding is needed to maintain the aging infrastructure of dams in Colorado. Loans and grants are available for local government and private projects through the Colorado Water Conservation Board (CWCB) Low Interest Loan and Grant Program. The construction loan program is a successful, self-supporting fund that continues to grow as interest on loan debt is paid. Some smaller private or agricultural dam owners may have difficulty obtaining loans due to their inability to service any loan debt. The bond authority of the Colorado Water and Power Development Authority (CWPDA) is another funding source for entities that can issue bonds. Colorado has recently utilized the FEMA High Hazard Potential Dam Rehabilitation (HHPD) and Pre-Disaster Mitigation (PDM) grant programs as cost share for several dam rehabilitation projects.

The U.S. Bureau of Reclamation (Reclamation) and USACE Dam Safety Programs perform periodic inspections on their dams that occasionally lead to recommendations for additional studies and actions. Many federal dams have been modified for safe performance as a result of federal dam safety legislation.

PUBLIC SAFETY & RESILIENCE

A 2012 study by the Colorado State Demography Office suggests that the Colorado population will continue to grow at rates exceeding the national average and is anticipated to reach nearly 8 million by the year 2040, approximately double the total population in the year 2000. The increase in population does not change the likelihood of failure of existing dams, but it will change the consequences. Variability in consequence can be attributed to numerous factors, such as population increases and increased development in both urban and rural areas downstream of existing dams that causes the hazard classification to escalate, a phenomenon commonly referred to as "hazard creep." As an example, the 2013 Colorado inventory of dams included 373 *High* hazard structures, and in 2019, that number had increased to 430. Fourteen new *High* hazard dams were constructed during that period and the remaining 43 were existing dams reclassified to *High* hazard for an average increase of seven per year.

Colorado's Dam Safety program provides regulatory oversight of dam water resource infrastructure and is sensitive to factors such as hazard creep. Dam safety programs are a critical element to responsible stewardship and management of dams. The Colorado Dam Safety program manages risk by reducing the likelihood of dam failure via inspections, engineering analyses, and dam repair/rehabilitation. In addition, Dam Safety implements consequence management programs via emergency action planning, public education, and coordination with the emergency management community.

Colorado Dam Safety has a staff of 12 engineers responsible for executing a comprehensive risk management program. Due to the effects of hazard creep and an increase in *High* hazard dam classifications, more staff may be necessary to adequately perform oversight and manage risk. Since 2013, increasing the number of new and/or updated EAPs has been a priority for the team. In 2013, 653 EAPs represented 96% of all high and significant hazard dams. However, only 43% of those EAPs were developed within the past five years and considered “up to date.” In 2019, 98% of high hazard dams had EAPs and 77% of those were considered up to date. In 2019, 96% of significant hazard dams had EAPs and 60% of those were considered up to date. For comparison, ASDSO reports that at the end of 2017, the national average for state programs was 81% of high hazard dams having EAPs.

Sustainability is a developing topic within dam safety and engineering. For example, the Colorado Office of Resiliency, which directs sustainability requirements and policy, has worked with Colorado Dam Safety to develop a database of how high hazard dam flood releases could have an impact on downstream floodplains as the effects of climate change increase. Colorado’s new Rules and Regulations for Dam Safety and Dam Construction include a rule requiring a climate change factor in dam spillway design as well as an adaptation strategy to account for climate change in public safety rules. In addition, Colorado Dam Safety uses a robust risk management program as the primary method to address rehabilitation and continued use of its infrastructure. Existing annual inspection programs combined with new programs, such as the Comprehensive Dam Safety Evaluation (CDSE) process, contribute to reductions in the probability of failure of dams. Consequence reduction is achieved through the following: continuing coordination with state and local emergency managers as well as dam owners; improvements to EAPs; and calculating Population at Risk (PAR) using new PAR and Social Vulnerability index tools. These concurrent activities provide continuous incremental improvement in dam safety risk reduction for the State of Colorado.





RECOMMENDATIONS TO RAISE THE GRADE

- **Improve funding sources throughout the State of Colorado, such as the CWCB low-interest loan program. In addition, utilize FEMA Hazard Mitigation grant programs to fix dams before disasters happen, advocate for the federal government to pass a Resilience Revolving Loan Fund to invest in hazard mitigation – drought prevention – through spending on infrastructure, and promote dams that could positively benefit from the HHPD Rehabilitation program.**
- **Increase awareness between dam owners and the public regarding the importance of safety surrounding dams.**
- **Share research regarding climate change and its effect on water storage infrastructure with other states across the nation as an example of what can be done to further sustainability.**
- **Require life cycle cost analysis, with an emphasis on sustainability, for approval of new dam construction.**
- **Continue standardizing Colorado Dam Safety Evaluation (CDSE) tools for inspections and condition assessments of all dam classes and ownership types.**
- **As the number of high hazard dams increases due to the increase in development downstream of dams, additional staff may be needed within the state dam safety program.**



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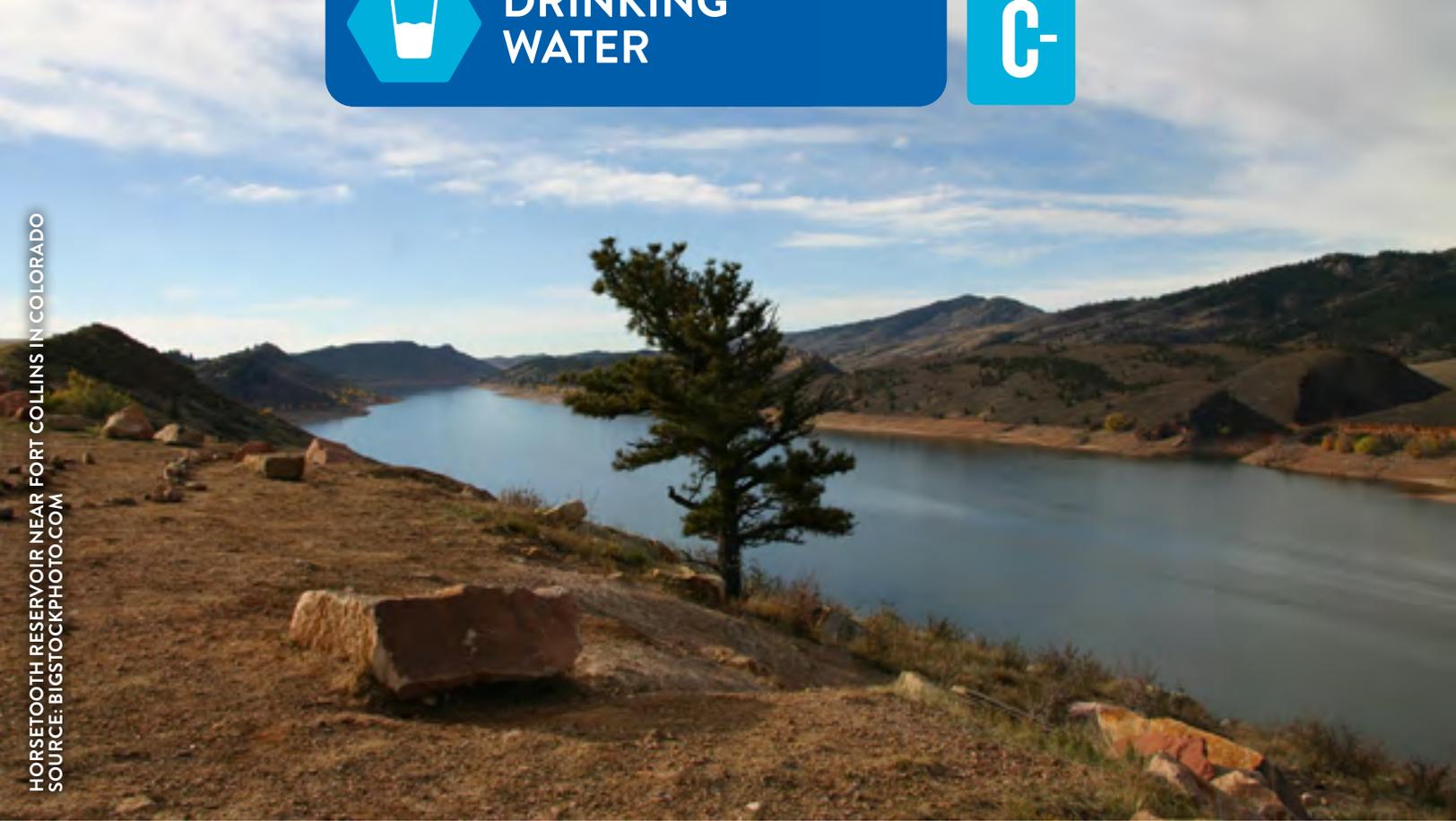
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DRINKING WATER



HORSETOOTH RESERVOIR NEAR FORT COLLINS IN COLORADO
SOURCE: BIGSTOCKPHOTO.COM



DRINKING WATER

GRADE: C-

EXECUTIVE SUMMARY

Three themes dominate the drinking water infrastructure sector in Colorado: a growing population, aging treatment facilities and conveyance pipes, and water consumption trends. The average age of the state's major drinking water treatment facilities and conveyance pipes is approaching 50 years, meaning they are nearing or at the end of their service life. Currently, average monthly service charges in the state range from \$20 to \$60 for a household with a ¾ inch water tap. Revenue derived from monthly service charges is reinvested in the system. For example, Denver Water's Pipe Replacement Program aims to replace around 60,000 linear feet of pipe each year with these revenues. While capacity is currently sufficient, some rural areas are challenged to provide clean water to their constituents because of aging pipelines. In addition to operation and maintenance, the continued increase in population and community development brings increased demand for additional water supply projects and improvements to treatment plants and distribution systems.

CONDITION & CAPACITY

The State of Colorado benefits, by and large, from near pristine source waters that include aquifers, surface water, and seasonal run-off from winter precipitation. It is estimated that between 70 and 90% of the State's water annually is obtained from snowmelt. High-quality drinking water is vital to the state in order to support the general population as well as agricultural and business sectors of the economy. As of July 2019, the average age of the state's major drinking water treatment facilities and conveyance pipes is approaching 50 years. With a standard design life of 50-60 years, many of the infrastructure components of our drinking water are approaching or have exceeded this range.

Some rural and less populated areas in Colorado have struggled to provide clean water to their constituents. According to Water Education Colorado, 98% of Colorado's water systems serve communities smaller than 10,000 individuals. One example of the lack of support in rural areas is the southeastern Colorado towns surrounding Pueblo. Connected by the deteriorating Fryingpan-Arkansas ("Fry-ark") project, the residents of these towns are regularly required to boil their water before drinking because of potential bacterial contamination from broken water mains. In 2014, after a faulty valve caused a crack in the community's main water line, the small mountain town of St. Mary's Glacier went more than three weeks without clean drinking water.

Meanwhile, major drinking water utilities are implementing pipe replacement programs that aim to annually replace large quantities of pipe. Denver Water's Pipe Replacement Program aims to replace around 60,000 linear feet of pipe each year. While this is commendable, with 15.8 million linear feet of pipe, it would take approximately 264 years to replace all underground assets in their network.

Currently, Colorado's water treatment capacity meets the demand. Five major water utilities in the Front Range serve nearly 80% of the population and boast an aggregate capacity of approximately 1,200 Million Gallons per Day (MGD). Average per person usage for Colorado residents is roughly 80 gallons per day, yielding the potential to provide a population of approximately 15 million people with drinking water, compared to the current state population of approximately 5.7 million people.

OPERATIONS & MAINTENANCE AND FUNDING

As noted, capacity currently meets demand. And, although the state is currently able to treat the excess capacity, it is possible that some amount of over-design (capacity > demand) may present unintended economic consequences such as increased maintenance for idle equipment or operational costs for unit processes within facilities. However, due to the increasing efficiencies and life cycle cost-effectiveness of nearly all currently installed mechanical and electrical equipment in drinking water systems, it is difficult to pinpoint a clear disadvantage of operating in this state of over-design.

Water infrastructure operation, rehabilitation, replacement, and expansion throughout the country are typically funded by rates paid by customers. However, in Colorado, the rate system is not currently meeting the needs of the state. In order to attempt to bridge the gap in the funding discrepancy, the state must utilize the State Revolving Fund (SRF) and federal grants and loans, such as the recently authorized Water Infrastructure Finance and Innovation Act (WIFIA). In FY 2019, Colorado received approximately \$21.7 million from the SRF. These funding sources provide utilities with access to low-cost financing for high-dollar infrastructure project investments. However, as a result of unsustainable funding practices, much needed projects that would increase efficiency, reduce waste, and better treat drinking water are being delayed.

When setting rates, utilities must consider full life-cycle costs to sustainably manage their assets. Many effective tools are available to accomplish this important goal. The University of North Carolina's Environmental Finance Center offers an effective tool for utilities to use in setting rates. After financially "shocking" rate changes to users in Denver in 2016, and a water fee price gouging scandal in Brighton in 2018, Colorado must carefully consider and educate the public in any future rate changes.

The current rate-based system requires end users to pay a monthly service charge, as well as a volume rate, which is typically in a tiered structure in which users of larger volumes of water must pay additional fees. Currently, average monthly service charges in the state range from \$20 to \$60 for a household with a ¾ inch water tap, with quantity charges hovering around \$3.00 per 1,000 gallons for Tier 1 (Residential) consumers. Colorado's drinking water rates compare to the national average of \$37 to \$116 for 2019.

Over the past two years, spending on drinking water infrastructure has increased across the state. However, due to population growth, EPA's 2016 estimate of \$10.19 billion needed over the next decade likely remains unchanged in 2019. Although new forms of funding are now available from the federal government, namely the Water Infrastructure Finance and Innovation Act (WIFIA), which provides "long-term, low-cost supplemental loans for regionally and nationally significant projects," Colorado has not yet been the beneficiary of projects funded by such programs.

FUTURE NEED

Water consumption in Colorado is nearly 50% lower than the national average due, in large part, to a successful public education program focusing on water conservation implemented in the early 2000's by various drinking water utilities. The increasing population and decreasing usage offset one another in revenue generation, yet it is good to note that utilities in the state have been raising rates to further capture revenue shortfalls. It is estimated that approximately \$10.19 billion is needed to maintain and upgrade existing services.

As climate around the world continues to change and the earth gets hotter, Colorado's risk of falling into drought increases. In May 2019, Colorado "celebrated" being drought-free for the first time in 21 months. The Denver Post described the nearly two year drought as contributing to "one of the worst wildfire seasons in 2018," noting that most state reservoirs continue to run below capacity. Wildfires threaten the integrity of all infrastructure, including water pipelines and drinking reservoirs. The threat of decreasing reservoirs due to drought must push Colorado to invest in more resilient and innovative sources of drinking water.

More water is also needed to reach new areas of growth across the state. The growth of the Denver International Airport is spurring new residential and commercial building in surrounding areas like Aurora. The booming city, in partnership with Colorado Springs, is currently seeking to build a new reservoir on the Western Slope and pump the water through tunnels to the Front Range to meet anticipated water needs.

PUBLIC SAFETY

The safety of drinking water in Colorado is regulated by the EPA, with permitting and enforcement delegated to Colorado Department of Public Health and the Environment (CDPHE).

The State of Colorado reports that 99% of the supplied drinking water meets all requirements of the Clean Drinking Water Act. However, as discussed in the Condition & Capacity section, rural areas still face difficulties with their aging pipelines, creating issues with drinking water.

Of particular interest to CDPHE is the prospect of facing additional challenges in treating contaminants of emerging concern including per- and polyfluoroalkyl substances (PFAS). PFAS present challenges to treatment because, according to the United States Environmental Protection Agency (EPA), they are very persistent in both the environment and within the human body, meaning they don't break down and can also accumulate over time. Several communities within the State have identified the presence of PFAS compounds and efforts are underway to begin developing a regulatory framework to address these concerns. The regulations must consider the optimum, actionable solution for Coloradans that balances the technical and economic trade-offs of managing emerging contaminants (i.e. increased economic impact of treatment (to utilities or the industrial creators of PFAS) that is able to achieve to levels prescribed by the local and federal government).

RESILIENCE

Colorado's geographic location plays a crucial role in limiting the risk of natural disasters. Although flooding may occur throughout the spring and summer months, other threats such as earthquakes and tornadoes are infrequent occurrences. However, as discussed in the Future Need section, drought is a threat to Colorado. In June 2016, along with six other Western states, Colorado "[finalized] a landmark drought plan to voluntarily use less Colorado River water." Colorado must strive to conserve water across the state to combat the effects of global climate change.

Several bills (HB18-1093, 1053, and SB18-038) signed into law in 2019 provide resilient options for industries like marijuana, hemp, and traditional crops by authorizing the use of reclaimed domestic wastewater for irrigation.

INNOVATION

Utility owners are increasing their reliance on automated meter reading (AMR) and increased instrumentation at treatment facilities, pump stations, and in pipelines to more accurately determine usage, leaks, and losses that may be occurring. These methods also provide more accurate data for operators and consumers.

Emerging technologies such as aquifer recharging and direct potable reuse continue to be researched and practiced throughout Colorado. Denver Water launched a pilot program study for aquifer recharge in 2016, and HB17-1076, passed in the 2017 regular session, "opened the door for opportunities to implement aquifer storage and recovery programs in nontributary aquifers outside of the Denver Basin". Taking strides in those directions prior to the need arising will better prepare Colorado for the continued population growth that is expected.



**DRINKING
WATER**



RECOMMENDATIONS TO RAISE THE GRADE

- **Increase rates so that subsidies from State or Federal government are less critical.**
- **Pass legislation agreeing to protect Colorado's water supply through conservation or by reclassifying surface water sources**
- **Continue to pursue alternative sources of water including groundwater or aquifer recharging and water reuse, through research and development, financial investment, and public outreach.**
- **Increase public awareness and education on rate fees and the importance of rate payer contributions to the addressing of future needs.**
- **Streamline/create a state-wide asset management tool for drinking water infrastructure in Colorado.**
- **Pass legislation to aid in further developing a regulatory framework to address contaminants of emerging concerns, including PFAS.**



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ENERGY



WIND TURBINE GENERATORS WITH A CELL TOWER
ON FARMLAND IN CENTRAL COLORADO
SOURCE: BIGSTOCKPHOTO.COM



ENERGY GRADE: C+

EXECUTIVE SUMMARY

Colorado power plants generate more than 54,000 gigawatt-hours of electricity each year, placing the Centennial State 27th in the nation for production. In 2017, just over half of that electricity came from coal, with natural gas and renewables each providing just under one-fourth. Natural gas production has grown in recent years, but that growth has caused bottlenecks in the pipelines that move gas to markets. The fastest growing source of energy in Colorado is renewables, which doubled their output from 2010 to 2017, driven mostly by wind. The state’s energy grid faces challenges; the existing transmission and distribution lines were not built to accommodate large amounts of renewable energy. Additionally, distribution lines in particular are vulnerable to severe weather events, contributing to the average Coloradan experiencing 2.8 hours of power outages annually, according to industry-reported data. While this compares favorably to the national average of 5.9 hours per customer per year, each outage has major impacts on quality of life and productivity. In the near and long-term, wildfires, heavy winds, and floods will put increased stress on the state’s energy infrastructure.

INTRODUCTION

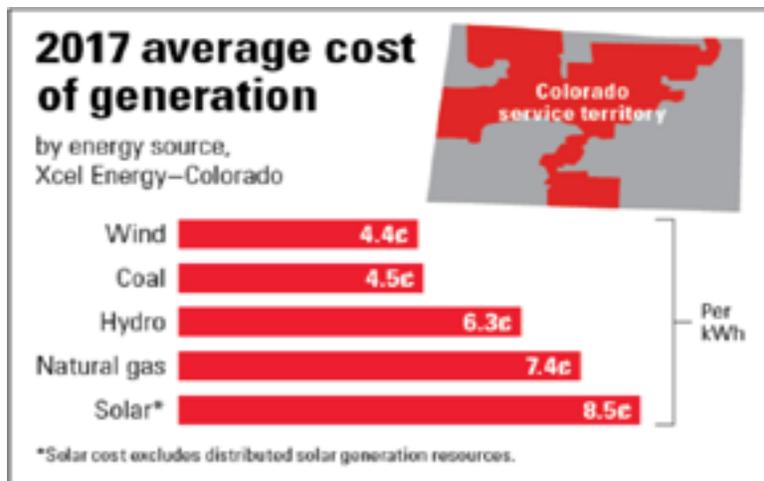
Colorado’s energy infrastructure serves as an economic engine for the state — creating jobs and attracting economic investment. While Colorado is rapidly transitioning to cleaner sources of energy, it remains a leading producer and transporter of oil and natural gas, a sector that supports more than 232,900 jobs in the state. With passage of House Bill 19-1261 in 2019, the state pledged to cut emissions of global warming gases 90% below 2005 levels by mid-century. Emissions cuts will require increased output from renewable sources — including wind from Colorado’s blustery eastern plains — as well as transmission and distribution lines to carry the electricity to market. But the state’s power lines face increasing threats from wildfires and severe weather, as well as mention old age. Natural gas could serve as a key fuel to help Colorado achieve its clean energy goals. As Coloradans use more natural gas to generate electricity and heat homes, it will require continued investment in pipelines and processing plants. Colorado’s population is among the fastest growing in the United States, thanks in part to its abundant sun and beloved outdoor recreation. Protecting this environment, while providing affordable energy to Coloradans, will require smart investments in Colorado’s energy infrastructure.

This chapter focuses on Colorado’s major sources of energy — coal, oil and natural gas, wind and solar — and the pipelines and power lines needed to get this energy to market.

CAPACITY & CONDITION

Colorado power plants generate more than 54,000 gigawatt-hours (GW-hr) of electricity each year, placing the Centennial State 27th in the nation for production. In 2017, just over half of that electricity came from coal, with natural gas and renewables each providing just under one-fourth. The fastest growing source is renewables, which doubled their output from 2010 to 2017, driven mostly by wind. In the decade prior to 2016, wind energy rose from 1.5% to 17.3% of Colorado’s electricity portfolio. In 2016, Colorado also ranked 11th in the nation for installed solar capacity, with nearly a GW of power-generating capacity. Utilities are investing heavily in renewables to meet state mandates to reduce emissions of global warming gases. Additional renewable energy generation will also be needed to replace electricity lost from the retirement of two coal-fired power units in Pueblo that Xcel Energy is closing in response to customer demands and economics favoring wind, solar and gas (see Figure 1). New energy must keep pace with Colorado’s burgeoning population, which grew to approximately 5.7 million people at the fourth fastest rate in the nation from 2010 to 2018.

FIGURE 1: 2017 AVERAGE COST OF GENERATION



Colorado's electricity is transported from power plants to population centers along thousands of miles of high and low voltage transmission lines throughout the state. Once transmission lines enter cities, the electricity is carried on thousands of miles of above-ground and below-ground distribution lines from substations to Colorado homes and businesses. The transmission and distribution system (T&D) is owned and operated by for-profit investor-owned utilities, such as Xcel Energy, which delivers more than 60% of the state's electricity, as well as non-profits including 29 municipal utilities and 22 rural electric cooperatives. Colorado's two investor-owned utilities — Xcel and Black Hills Energy — as well as Tri-State Generation and Transmission Association, which supplies electricity to the cooperatives, receive varying levels of oversight from Colorado's Public Utilities Commission (PUC). Integrating more renewables onto the electric grid will require significant T&D upgrades, including "smart grid" technologies that allow utilities to better manage consumer demand.

Colorado is also a major producer of oil and natural gas. In 2017, Colorado's natural gas production was the sixth highest in the nation and accounted for 6% of the U.S. total. Colorado in 2018 ranked fifth in the nation for oil production, accounting for 4% of the U.S. total. Production of oil has risen significantly, more than quadrupling since 2010 thanks to directional drilling and hydraulic fracturing technologies. Oil and gas in Colorado is moved by a system of 69,301 miles of pipelines used for gathering, transmission and distribution. While pipelines are seen as a safer alternative compared to tanker trucks or trains, there have been at least 35 "incidents" or "accidents" involving federally regulated pipelines since 2017. State officials say deficient pipelines are responsible for 10% of the toxic spills that impair Colorado's environment. Coloradans have sought to balance oil and gas development with stronger government oversight. Voters in 2018 rejected a ballot initiative that would have greatly increased oil and gas drilling setbacks from homes, schools and protected lands. In 2019, state lawmakers passed SB 19-181, signed by Gov. Polis, which gives local governments greater oversight of oil and gas development and requires the Colorado Oil and Gas Conservation Commission — the state's primary drilling regulator — to place a higher priority on protecting human health and the environment.

ELECTRICITY

Xcel, the state's largest utility, has developed a roadmap toward cleaner electricity called the Colorado Energy Plan. The plan, which received PUC approval in August 2018, pledges \$2.5 billion in investments in eight counties to add more than 1,100 MW of wind generation, more than 700 megawatts of solar generation, and 275 megawatts of large-scale battery storage. Two coal-fired power plants in Pueblo will be retired, with the energy replaced by a mix of renewables and natural gas generation. The plan calls for achieving nearly 55% renewable energy on Xcel's power grid by 2026, a near doubling of current levels.

Tri-State, meanwhile, in summer 2019 announced its Responsible Energy Plan to transition to cleaner energy while maintaining affordable rates for its predominantly rural customers. The company last year announced plans to buy power from the 100-MW Spanish Peaks Solar Project and the 104-MW Crossing Trails Wind Farm, which, when built, will increase the Westminster, Colo.-based cooperative's wind and solar use by 45%. In addition, Tri-State in 2019 announced it will be retiring its 100-MW Nucla coal-fired power plant early this year, two years earlier than anticipated. Transmitting power affordably to its rural, dispersed members poses unique challenges for Tri-State.



Colorado's existing T&D system was not designed to accommodate renewable energy as the largest source. Renewable energy, unlike coal or natural gas, fluctuates with the changing winds and sun. Failure to update the grid could result in brown- or blackouts in the future. Distribution lines are the most vulnerable part of Colorado's T&D system due to their susceptibility to severe weather events including heavy winds and ice storms. The average Coloradan experiences 2.8 hours of power outages annually, according to industry-reported data. While this compares favorably to the national average of 5.9 hours per customer per year, each outage has major impacts on quality of life and productivity.

OIL & GAS

Colorado boasts the third largest natural gas reserves in the nation and has seen its output double since 2001. Producers mined 1.8 trillion cubic feet of natural gas in 2018, an all-time record for the state. Today, nearly one-quarter of Colorado's electricity generation is powered by natural gas and demand from power plants and residents is increasing by about 2.5% each year. Roughly three-quarters of Colorado's homes are heated with natural gas, underscoring the need for reliable and safe supply.

Increases in natural gas production have sparked new gas pipeline construction in recent years. Colorado's 17,760 miles of natural gas interstate pipeline and 16,320 miles of oil interstate pipeline represent 4% of all interstate pipelines in the U.S. Yet Colorado's capacity to process natural gas is lagging. In 2018, almost 3.7 billion cubic feet of natural gas was flared, according to state data. This gas, which was burned off at the well site rather than being sold to consumers, represents roughly 3% of the gas consumed annually by Colorado residences. Much of this gas was produced as a byproduct of oil drilling in northeast Colorado, but producers lacked the pipelines to get it to market. While industry investments have alleviated some pipeline constraints, the lack of access to pipelines is still a bottleneck to moving natural gas liquids. Colorado is a net exporter of oil and natural gas. The state consumes only one-fourth of the natural gas it produces, with the excess supply loaded to interstate pipelines reaching nearly a dozen states from California to West Virginia.



SOLAR PANELS AGAINST A BLUE SKY WITH A PICTURE OF THE FLAG STATE OF COLORADO SOURCE: BIGSTOCKPHOTO.COM

FUNDING & FUTURE NEED

Colorado's energy infrastructure is funded largely by the private sector. Regulated utilities such as Xcel and Black Hills Energy, which serves the Pueblo area, require approval from the PUC before pursuing large energy and transmission projects. If the PUC approves such projects — deeming them prudent and in the public's interest — utilities may pass the costs along to ratepayers. A new law passed in 2019, Senate Bill 19-236, codified the PUC's policy of considering the "social cost of carbon" — including harm to human health, property, and food production resulting from power plant emissions — in its decision-making process. The law, which prescribed a cost for carbon emissions and a method to calculate it in the future, could support more aggressive adoption of clean energy. Xcel in late 2017 received historically low bids for wind and battery storage that were cheaper than the cost of coal, a sign that the cost of renewables is falling. While the PUC has approved Xcel's Colorado Energy Plan in concept, successful implementation of the plan is critical for the utility to upgrade and expand infrastructure to accommodate more renewables to maintain reliable service. In 2016, the company forecast a 1.4% annual growth in electricity demand, with 126,000 new customers by 2023. Meanwhile, consumption of both natural gas and refined products, which include transportation fuels, has risen, with a 30% increase in natural gas consumption and a 6% increase in refined products consumption from 2000 to 2018. Nationwide, oil production is expected to rise from current levels of 14 million barrels per day to 20 million barrels per day by 2035, according to a 2018 industry study. Research by the Interstate Natural Gas Association of America, predicts companies will spend an average of \$14.7 billion annually on new pipelines through 2035. Maintaining existing and new pipelines is critical in Colorado, where at least 120,000 pipeline segments run within 1,000 feet of homes.

Severe weather — namely wildfires, heavy winds, and floods that scientists warn will become more intense and frequent due to climate change — are putting increased stress on the state's energy infrastructure. Severe flooding along Colorado's Front Range in 2013 damaged 20 miles of pipeline and thousands of electrical and natural gas meters, costing Xcel roughly \$15 million and leaving thousands of residents without power. Xcel in 2019 proposed raising rates by \$158 million annually — a roughly 7% increase per bill for residential and small business customer — to help upgrade its grid and protect it from increasing severe wildfires. Colorado residents currently pay roughly 12.7 cents per KW-hr of electricity, just under the national average of 13.3 cents per KW-hr. The utility has 80,000 more residential customers in its service area in Colorado today than it did five years ago.

PUBLIC SAFETY, RESILIENCE & INNOVATION

Utilities across the state are installing new state-of-the-art electric meters that will give consumers better insight over the energy they're using while improving grid reliability and allowing the integration of more distributed energy sources, such as roof-top solar panels, batteries, smart appliances, and electric vehicles.

Black Hills Energy, an investor-owned utility serving areas around Pueblo, recently rolled out 100% advanced metering infrastructure (AMI) to its customers with help from a federal grant. The Colorado Springs municipal utility has installed an AMI system and the Delta Montrose rural electric cooperative recently installed 31,000 smart meters. Xcel in 2017 received PUC approval for its Advanced Grid Intelligence and Security (AGIS) initiative, which includes smart meters as well as a new technology called Integrated Volt Var Optimization (IVVO), which will enable customers' appliances to run more efficiently with less energy. The AGIS program will be rolled out from 2019-2024.



ENERGY



RECOMMENDATIONS TO RAISE THE GRADE

- **Strengthen Colorado’s energy infrastructure against increased threats from severe weather and wildfires. Extreme weather events pose an increasing risk to the reliability of Colorado’s energy assets.**
- **Continue to invest in “smart grid” and energy storage technologies to help bring more renewables onto the grid. Advanced metering could support broader use of rooftop solar and allow utilities to control when appliances draw power from the grid, potentially eliminating the need for new power plants. Large-scale batteries would allow excess renewable energy to be stored for future use, making wind and solar more valuable.**
- **Support construction of high-voltage direct-current transmission lines to more efficiently bring remote renewable energy to metro areas. A recent study commissioned by the U.S. Energy Information Administration found that DC lines have potential benefits that could support renewable energy, including cost effectiveness, lower electricity losses and the ability to handle overloads and prevent cascading failures. However, DC lines have historically been hampered by high costs and permitting constraints.**



ENERGY



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HAZARDOUS WASTE



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HAZARDOUS WASTE GRADE: C-

EXECUTIVE SUMMARY

Colorado has relied on industries that produce hazardous waste to strengthen and support its economy for over 100 years. Today, Colorado is home to 29 Superfund sites and 113 Brownfields. Superfunds contain hazardous waste that was mismanaged in the past and now poses a threat to public health or welfare of the environment. Brownfields are sites previously used for industrial or commercial purposes with known or suspected pollution. In addition to these existing sites, there are 4,584 facilities in Colorado that generate new hazardous waste every day, like hospitals, dry cleaners, oil refineries, and more. The current laws in place to protect the welfare of the public and environment may not be strict enough, and oftentimes the clean-up of hazardous waste falls to government programs instead of responsible parties. Meanwhile, government organizations like the Hazardous Materials and Waste Management Division of CDPHE can be understaffed and the federal and state government must decide how to maximize limited budgets.

BACKGROUND

Sites contaminated with hazardous waste are regulated by various agencies and therefore classified into various categories. These sites differ based upon the agency governing the remediation. The leading regulations related to hazardous waste sites are defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, commonly known as Superfund), and the Resource Conservation and Recovery Act (RCRA).

RCRA has been, and continues to be, a major regulatory tool for managing solid and hazardous waste at currently operating sites and facilities. Since it was passed in 1976, RCRA has given the Environmental Protection Agency (EPA) authority and guidelines to control solid waste in the U.S. at any point in the material's lifetime, including disposal.

Superfunds contain hazardous waste that was mismanaged in the past and now poses a threat to public health or welfare of the environment. Once a location is deemed a CERCLA site, it is placed under EPA's control. If a site is placed on the National Priorities List (NPL), cleanup efforts are overseen by the EPA; otherwise efforts are overseen by the state environmental governing body. In Colorado, the lead agency that implements RCRA is the Colorado Department of Public Health and Environment (CDPHE), specifically the Hazardous Materials and Waste Management Division (HMWMD). However, other agencies in Colorado regulate cleanup of other contaminants not specifically defined as hazardous waste. These include:

- Colorado Department of Labor and Employment, Division of Oil and Public Safety (CDPHE-OPS) which regulates and oversees the cleanup of the release of petroleum hydrocarbons from underground storage tanks,
- Colorado Oil and Gas Conservation Commission (COGCC), which regulates oil and gas production in Colorado
- Department of Natural Resources, Division of Mining and Safety, which regulates mining activities in Colorado.

One major source of hazardous waste in Colorado is the mining industry. Hard rock mines are released from the responsibility of cleaning up waste by the General Mining Act of 1872. This law was put in place during the mining boom in the mid-19th century. At the time, it was an effective way to transfer property rights between individual miners. Today, the Mining Act of 1872 inappropriately applies to multi-billion-dollar companies. This law enables an overly simple transfer of mineral rights, requires little oversight for exploration and administration, and releases responsible parties of obligation to clean the area once the mining has ceased. It is estimated that 40% of the watershed in the western United States is contaminated by pollution from hard rock mines, with 1,800 miles of streams impaired in Colorado alone.

CONDITION AND CAPACITY

According to data published by the CDPHE, Colorado is home to 29 Superfund sites and 113 Brownfields. The CDPHE provides the public with access to records of all hazardous material clean ups, including site locations, materials of concern at each site, and specific officials in charge of each site.

All states are required to follow RCRA guidelines at minimum for sites with active hazardous waste control. Although Colorado does not have more stringent regulations than RCRA, it does have additional assistance and regionally-specific guidance available for the control of hazardous waste. Guidance documents for the disposal of a wide variety of materials can be found on the CDPHE website; the agency also completes inspections, and enforcement of RCRA hazardous waste sites in Colorado. The HMWMD also oversees the cleanup of RCRA hazardous waste sites.

RCRA sites in Colorado include about 200 facilities where remediation of old hazardous waste is required (including universities and an aircraft manufacturer) and 4,584 facilities that generate new hazardous waste every day, like hospitals, dry cleaners, oil refineries and more. Facilities that generate hazardous waste in Colorado are subject to pre-planned compliance inspections.

The lead agency in Colorado for most Superfund sites is the CDPHE. However, 20 of the 29 sites in Colorado are listed on the NPL and thus are “owned” by the EPA. The Superfund sites in Colorado include three sites associated with the military, two landfills, and twelve mining operations, among others. The only site currently being cleaned, using entirely private funds and efforts, is the Bonanza Mining District. Many potentially responsible parties (PRP), such as Broderick Wood Products, are either active in the cleanup efforts on their respective sites or help pay for a portion of the cleanup. In the case of some Superfund sites, like the Captain Jack Mill, the PRP was a company that no longer exists or has declared bankruptcy. Consequently, all of the funding and cleanup efforts became the responsibility of the EPA and CDPHE.

Petroleum extraction, and in particular hydraulic fracking, has become a major economic power in Colorado in recent decades. The regulation of petroleum extraction and compliance of storage sites falls under the responsibility of the COGCC respectively. As of 2018, according to the Department of Labor and Employment, there were 55,137 active wells in the state of Colorado and 11,508 tanks for oil storage.

FUNDING AND OPERATION & MAINTENANCE

In 2018, Colorado specifically received \$2.4 million in grants from the EPA for the Brownfields program. These grants have gone to various municipalities and not for profit agencies. One example is the City and County of Denver, who has obtained two Brownfield Grants over the past five years, the Colfax Mainstreet Coalition and the South Platte RiverPlace Initiative grants which supplied funds to parties interested in redeveloping properties located along a section of Colfax Avenue and the South Platte River.

Funding for the Colorado Hazardous Waste Program, responsible for RCRA sites, comes from a mixture of federal grants, cash fees, and the Chemical Demilitarization Fund. It does not receive any state funding. Fees received from RCRA sites, including annual fees for generators, are leveraged to fund a majority of the costs of the program. The Hazardous Waste program estimates that fees will be adequate to cover funding needs for the next two years.

The HMWMD also operates a state lead Voluntary Cleanup Program that provides tax credits to individuals who are not the PRP, but are interested in redeveloping a site and as a result will complete some cleanup to remove exposure risks to users of the site.

Funding for Colorado’s Superfund sites comes from the state’s Hazardous Substance Response Fund (HSRF), which is funded itself by a fee applied to solid waste disposal at landfills. These fees are flexible and can be increased. However, the HSRF currently cannot exceed \$10 million total. For all Superfund sites where no PRP has been identified or is no longer in operation, the federal government is responsible for 90% of cleanup costs while the state is responsible for the remaining 10%. The exact number contributed by the EPA to the Colorado CERCLA program is not readily available to the public.

One example of CERCLA site funding in Colorado is the Summitville Mine, a site that has undergone cleanup efforts since 1992. The CDPHE and the EPA surpassed monetary contributions made by the responsible parties in just six years and will continue to contribute at least \$2 million in operating costs a year for the foreseeable future.

The cleaning of hard rock mines not under the Superfund umbrella has no source of federal funding. Instead, costs are incurred by stakeholders, the state government and non-governmental organizations (NGOs). Legislation that has been proposed by United States Senator Michael Bennet of Colorado, entitled the Hardrock Mining Reform Act of 2019, could enforce royalty fees on hard rock mining.

Sites in Colorado affected by petroleum contamination as a result of a release of petroleum hydrocarbons from storage tanks that are regulated by the CDLE-OPS can often be eligible for cleanup reimbursement through the Petroleum Tank Storage Fund. The money for this fund is supplied through fees applied to the purchase of fuel by operators of these sites and responsible party. Monetary contributions to this fund are on a sliding scale and are dependent on the dollar amount in the fund at a given time. Currently, the fee is \$75 per tanker truckload, meaning there is between \$3 million and \$6 million available in the fund. As of 2018 the Petroleum Tank Storage Fund had a surplus. The CDLE-OPS also operates a Petroleum Brownfield Fund, to assist non-responsible parties with funding to complete cleanup and redevelopment of sites that formerly operated storage tanks.

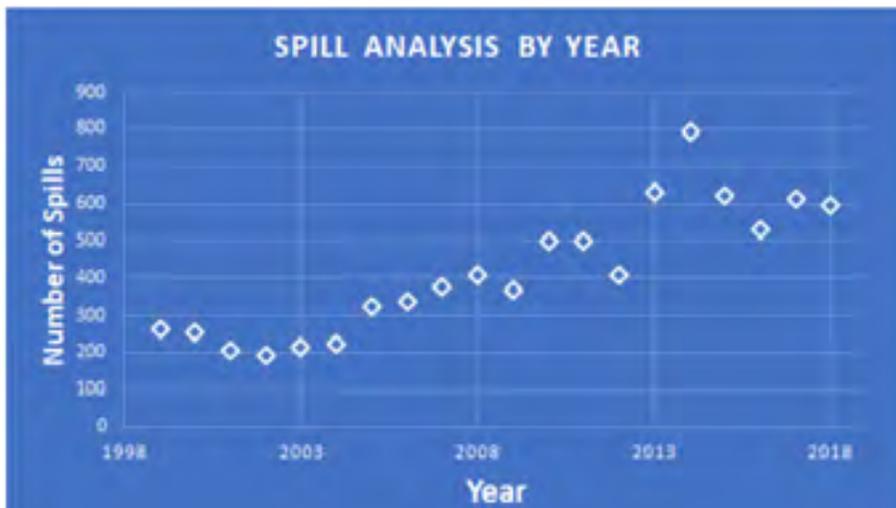
In Colorado, release from oil and gas production are regulated under several regulations issued by the COGCC. These cleanups are funded completely by the responsible party.

PUBLIC SAFETY

There are hundreds of sites around the state that produce and handle hazardous waste every day, not including the 23,000 abandoned mine locations. These mines are estimated to release 5.4 million gallons of acidic mine drainage per day into the Animas River alone.

Although the economy of Colorado relies heavily on the petroleum industry, the welfare of the public should be considered when reviewing regulations. In 2018 alone, there were more than 597 spills of oil. Seven of those spills contaminated surface water, while the rest may have impacted groundwater and soils across Colorado. In comparison, Wyoming, who produces about half as much oil as Colorado, had approximately 270 spills in 2019. However, this may be a reflection on how a state reports spills rather than which state is spilling the most. When a spillage releases oil into surface water, strict penalties are applied — \$3.6 million in penalties were enforced in 2018. In addition, the responsible party is responsible for completing cleanup of these releases to the standards outlined by the COGCC.

FIGURE 1: DATA PROVIDED BY THE COLORADO OIL AND GAS CONSERVATION COMMISSION



RESILIENCE AND INNOVATION

Sites contaminated with hazardous materials are particularly susceptible to the dangers of climate change. According to the Intergovernmental Panel on Climate Change, climate change has detectably influenced variables that contribute to flooding. If hazardous waste sites were to flood, there could be risks to public safety. According to an analysis completed by the Associated Press, there is at least one-superfund site in a 100-year floodplain in Colorado, the Broderick Wood Products site in northern Denver. There are approximately 5,000 residents within a mile radius of this Superfund site.

Several other Superfund sites in Colorado are located in mountainous areas where flash flooding may become more frequent due to forest fire burn scars and beetles kill trees. Some of these sites, like the Captain Jack Mill in Boulder County, which is contaminated with metals and hazardous chemicals, could be inundated with rushing water in a moment's notice, undermining cleanup efforts and putting downstream communities at risk.

The EPA has been aware of the risks climate change may pose to Superfund sites and has funded research efforts towards mitigating risk in hurricane prone areas. It is unclear if there are assessments being completed in mountainous, flood-prone areas that are common in Colorado.

The State of Colorado has embraced several new technologies used to complete site characterization of hazardous waste sites. These assessment technologies improved the ability for the identification of contaminants in the subsurface allowing for more efficient cleanups. The state has also developed new tools for mapping known hazardous waste sites. All the agencies have developed GIS mapping tools that illustrate the location of hazardous release sites, storage tank facilities and oil and gas wells. These maps have made it easier for the public to know where these properties are throughout Colorado. The state has also developed Voluntary Cleanup Programs and risk based closure approaches that result in the safe redevelopment of properties that would otherwise sit vacant.

FUTURE NEED

In 2018, only 217 out of the 4,584 RCRA facilities in Colorado were inspected. This low rate of inspections can be contributed to the fact that there are only 21 employees in the Colorado HMWMD. The limited staff in the division hinders its ability to complete regular inspections of the RCRA facilities in Colorado. In addition, the lack of steady source or increase in funding limits the ability of the division to increase staff as well as support individuals who might not have adequate funding to complete the cleanup. For instance, small business owners that operate dry cleaners often don't have the money or the other resources (such as insurance) to pay for cleanups and as a result these cleanups linger or abandon.

The Summitville Mine Superfund site is likely to become a major roadblock for the budgeting of Superfund cleanups in Colorado. This is because the EPA holds the right to cost-share for only 10 years in groundwater restoration projects, at which point they may withdraw funding and leave the clean up to the state. This one site has the potential to take up 20% of the funds available to the 29 sites in Colorado in 2025.

Colorado's Rocky Mountains serve as the headwaters for multiple major rivers that are then used throughout the western United States. Much of the headwaters tributaries and streams are impacted by abandon mines that litter the Colorado Rockies. As water becomes more and more of a finite resource maintaining the quality of this water become paramount not only to the state but the western United States. As a result, efforts to fund mitigation of these mines is necessary.

More and more each day emerging chemicals of concern come to the forefront, these include PFOA and PFOS, various dioxanes and others. As the EPA continues to study and develop regulations related to these emerging contaminants more locations throughout Colorado are being found to be impacted by these emerging contaminants. The state needs to develop an understanding of how these emerging contaminants are going to impact the public and how they will be managed.



RECOMMENDATIONS TO RAISE THE GRADE

- **Increase research efforts and public awareness applied to flood resilience in mountainous Superfund Sites to prevent endangering the public in the case of a natural disaster.**
- **Increase the \$10 million cap for the Hazardous Substance Response Fund and increase the fee to 50 cents per ton for solid waste facilities to allow for larger staff to be hired and an increased number of inspections completed.**
- **Apply royalties to hard rock extraction and put the money towards cleanup of abandon mines. Develop a state lead Brownfield program beyond the Voluntary Cleanup Program that will allow for the funding of cleanups.**
- **Increase or develop a RCRA generator fee to be placed into a fund for which PRPs can make application to use for payment of cleanups.**



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LEVEES



SOUTH PLATTE RIVER LEVEE BREACHES IN JUNE, 2015.
SOURCE: THE DENVER POST



LEVEES

GRADE: D+

EXECUTIVE SUMMARY

Levees are an integral tool in protecting people and property during flood events. Over 30,000 Coloradans live behind 61 known levee systems that also protect billions of dollars of water supply systems, bridges, roads, businesses and countless other critical infrastructure, education facilities, and treatment plants. Twenty of these levee systems are under the sponsorship of U.S. Army Corps of Engineers (USACE) and are regularly inspected. Three-quarters of these levees are in a minimally acceptable condition and one-quarter are in an unacceptable condition. The remainder of Colorado's levees are owned and maintained by local municipalities, other state or Federal agencies, flood control districts and similar entities. There are 15 levee systems in Colorado with unknown owners and many more may exist. The lack of a robust and accurate inventory of Colorado levees creates considerable issues about the condition of levee systems and the hazards these structures may pose. Where information on levee condition exists, the conditions are oftentimes poor.

BACKGROUND

Levees have a long history in Colorado and the oldest were constructed over 100 years ago. A three-mile-long levee system was completed in 1927 and protects downtown Pueblo, which was devastated by a flood on June 3, 1921.

FIGURE 1: 1921 PUEBLO FLOOD (SOURCE: PUEBLO COUNTY)



An inspection of this levee system in 2013 showed extensive issues, damage and significant concerns with its ability to withstand a large flood event. The Federal Emergency Management Agency (FEMA) refused to certify the levee as safe, which dramatically altered these landowners from being recognized by the Flood Insurance Rate Maps (FIRM) and ability to participate in obtaining flood insurance. Levees recognized by FEMA's Flood Insurance Rate Maps must follow FEMA's levee certification standards and the State of Colorado's Floodplain Rules and Regulations.

The Pueblo Conservancy District, which represents property owners in all of Pueblo County, generated funds through the sale of bonds to reconstruct the levee.

FIGURE 2: RECONSTRUCTION OF THE PUEBLO LEVEE (SOURCE: DEL SHANNON)

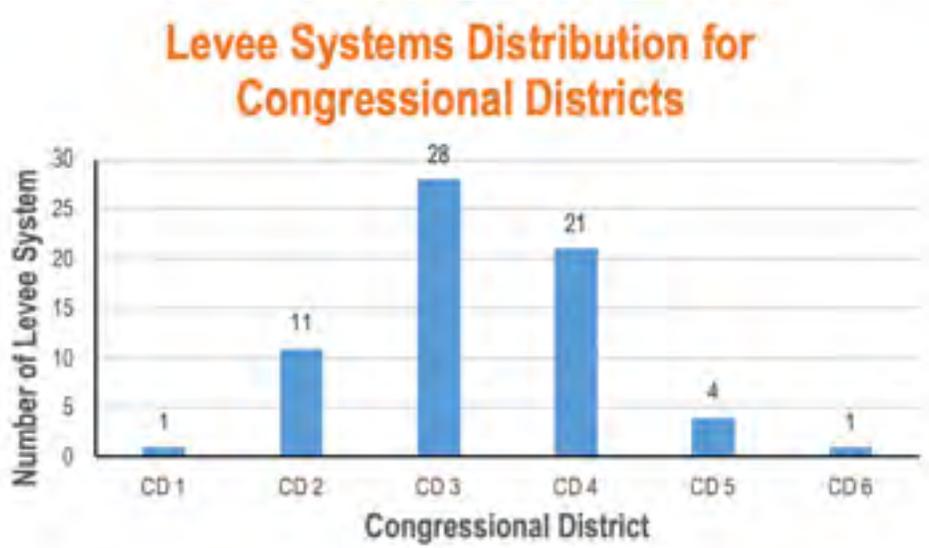


However, the vast majority of levees in Colorado are not being maintained as proactively as the Pueblo levee system. Outside of levees impacted by FEMA's Flood Insurance Rate Maps, there are no consistent standards or regulations in the state governing the evaluation or inspection of levee performance and condition.

Levees are crucial to public safety, however, because of their critical nature vulnerable structure information is often withheld. This lack of information creates significant gaps in understanding the current condition and safety of these structures. The National Levee Database is the best source of information about the levees in the United States and is a Congressionally authorized database maintained and published by USACE. The NLD provides the general condition, population and structures at risk, property value, and last known assessment/inspection dates of levees recognized by the database.

The levee infrastructures of Colorado are located within FEMA Region 8. These structures are sponsored and maintained by the Federal government, local governments, conservation districts, public universities, private institutions and other entities. There are 15 levee systems, totaling over 10 miles, in Colorado recognized by the NLD where the sponsor or owner is unknown or undefined. More concerning is over 70% of the permitted levees in Colorado were constructed prior to 1988, when specific levee design requirements were adopted by Colorado's Department of Natural Resources in the Rules and Regulations for Regulatory Floodplains. A statewide inventory of levees has never been undertaken and many unpermitted levees exist, especially in rural areas.

FIGURE 3. DISTRIBUTION OF COLORADO STATE LEVEES BY CONGRESSIONAL DISTRICTS.



OPERATION & MAINTENANCE

In most cases, for levees designed and constructed by the USACE in Colorado, non-Federal sponsors have the responsibility of operations and maintenance. Non-Federal sponsors are typically a community, drainage district, Colorado State agency (such as the Colorado Water Conservation Board), or levee district. The Templeton Gap Floodway, currently managed by the City of Colorado Springs, is an example of a non-Federal sponsor. These communities participate in the USACE’s PL 84-99 program, which allows the USACE to provide funding and assistance for preparedness, response activities, and certain types of rehabilitation. As part of this program, the USACE completes annual inspections and more detailed periodic inspections of the levee systems once every five years. Eligibility for the PL 84-99 program requires the levee sponsor to maintain the levee system in an acceptable or minimally acceptable condition. Table 1 details the USACE’s levee inspection rating system.

TABLE 1: LEVEE SYSTEM INSPECTION RATINGS

ACCEPTABLE	All inspection items are rated as Acceptable.
MINIMALLY ACCEPTABLE	One or more inspection items are rated as Minimally Acceptable or one or more items are rated as Unacceptable and an engineering determination concludes that the Unacceptable inspection items would not prevent the segment/system from performing as intended during the next flood event.
UNACCEPTABLE	One or more inspection items are rated as Unacceptable and would prevent the segment/system from performing as intended, or a serious deficiency noted in past inspections (previous Unacceptable items in a Minimally Acceptable overall rating) has not been corrected within the established timeframe, not to exceed two years.

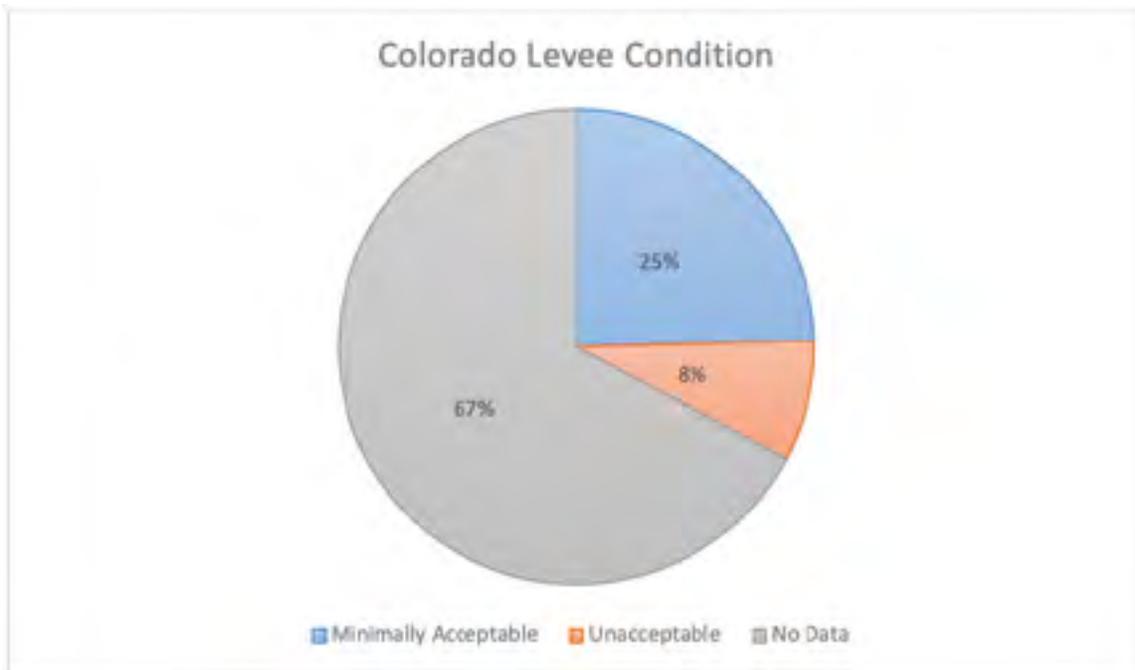
FEMA requires that all levees providing protection for the 1% chance annual flood event (the 100-year flood) on a FIRM must be certified by a Colorado licensed professional engineer. FIRM are used by local communities to administer floodplain management ordinances and to remain in compliance with the National Flood Insurance Program (NFIP). FIRM are also used by lending institutions to determine if a home is in a 100-year floodplain.

Homeowners with federally backed mortgages whose homes are within the 100-year floodplain are required to purchase NFIP flood insurance. If a levee system in Colorado were to lose its FEMA accreditation by not being certified, then those residents would be mapped as being in the 100-year floodplain and subject to mandatory flood insurance requirements for federally backed mortgages and other regulations. The requirements for levee certification are in FEMA's Code of Federal Regulations, Section 65.10 (CFR 65.10). Among these requirements are the expectation of adequate freeboard (vertical distance between the top of the levee and the full supply level on the reservoir) for the 1% chance annual flooding event, meeting levee seepage and stability levee design requirements, and maintaining an operations and maintenance manual. FEMA requires this documentation of certification to continue to be shown as providing protection on any new FIRM project.

CONDITION

Regular maintenance and inspection of all levees in Colorado is the responsibility of the individual levee owners or sponsors. As mentioned, only twenty of the sixty-one levee systems in Colorado are regularly inspected. Figure 4 below shows the current condition of these levees.

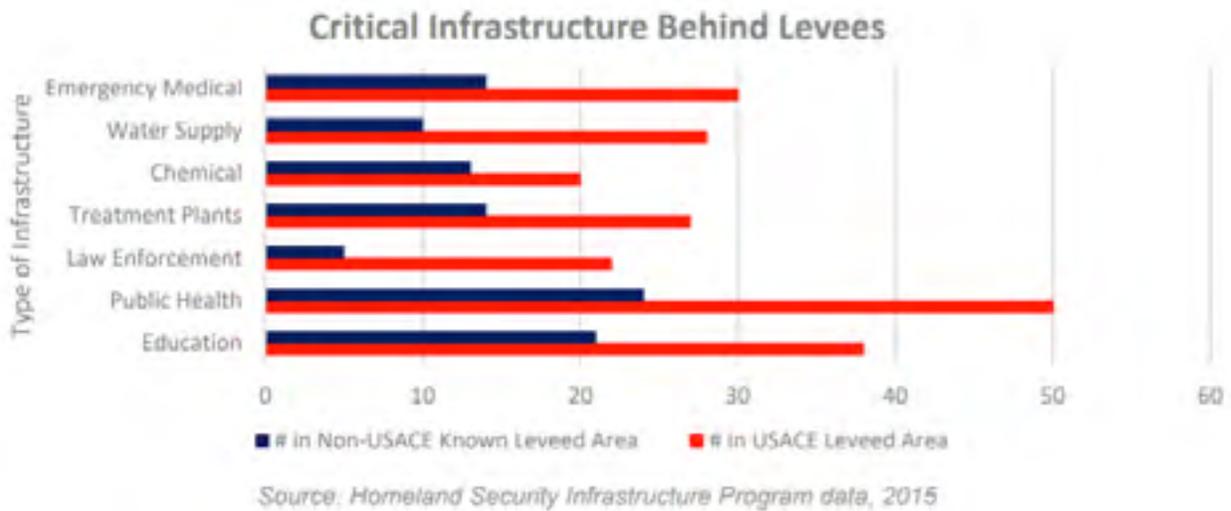
FIGURE 4. COLORADO LEVEE SYSTEM CONDITION



Colorado levees in the NLD have an average age over 42 years, which is lower than the national average age of 56 years. Although the information gathered on documented levees indicates good inspection and maintenance frequency, the NLD information represents much less than half of the actual levee miles in Colorado. Because the levees in the NLD are typically in the USACE PL 84-99 program, they see much more maintenance and repairs than levees not included in the NLD.

In addition, ageing levees require more intensive maintenance and vigilance to ensure proper performance should a large flood event occur. Figure 5 shows critical infrastructure protected by Colorado's levees. However, these protected residents and businesses often aren't aware of this protection nor do they understand the maintenance and repair these structure require. According to the 2019 USACE Levee Safety Report, there are approximately 30,000 people living behind known levees in Colorado. Further, hundreds of critical infrastructure systems are protected by levees throughout Colorado, which represents billions of dollars in assets. Without state standards and regulations for inspection, operation, and maintenance of levees, the actual condition and risk to properties protected by levees is often misunderstood.

FIGURE 5. CRITICAL INFRASTRUCTURE BEHIND COLORADO LEVEES
(SOURCE: USACE LEVEE SAFETY PORTFOLIO REPORT 2018)



The USACE has two types of levee inspections: routine and periodic. Routine inspections include the visual verification and rating the levee system operation and maintenance, which are typically performed annually for all USACE Levee Safety Program levees. Periodic inspections are more comprehensive and are performed by USACE multidisciplinary teams led by a professional engineer. Periodic inspections occur every five years on the federally authorized levees in the USACE Levee Safety Program.

Because the full extent of levees in Colorado is not accurately inventoried, the hazards associated with levee failures have not been fully identified and the resources required to provide acceptable levee hazard mitigation are unknown. Where information on levee condition does exist, it shows the condition is typically poor. Funding is limited and cannot be effectively prioritized due to lack of information on hazard level and levee condition.

FUNDING & FUTURE NEED

Without adequate data it is difficult to quantify the cost of the repairs, inspections, and relevant operation and maintenance (O&M) activities Colorado's levees. However, to better estimate the cost of future work, scopes of work were developed for 350 individual levee segments with Very High, High, and Moderate risk characterizations.

Based on past projects, environmental construction cost factors of 13% were used for levees within the western portion of the U.S., whereas 4% was used for the rest of the Nation. The USACE pays 75-100% of repairs if the levee system in USACE's programs and funding is available.

Following the methodology used by the Kansas chapter of the American Society of Civil Engineers' 2013 Infrastructure Report Card Committee for estimating the cost of repairs, levee repairs can be up to \$50,000 per levee mile for minor repairs and upkeep to several million dollars per mile for upgrades or repairs following a levee failure.

Assuming twice the number of miles than reported in the NLD, there are approximately 132 miles of levee in the state, and nearly all will require maintenance in the next 20 years. Assuming an average improvement cost of \$500,000 to \$1 million per levee mile, the resulting funding deficit is likely \$500 million to \$1 billion over the next 20 years, or approximately \$25 to \$50 million per year. It is likely that only a small percentage of levees in the state have adequate funding for long-term repairs that will be required as the levees continue to age.



RECOMMENDATIONS TO RAISE THE GRADE

While there should be a strong Federal role in supporting levee safety programs, Colorado state agencies and municipalities have a role to play as well. Specific action items that Colorado should adopt include:

- **Advocacy for full implementation and funding for the USACE National Levee Safety Initiative.**
- **Establish performance standards for Colorado levees that are consistent with other hazards faced by state residents, rather than relying on the Federal default protection for 1 in 100 year floods.**
- **Require hazard assessments for all Colorado levees**
- **Require regular inspection of all significant and high hazard levees within the state's jurisdiction and provision of the information to the national levee database.**
- **Require, and fully fund, levee improvements for all high or significant hazard levees in an unacceptable condition.**

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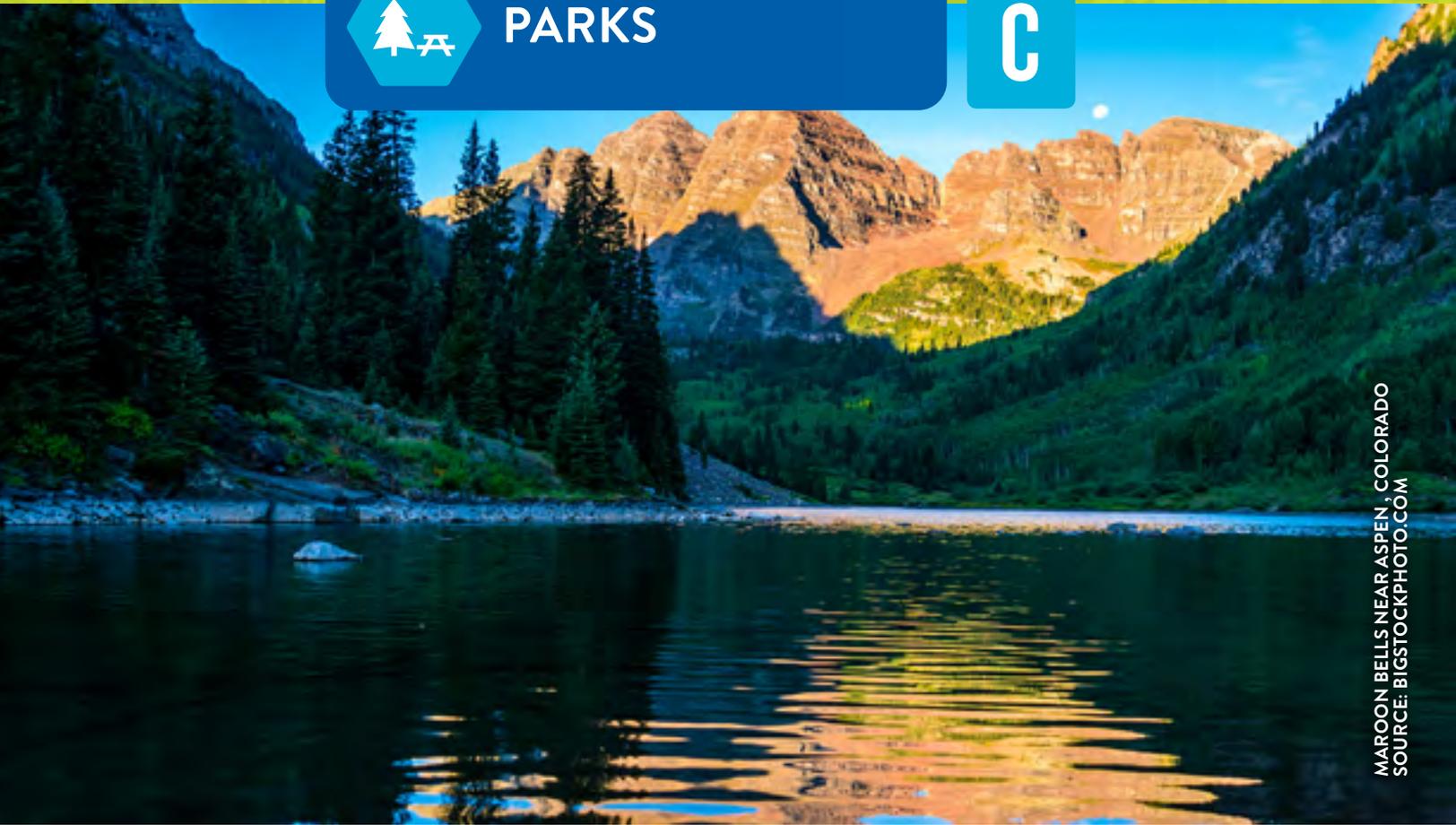
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PARKS



MARON BELLS NEAR ASPEN, COLORADO
SOURCE: BIGSTOCKPHOTO.COM



PARKS GRADE: C

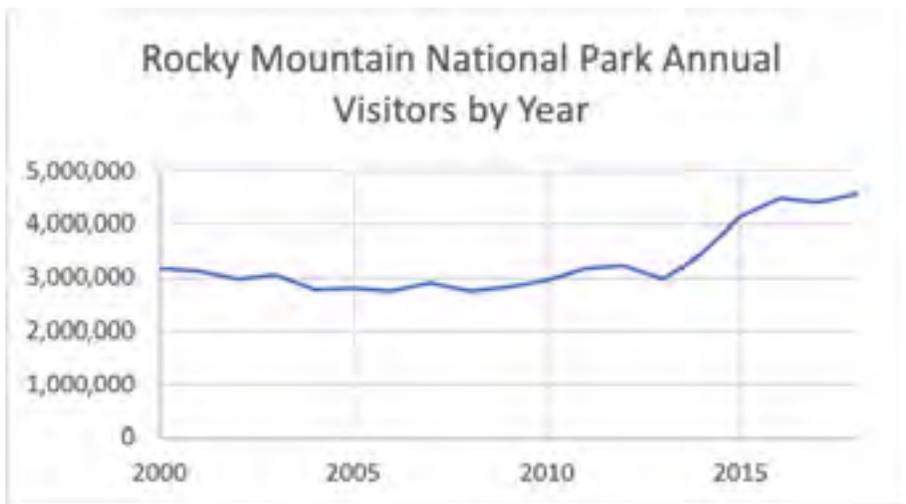
EXECUTIVE SUMMARY

Colorado proudly maintains 12 national parks and monuments, 41 states parks, and numerous open areas, recreation areas, city parks, and trails across the state. Parks are crucial to Colorado's economy, contributing approximately \$62 billion annually to the state, including over 500,000 jobs. Despite their importance, many park agencies lack the financial resources to adequately maintain trails, restrooms and more, especially as usage rates rise. Colorado Parks and Wildlife (CPW) reports a \$14.4 million backlog of large capital construction and maintenance projects. The National Park Service identifies \$247.6 million of deferred maintenance in the 12 parks and monuments managed in Colorado. Meanwhile, many local regions are losing green space to accommodate a rapidly growing population. Denver County land is currently 50% paved and is predicted to be almost 70% paved by 2040. However, CPW is helping to address the lack of green space through its *Colorado the Beautiful Initiative* that aims to have all Coloradans living within a 10 minute walk of a park system.

CAPACITY

Colorado is home to 12 national parks and monuments, 41 state parks, and numerous open areas, recreation areas, city parks, and trails across the diverse state. Colorado’s parks are managed by entities including Colorado Parks and Wildlife (CPW), National Park Service (NPS), U.S. Forest Service (USFS), and numerous local municipalities and volunteer organizations. Ninety two percent of Coloradans recreate outdoors and use Colorado’s vast recreation system at least once every few weeks. Additionally, over 85 million tourists visited Colorado in 2017 to enjoy the outdoors, often hiking on one of Colorado’s estimated 33,000 miles of trails. National Parks in Colorado alone have approximately 7.7 million visitors annually and the number of visitors is rising quickly. Specifically, Rocky Mountain National Park has seen a steep increase in the number of visitors in the past five years as seen in Figure 1 below.

FIGURE 1: ROCKY MOUNTAIN NATIONAL PARK ANNUAL VISITORS BY YEAR



While landmark locations are seeing the burden of overuse, many local regions are losing green space to accommodate a rapidly growing population. Denver County land is currently 50% paved and is predicted to be almost 70% paved by 2040. Not only does the loss of parks and green space in cities put an increased demand on Colorado’s parks outside the city, but it can also cause problems associated with stormwater management, temperature regulation, and air quality. Many regions in Colorado are addressing the lack of green space with support from initiatives through CPW. Aptly named, the *Colorado the Beautiful Initiative* aims to have all Coloradans living within 10 minutes of a park system. Numerous grants through CPW have been awarded that contribute to this goal.

CONDITION

Park conditions vary across Colorado. Throughout the state, outdoor recreation priorities are being addressed through many initiatives and funds. For example, the *Great Outdoors Colorado Fund (GOCO)* has assisted in financing almost 100 projects in the fiscal year 2018 alone. One of these projects was the *Prairie Ridge Trail Project* in Loveland, Colorado which includes the development of several miles of trails in the *Prairie Ridge Natural Area*. A portion of the new trail will be ADA accessible, in line with goals to serve all Coloradans’ park needs. Initiatives and grants like these are adding to and improving parks across the state.

Despite these efforts, many parks and trails are still in poor condition, including landmark recreation locations like many Colorado Fourteeners. “Fourteeners” are peaks in Colorado that are above 14,000 feet in elevation and most are on public land. More than a third of the peaks and routes inventoried by the Colorado Fourteeners Initiative in 2015 received a grade of D+ or lower due to degradation from overuse and misuse. Ill-defined trails and user-created routes can result in trail braiding and loss of fragile alpine tundra soil and vegetation, quickly eroding the peak and its routes. Many Fourteeners trails are estimated to need \$1 million or more to restore routes to ideal conditions.

FUNDING

In Fiscal Year 2017 - 2018, Colorado Parks and Wildlife (CPW) had \$231.8 million in funding. This funding comes from taxes, grants, license fees, donations, and GOCO. Unfortunately for recreators across the state, funds for parks and wildlife have not kept up with inflation and population growth. In 2014, CPW received approximately \$70 million from licensing. Adjusting for inflation, funding from licensing in 1990 would be \$140 million today. Despite an increase in population, licensing revenue is approximately half of what it was almost 30 years ago. An additional large contributor to park funding, GOCO, is also falling behind the needs of the state. GOCO utilizes portions of lottery revenues to enhance park systems and currently sees a demand of 3:1 for available funding.

Many cities are not seeing adequate funding for local parks, open spaces, and trail systems. Cities and municipal districts receive additional funding through programs such as the Land and Water Conservation Fund (LWCF). However, the LWCF is often underfunded, thus reducing the number of grants awarded. In recent years, Colorado has only been allocated roughly \$750,000 annually. Cities and counties can also apply for grants and work with other agencies such as CPW, but the lack of funding within these organizations has made funding open spaces and parks difficult.

OPERATIONS & MAINTENANCE

While many programs and taxes exist in Colorado to maintain and improve parks, the funding is not keeping up with increases in usage. CPW's latest figure on backlogs of large capital construction and maintenance was estimated at \$14.4 million. The National Park Service lists \$247.6 million of deferred maintenance in the 12 parks and monuments managed in Colorado.

In addition to financial backing, Colorado parks rely heavily on Coloradans who volunteer their time and effort for everything from organizing events to trail building and maintenance. Thus, calling attention to these important resources is paramount. Volunteers for Outdoor Colorado have logged more than 38,000 hours of volunteer time in 2018. National parks in Colorado have seen 236,570 hours of volunteer time in 2018's fiscal year.

FUTURE NEED

The current population of 5.7 million in Colorado is projected to expand to 8.5 million by 2050. CPW predicts recreation acres per capita across the state will drop from 5 to 3.5 acres by 2050. Increased use of parks across Colorado will directly result in a need for increased funding to improve maintenance and for creation of more recreation systems.

FIGURE 2: ARVADA, CO PARK (SOURCE: ARVADA.ORG)



In addition to a growing population, Colorado has an aging population. By 2040, the population over the age of 65 will be nearly three times what it is today, increasing twice as fast as the total population within the state. Future planning of recreation and park spaces will need to consider the needs of a changing population, including parks and spaces that are easily accessibility for citizens with disabilities.

Parks across the state are accessed and used differently throughout the diverse population. CPW addresses the need for consideration of economic and racial diversity in its Statewide Comprehensive Outdoor Recreation Plan and brings attention to this issue on the grander scale. For example, areas with some of the lowest park access and participation include historically Black and Latino communities. Additionally, future parks should consider different needs from various classes, ability levels, and locations from rural to urban. Colorado is also home to tribal lands that present unique needs with respect to parks and outdoor recreation with priorities such as development of team sports facilities and improving outdoor education facilities and programs.

The future of Colorado parks includes an increased need for funding to manage large parks and landmark locations that have defined the landscape of Colorado, such as its many Fourteeners or Rocky Mountain National Park. However, Colorado must also grow and adapt to the changing population's needs for local and accessible outdoor and green space.

FIGURE 3: SIGNAGE NEAR CHASM JUNCTION IN THE LONGS PEAK AREA, RMNP (SOURCE: NATIONAL PARKS SERVICE)



PUBLIC SAFETY

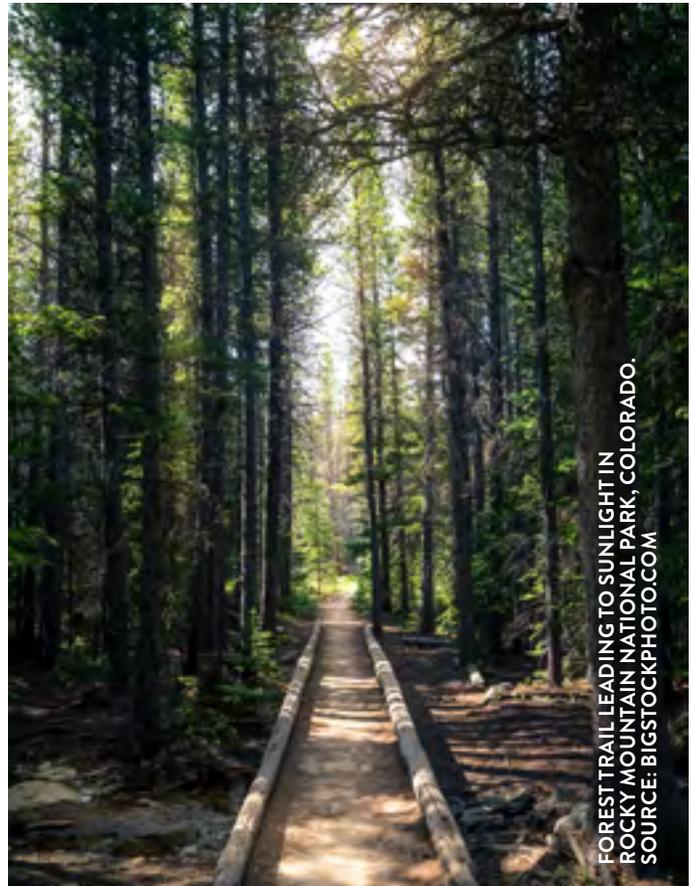
Colorado is among the least obese states in the nation and access to outdoor recreation is a key component to this. CPW recognizes the role nature-based recreation can play in improving not only physical, but emotional health of Coloradans. In 2017, Colorado's Outdoor Recreation Industry Office convened the OutdoorRX Collaborative. The group has researched and confirmed that green space and nature are crucial to the health and happiness of Coloradans. Funding to maintain access to and the health of outdoor spaces is key to keeping Colorado a healthy state.

As climate change causes more extreme weather events, wildfires will only worsen, and increased funding will be needed to manage the risk in open spaces. In 2018, one of the worst fire seasons on record, over 475,000 acres were burned. CPW's forest management program from 2002 includes dedicated funding from GOCO to maintain forest spaces for wildfire prevention. Funds are required to maintain at-risk regions through methods such as carefully planned and coordinated controlled burns. As the population grows, people will live and work in regions closer to parks and open spaces most at risk for wildfires, presenting an obvious public safety concern. Wildfires can also be detrimental to water supplies contained by or neighboring Colorado's parks and damage nearby electrical grids.

RESILIENCE AND INNOVATION

Initiatives aimed at increasing awareness, respect, and education regarding use of parks are crucial to the future of parks. An example of these initiatives is the "Leave no Trace" Initiative by CPW that encourages users to keep spaces beautiful by packing out trash and properly disposing of human waste. Investing in public education and participation helps to decrease maintenance costs and wildfire hazards.

Investigating new opportunities for funding projects should be explored, such as public-private partnerships for large-scale projects. Public-private partnerships can streamline projects to improve parks and park access when full funding is not available.



FOREST TRAIL LEADING TO SUNLIGHT IN ROCKY MOUNTAIN NATIONAL PARK, COLORADO. SOURCE: BIGSTOCKPHOTO.COM



RECOMMENDATIONS TO RAISE THE GRADE

- **Focus on a sustainable approach to maintaining and creating infrastructure. Future park infrastructure should consider future maintenance and full life cycle costs when approaching design.**
- **Adjust fees for inflation, such as licensing fees.**
- **Identify and invest in park systems that are valuable to a diverse population.**
- **Local agencies should put an emphasis on identifying and creating green space and parks within urban environments, taking advantage of options for public-private partnerships to streamline large capital projects.**
- **Statewide bond measures could provide required funding to address large backlogs to park maintenance, such as the Colorado Outdoor Recreation & Economy (CORE) Act.**



PARKS



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RAIL



LANDSCAPE WITH AUTUMN TREES AND RIVER. ROCKY MOUNTAINS, COLORADO SOURCE: BIGSTOCKPHOTO.COM



RAIL
GRADE: B-

EXECUTIVE SUMMARY

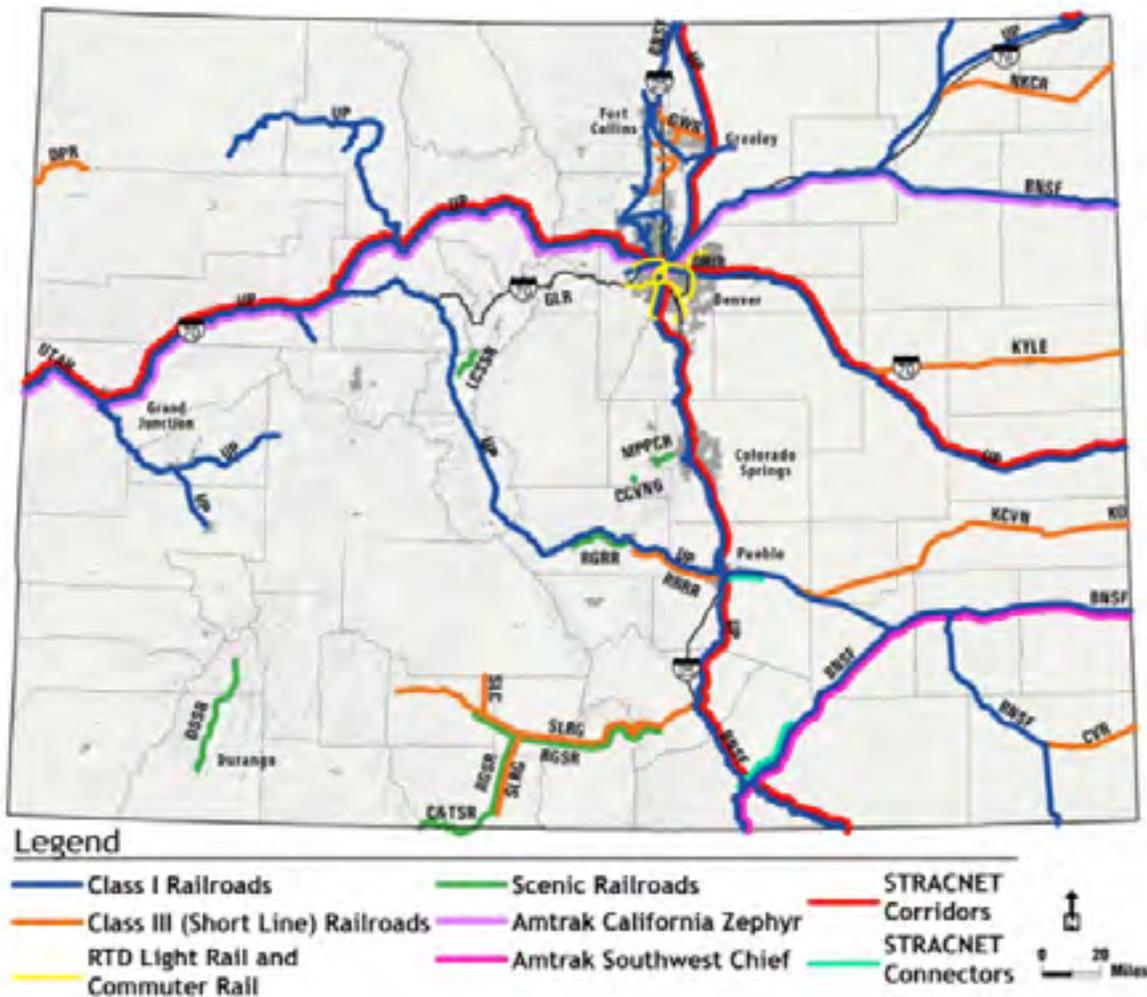
Every day, Colorado’s rail system transports 400,000 tons of goods—including coal, crude oil, lumber, cement, and grain—into, out of, and through the state. In those same 24 hours, Amtrak hosts 19,400 boardings over the whole Colorado passenger rail service. Class I rail lines transport the majority of goods over Colorado, while Class III (short-line) routes provide connections to towns and key agricultural and natural resource producing regions. Two year-round passenger services run through the state and connect Colorado communities to each other and to neighboring states. Colorado rail is largely privately-funded and meets acceptable standards in most criteria, but still faces challenges. Short-line rail is underfunded and often struggles to maintain standards needed for Class I connectivity. Passenger rail seeks growth in funding to support underserved regions. Overall, investment needs require more development across the whole spectrum of freight and passenger rail. As population grows, and economic and environmental issues continue to affect Colorado, a safe, efficient, and reliably financed freight and passenger rail system is key to ensuring the success of the state and its residents.



INTRODUCTION

Colorado is served by two Class I railroads, BNSF Railway and Union Pacific Railroad, that own and operate 80% of the trackage in the state. Twelve smaller Class III – or short-line railroads – connect the Class I railroads across the state to towns and key agricultural and natural resource producing regions. In addition, Amtrak provides passenger rail service over two multi-state regional routes and one intercity route. Eight scenic railroads provide specialized service attracting tourism. Segments of the rail network are part of the 38,000 mile Department of Defense’s Strategic Rail Corridor Network (STRACNET) providing rail access to critical industries and defense locations across the United States.

FIGURE 1: COLORADO FREIGHT AND PASSENGER RAIL SYSTEMS MAP
(SOURCE: 2018 COLORADO STATE FREIGHT AND PASSENGER RAIL PLAN)



In 2014, freight rail moved more than 154.7 million tons of product into, out of, and through Colorado. Approximately 65% of all freight traffic is through traffic, meaning goods and products are manufactured or produced elsewhere and destined for consumers outside of Colorado. The revenue value of rail freight traveling to, from, and within Colorado is approximately \$2.4 billion based on 2014 survey data. Currently, 13% of total freight in the state is transported by rail. Intermodal shipment is a growing volume of rail traffic; however the current data collection of freight by tonnage understates this category.

The passenger system is operated by Amtrak, which does not own its own rail lines, but instead is hosted on private freight rail lines throughout the state. There are currently three routes operated through Colorado: California Zephyr, Southwest Chief, and the seasonal Winter Park Express.

CONDITION & CAPACITY AND OPERATION & MAINTENANCE

Colorado freight railroad companies fund improvements and maintenance projects throughout the state, with Class I railroads having more secure financial ability to do so than short lines. Freight rail traffic in Colorado is not seeing an increase like many other parts of the country, largely because of the decrease in coal traffic. The decrease in coal cars has been at least partially offset by increased intermodal traffic with rail freight volumes particularly sensitive to economic conditions and agricultural production. Track capacity is sufficient to meet existing needs. There are concerns among the agricultural shipping community that track and train capacity is strained during peak months, but proposals for improving capacity have not been advanced. As coal traffic declines and intermodal traffic increases, there is a potential need for added capacity.

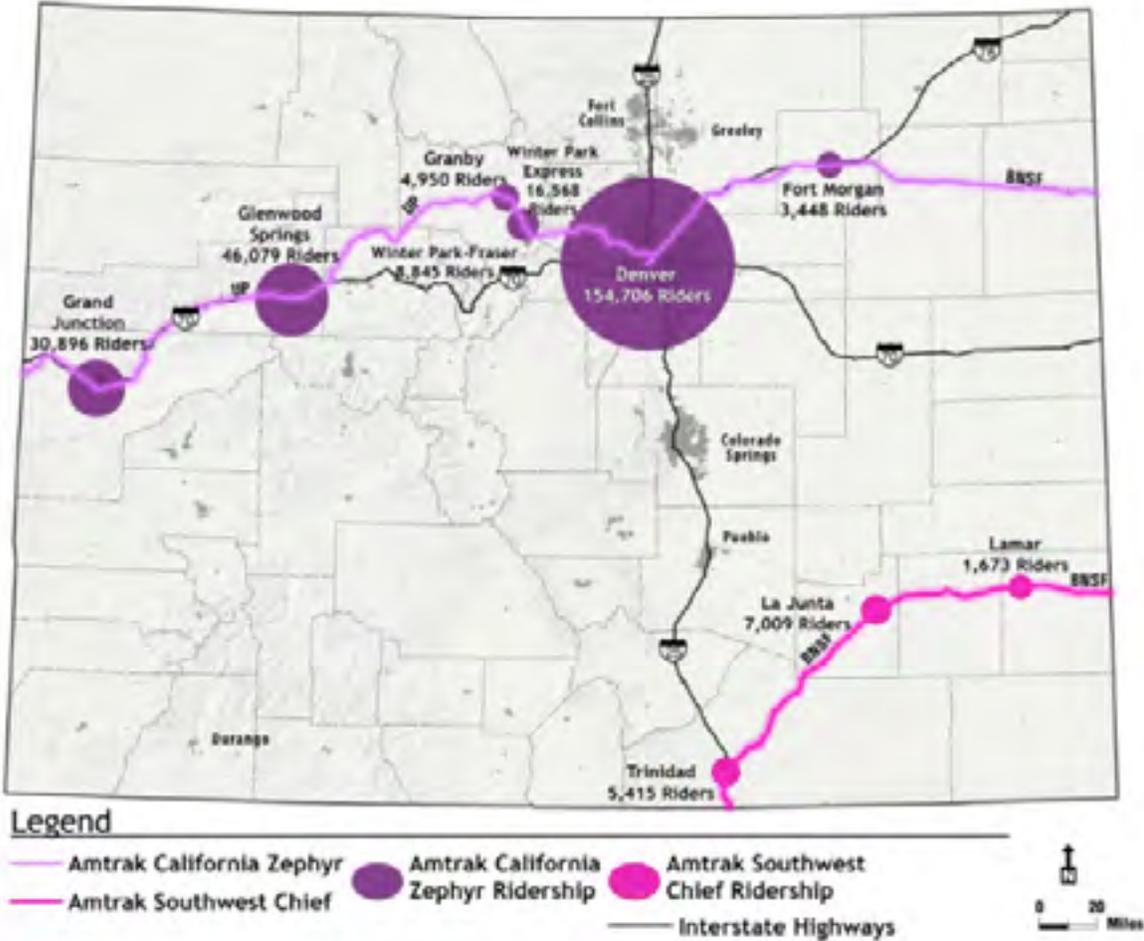
The Class I railroads generally have the ability to upkeep their tracks for the capacity and operations requirements throughout Colorado, though the short line railroads often fall short in their ability to fully match this effort. Colorado relies on its short line railroads to reach areas of the state that would otherwise be unconnected to the freight rail network. Much of Colorado's short line track does not meet current standard weight limit for a rail car (286,000 pounds), resulting in less efficient rail operations limiting customer service.

Two Amtrak routes—the California Zephyr and the Southwest Chief—run through the state. From 2011-2016, between 33.3% and 41.7% of passenger train delays were caused by slow orders and conflicts with freight railroad operations. These Amtrak long-distance routes are also encumbered by a backlog of station maintenance and improvements as well as aging equipment.

Amtrak has made improvements across the state in recent years. For example, it has improved statewide coverage by creating connecting bus routes. Amtrak has also created new lines, like the inter-city Winter Park Express that supports winter service from Denver Union Station to the Winter Park ski resort. This new line reduces congestion on the state's main East-West I-70 thoroughfare. In its inaugural 2017 season, the Winter Park Express served more than 16,000 passengers.

Outside of these Amtrak lines, Colorado's passenger rail service lacks the regional and interregional lines needed to connect the state. The most populous corridor runs along Interstate 25, from Fort Collins to Trinidad. The figure below identifies the current passenger services in the state, and, more noticeably, the absence of such a service along this corridor. This area contains 82% of the state's population and accounts for the clearest capacity needs of the state's passenger rail system. The Colorado Department of Transportation (CDOT) and the Southwest Chief/Front Range Passenger Rail Commission are currently investigating the potential for this service. As of May 2019, CDOT has procured services for a formal study.

FIGURE 2: AMTRAK INTERCITY PASSENGER SERVICE RIDERSHIP BY ROUTE MAP, 2017 (SOURCE: 2018 COLORADO STATE FREIGHT AND PASSENGER RAIL PLAN)



FUNDING

The Colorado Public Utilities Commission (PUC) and the Federal Highway Administration (FHWA) Railway-Highway Crossings (Section 130) Program provide funding for railway-highway crossing improvements of approximately \$3 million annually for projects considered most hazardous. Additional yearly funding, though not sufficient for all remaining projects, comes from the Colorado Highway-Rail Crossing Signalization Fund (HRCFSF) jointly with local governments and railroad operators.

The Funding Advancements for Surface Transportation and Economic Recovery Act of 2009 (FASTER) provides CDOT with transportation funding, including \$10 million for non-local transit. From 2012-2017, FASTER has awarded \$6 million for rail safety, capital infrastructure, and rail planning projects.

Passenger rail with diverse stakeholders has succeeded in acquiring funding in recent years. The Winter Park Express resumed service in 2017 and was funded by multiple stakeholders including the Winter Park ski area operator company Intrawest Resort Holdings, CDOT, City and County of Denver, and Town of Winter Park. The Southwest Chief, another Amtrak line, was awarded Transportation Investment Generating Economic Recovery (TIGER) funding in 2014, matched by Amtrak, BNSF, and stakeholder organizations (municipal and non-governmental) from Colorado, Kansas, and New Mexico.

There are several funding programs that are not currently being utilized for rail projects. The Colorado State Infrastructure Bank (COSIB) is a revolving fund of \$1.5 million authorized to provide low interest loans for financing transportation projects, of which rail is one of four distinct programs; despite the inclusivity, COSIB funding is primarily utilized for aviation projects. The High-Performance Transportation Enterprise (HPTE) is an entity within CDOT able to seek innovative and efficient funding options, such as public-private partnerships (P3s), for any surface transportation project; none to date have been sought for rail endeavors. The State Rail Bank Fund was created in 1997 to acquire abandoned freight and passenger right-of-way for the public's benefit; this has only been used once, in 1998.

Other federal grant programs, such as Better Utilizing Investments to Leverage Development (BUILD), previously known as TIGER, and Fixing America's Surface Transportation (FAST) Act, have the potential to be utilized for maintaining and improving Colorado rail infrastructure, but neither have seen significant use on this front.

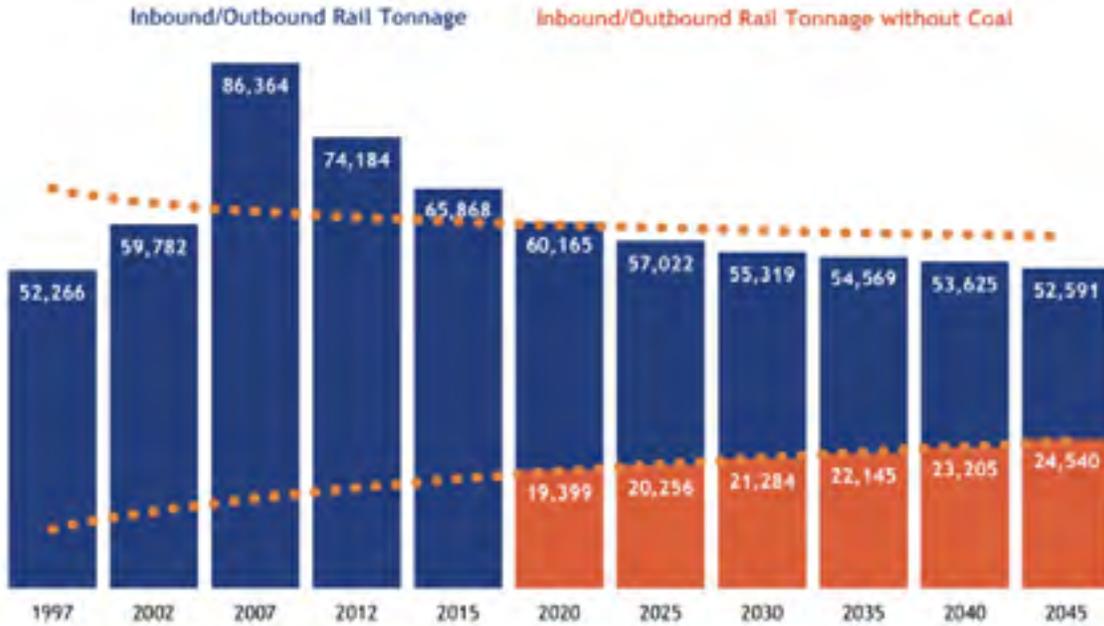
According to the Colorado Freight and Passenger Rail Plan produced by CDOT, Colorado needs rail investment into the tens of billions of dollars over the next 20 years. Colorado is one of the few states with significant short-line activity that does not have a funded assistance program, which would better enable the short line railroads to maintain their infrastructure through grants and low-interest loans. Many of the funding programs discussed in this section involve loans requiring funds for payback or grants that must be matched at least in part by other funding sources; there is no dedicated recurring state funding for freight or passenger rail projects, which is one of the reasons these programs are underutilized.

FUTURE NEED

The State Demography Office of the Colorado Department of Local Affairs predicts that by 2030, the population will increase by 1.4 million new residents to total 6.9 million in the state. The majority of this population boom will be young people moving to the Front Range. This population boom will place more stress on rail crossings and will increase the advocacy for quiet zones. Quiet zones limit train whistles at railroad crossings to combat noise pollution, but also decrease safety at these crossings. Other areas of the state, such as communities in the San Luis Valley, will not experience much growth, and preservation of Class III railroads will be crucial to maintain their ability for upward mobility.

Current FHWA Freight Analysis Framework (Currently FAF4) projections show freight tonnage in Colorado decreasing by 19% by 2040. This is primarily predicted to be from a large decrease in coal production nationwide.

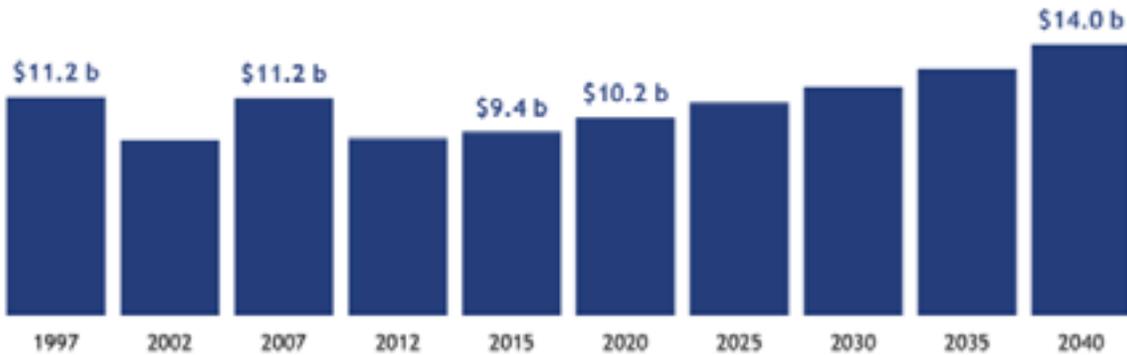
FIGURE 3: TRENDS IN FREIGHT RAIL TONNAGE TO AND FROM COLORADO, 1997 TO 2040 (SOURCE: 2018 COLORADO STATE FREIGHT AND PASSENGER RAIL PLAN)



Source: Federal Highway Administration, Freight Analysis Framework, 2017

However, rail transportation is assessed through tonnage. An increase in lighter commodity goods is occurring but this is overshadowed by a weight bias. On a value basis, rail shipments are expected to increase from 2015 to 2040 by 48%, or by \$4.5 billion, and supporting the current coal corridors will be necessary to maintain freight rail capacity in the future.

FIGURE 4: VALUE OF FREIGHT RAIL SHIPMENTS TO AND FROM COLORADO, 1997 TO 2040 (CONSTANT DOLLARS)(SOURCE: 2018 COLORADO STATE FREIGHT AND PASSENGER RAIL PLAN)



Source: Federal Highway Administration, Freight Analysis Framework, 2017

Considering passenger rail between 2006 and 2016, Amtrak ridership grew by over 28%. This number is projected to rise in future years as the state population grows, so passenger rail capacity must increase to meet this projected growth. CDOT and the Southwest Chief/Front Range Passenger Rail Commission are currently studying the potential for implementing a passenger rail service along the I-25 corridor.

PUBLIC SAFETY

Colorado rail incidents at crossings declined from 32 to 27 incidents between 2007 and 2017 despite an increase in traffic on the road. Railroad-highway incidents have stayed relatively stable with an average of three fatalities and six serious injuries per year. Most major accidents occur at at-grade crossings. At-grade crossings occur where railway lines and roads meet at the same level, rather than being separated by an overpass or tunnel. In 2018, 82% of public railway-highway crossings were at-grade. More than 1,063 private at-grade railway-highway crossings do not fall under the jurisdiction of CDOT or PUC and are privately maintained. Under the jurisdiction of CDOT, 56 crossing improvement projects are planned between 2018 and 2022.

Other causes of accidents mainly include collisions and derailments, with the majority being derailments in the train yard.

All railroads in Colorado are compliant in implementing positive train control (PTC). PTC is an advanced system that allows trains to automatically stop to avert major accidents.

RESILIENCE

The U.S. Department of Defense's (DOD) Railroads for National Defense Program (RND) oversees the Strategic Rail Corridor Network (STRACNET). This program ensures that U.S. rail and highway infrastructure can support itself and the nation through national emergencies by identifying and monitoring the main rail lines necessary to meet the DOD's minimum rail needs. The Federal Railroad Administration (FRA) monitors the STRACNET and connector lines to ensure they meet inspection compliance. Lines are compliant with defense readiness standards if they meet clearance for oversized shipments, weight bearing-capacity, and maintenance condition. On a five-year basis, the FRA in conjunction with the Military Surface Deployment and Distribution Command Transportation Engineering Agency (SDDCTEA) update the rail lines designated to be part of the STRACNET. In Colorado, the STRACNET encompasses 994 miles of track which include access to the Pueblo Chemical Depot and the Piñon Canyon Maneuver Site. Additionally, Colorado is home to the Transportation Technology Center Inc. (TTCI). TTCI houses the Security and Emergency Response Training Center which oversees domestic response training for Colorado and conducts research for nation-wide security. Tunnels, bridges, and intermodal rail yards are vulnerable despite security precautions. Rail infrastructure is inherently reliant upon these non-redundant structures, which amplifies a vulnerability across an entire rail corridor. The largest security breach of all occurs from pedestrian trespassing.

INNOVATION

TTCI, along with the FRA, continues ongoing research into rail technology. This technology is further incorporated into Colorado rail systems by private entities to detect defects before incidents can occur. New technologies use ultrasound and lasers as well as wayside detectors to monitor tracks. HiRail trucks are mounted with these sensors and run along the track or are positioned next to the tracks



RECOMMENDATIONS TO RAISE THE GRADE

- Develop detailed investment needs for rail infrastructure renewal and expansion with a specific emphasis on:
 - underfunded and under-maintained Class III lines.
 - passenger rail in underserved geographic areas.
- Define public funding opportunities and actively develop state, local, and other stakeholder funding sources to match federal financing options.
- Foster public-private partnerships to support funding of statewide rail maintenance and capital projects.

DEFINITIONS

CLASS I, II, & III RAILROADS - As of January 2006, a Class I railroad was defined as one that generates revenues of \$289.4 million or more each year. Class II railroads are those with annual revenues between \$20.5 million and \$289.4 million. Class III railroads have earnings of less than \$20.5 million.

FREIGHT RAIL - Rail service transporting goods and commodities for industrial and commercial use.

HIRAIL - A road-rail vehicle which can operate both on rail tracks and a conventional road. They are also called hi-rail, from highway and railway, or variations such as high-rail, HiRail, Hy-rail, etc.

INTERMODAL - Shipping method involving multiple modes of transportation, most commonly truck, railroad, and ship, often consisting of consumer goods.

PASSENGER RAIL - Rail service transporting regional and interregional users, not consisting of RTD (Regional Transportation District) service (see Transit Chapter).

POSITIVE TRAIN CONTROL (PTC) - A signal and operation system designed to utilize a train's location, direction, and speed to prevent collisions, derailments, and unauthorized movements.



DEFINITIONS (CONT.)

RAILWAY-HIGHWAY GRADE CROSSING - Infrastructure location where a railroad and a roadway for automobiles intersect, resulting in increased difficulty in maintenance and safety for both.

SHORT LINE - A railroad operating over a significantly lesser distance than the national railroad networks, used interchangeably with Class III railroads in this report.

SLOW ORDER - A local speed restriction on a rail line which is set below the track's normal speed limit. Slow orders are usually imposed by railway dispatchers for sections of track that are in some way deficient, or when there is a requirement to perform maintenance on a section of railway.

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ROADS



SCENIC TRAIL RIDGE ROAD IN ROCKY MOUNTAIN
NATIONAL PARK, COLORADO
SOURCE: BIGSTOCKPHOTO.COM



ROADS GRADE: C-

EXECUTIVE SUMMARY

Colorado's road conditions, although some of the most difficult in the nation to maintain due to the large number of mountain passes and elevation changes, are in better condition than the national average. In Colorado, 44% of roads are in good condition as compared to the national average of 28%. However, the natural beauty and economic opportunities that draw new residents to the state also lead to roadway congestion. While Colorado has some of the costliest maintenance challenges in the country, Colorado drivers pay approximately 13% less than the national average per gallon in gas taxes. As such, lower investments in operation, maintenance, expansion, and innovation to Colorado's roadways leads to additional costs to drivers. Costs borne by motorists for additional road repairs, traffic crashes and time lost in congestion is estimated to be \$7.1 billion annually, or as much as \$2,306 per driver in the Denver metropolitan area. Without an increase to the state's gas tax, which has not been raised since 1991, adequate resources will not be available to address surface transportation conditions or roadway congestion moving forward.

INTRODUCTION

Colorado’s roads create essential connections for the state’s residents. The state’s highways, interstates, and local roads provide visitors access not only to their homes and work, but to vital aspects of Colorado’s economy like shopping and recreation. A key resource in reporting the condition of Colorado’s roads is the Colorado Department of Transportation (CDOT), which is responsible for 9,077 centerline miles (22,970 total lane-miles) and handles approximately 32 billion vehicle-miles of travel (VMT) each year. Due to its extreme climate and topography, the state of Colorado has some of the most difficult roadways in the nation to maintain. CDOT manages thirty-five mountain passes, seven of which have elevations greater than 11,000 feet.

CONDITION

The Federal Highway Administration (FHWA) requires all states to evaluate and report the condition of their interstate and National Highway System (NHS) roads using the rating of good, fair or poor. These values are based on the International Roughness Index – IRI. TRIP, a national nonprofit organization that researches, evaluates, and distributes economic and technical data on surface transportation issues, further synthesizes the FHWA, IRI, and Present Serviceability Rating (PSR) to characterize the condition of the nation’s roadways. Table 1 describes the rating systems and overlapping thresholds that distinguish each category. Overall, TRIP recognizes that there is variance in the ways transportation officials may apply the indices, but in their 2018 report *Bumpy Road Ahead: America’s Roughest Rides and Strategies to Make Our Roads Smoother*, they acknowledge “the FHWA data are the only national source of pavement condition ratings based on a consistent criterion”.

TABLE 1: PAVEMENT CONDITION RATING SYSTEMS AND OVERLAPPING THRESHOLDS THAT DISTINGUISH EACH CATEGORY (ADAPTED FROM BUMPY ROAD AHEAD: AMERICA’S ROUGHEST RIDES AND STRATEGIES TO MAKE OUR ROADS SMOOTHER, TRIP REPORT 2018)

RATING NAME OR INSTITUTION	CONDITION CATEGORIES AND RATING SCALES			
	Good	Fair	Mediocre	Substandard (Poor)
International Roughness Index (IRI)	≤ 94	95 – 119	120 – 170	> 170
Federal Highway Administration (FHWA) using IRI rating	≤ 94	95 – 170		> 170
Present Serviceability Rating (PSR)	≥ 3.5	3.1 – 3.4	2.6 – 3.0	≤ 2.5

In 2018 CDOT reports that about 44% of interstate pavement in Colorado was in good condition while about 53% was in fair condition, and 2.5% was in poor condition. At the same time, CDOT explains that about 42% of non-interstate NHS pavement in the state was in good condition, 55% of such pavement was in fair condition, and 3% was in poor condition.

In TRIP’s 2018 report, the four-part distinction is made regarding roadway condition. TRIP reports that for major, locally- and state-maintained roads, Colorado has 44% good, 16% fair, 20% mediocre, and 20% in poor condition. Furthermore, these values disaggregate into urban and rural values. The major locally- and state-maintained urban roads and highways were categorized as 54% good, 8% fair, 11% mediocre, and 27% poor. When considering the rural areas, the larger values at the extremes of the urban context (good and poor) shift to the mid-range categories (fair and mediocre). The major locally- and state-maintained rural roads and highways are 36% good, 22% fair, 27% mediocre, and 15% poor. Overall, Colorado’s road conditions compare favorably to the national average of 28% in good condition, 39% in fair or mediocre condition (14% and 25%, respectively) and 33% in poor condition.



FIGURE 1: COLLAPSE OF US-36 (SOURCE: CPRNEWS)



While TRIP’s 2018 report shows the state’s values compare favorably to the nation, the condition of Colorado’s roads was thrust into the public eye with the collapse of the Eastbound lanes of US-36. 200 feet of road and a retaining wall were destroyed on the route that connects two of Denver’s largest economic and population hubs. After a quick 3-month construction fix, all of the lanes affected on US-36 are working according to their normal configuration.

In addition to CDOT’s road condition data, Table 2 reflects TRIP use of FHWA data within their synthesized rating system to categorize the road conditions for the state’s largest urban areas.

TABLE 2: PAVEMENT CONDITIONS ON MAJOR ROADS IN COLORADO’S LARGEST URBAN AREAS

LOCATION	POOR	MEDIOCRE	FAIR	GOOD
Colorado Springs	37%	25%	16%	21%
Denver	40%	28%	14%	18%
Northern Colorado	25%	26%	17%	32%
Grand Junction	32%	21%	15%	31%
Pueblo	49%	23%	13%	16%
Colorado Statewide	20%	20%	16%	44%

Table 2 represents TRIP's analysis of 2016 data on pavement conditions for major roads in Colorado's largest urban areas. While it reports that 40% are in poor and mediocre condition, a newly released update of the statewide model calculates the new value at 46%. These values are updated when newly reported information from FHWA, the American Automobile Association, and other sector partners is published (TRIP's finalized report forthcoming). Accordingly, TRIP has also updated calculations, based upon 2016 - 2018 data, for the additional vehicle operating costs (VOC) to Colorado motorists of driving on roads that are not assessed to be in good condition. These costs include accelerated vehicle depreciation, additional vehicle repair costs, increased fuel consumption, and increased tire wear. The additional costs borne by Colorado motorists are estimated to total \$2.6 billion, or \$637 annually per driver.

CAPACITY

Between 2000 and 2019, Colorado's population increased by 30% to approximately 5.6 million residents. Traffic congestion throughout the state has followed the same increasing trend. Similarly, Colorado's annual vehicle miles of travel (VMT) increased by 25% from 2000 to 2016, from 42 to 52 billion miles traveled annually. TRIP calculates the impact from congestion at approximately \$3.1 billion a year due to lost time and wasted fuel (see Table 3).

TABLE 3: ANNUAL HOURS LOST TO CONGESTION AND CONGESTION COSTS PER DRIVER (SOURCE: COLORADO TRANSPORTATION BY THE NUMBERS, TRIP REPORT 2018)

LOCATION	HOURS LOST TO CONGESTION	ANNUAL COST PER DRIVER
Colorado Springs	37	\$850
Denver	52	\$1,190
Northern Colorado	18	\$405
Grand Junction	11	\$229
Pueblo	12	\$270

Several major projects are attempting to ease congestion along the Front Range. "The Gap" Project will widen 18 miles of road on I-25 from Monument to Castle Rock. An effort to add additional lanes to I-70 West through Idaho Springs, a congested stretch of highway during peak ski-season, is also underway. However, CDOT's biggest transportation undertaking in decades began in summer 2019. This \$1.7 billion "Central 70" project aims to address congestion by reconstructing 10 miles of Denver's "main vein" to include new express toll lanes. This project took a long time to get under way due to a lengthy environmental permitting process which included environmental justice concerns.

OPERATIONS AND MAINTENANCE

In addition to the good, fair, poor reporting required by FHWA, in 2013 CDOT began evaluating driving conditions on pavements for different local jurisdictions to determine a roadway's Drivability Life (DL). Drivability Life is a means to maximize acceptable driving conditions for the driving public in the state. In other words, DL is a measure of how many years a highway will have acceptable driving conditions. This metric helps roadway authorities make better decisions about how to maintain the road quality expected by the driving public. CDOT's Risk Based Asset Management plan aims to have 80% of pavement as either high DL (greater than 10 years)

or moderate DL (between three and 10 years). For 2018, CDOT met its target with 89% of interstate pavement having a High or Moderate DL. CDOT also met its target in 2018 for the entire state highway system with 80% High/Moderate performance. Against average projected budgets for the surface treatment program, the predicted deficit for the next 10 years is over \$100 million per year. These measurements apply to CDOT maintained interstates and highways.

Each fiscal year, CDOT internally assigns a letter grade to evaluate the performance of overall and important areas of maintenance, such as snow and ice control. For FY 2019 CDOT set a target of B for its snow and ice control operations and achieved a score of B+, which was an increase from the B that was received in FY 2018. Currently, 48% of CDOT's annual operating budget is used to maintain the state's highway system. As the demands on the existing highway system increase, CDOT will have to use an ever-increasing portion of its annual operating budget to maintain the highway system.

FUNDING

CDOT's funding is generated through the assessment of state and federal gas taxes and user fees, such as vehicle-registration fees. Colorado's state gas tax is currently 22 cents per gallon and has not increased since 1991. The federal gas tax of 18.4 cents per gallon for gasoline and 22.4 cents per gallon for diesel, assessed in Colorado in addition to the state tax, has not increased since 1993. The total fuel tax in Colorado (both state and federal) of 40.4 cents per gallon for gasoline is approximately 13% below the national average of 46.7 cents per gallon. This is even lower than nearby states that have no mountain highways, which typically demand higher maintenance costs due to rock fall, mudslides, and avalanches.

In 2017, CDOT concluded a pilot study of another possible source of funding, the road usage charge (RUC). The RUC is essentially a VMT charge. A charge such as this will also allow electric and hybrid vehicles to pay their fair share of the public roads. Although the RUC model was well operated and showed strong support from pilot participants, political challenges have restrained further state-wide progress for pursuing this funding method.

FIGURE 2: FUEL TAX AMOUNTS IN OTHER STATES (SOURCE: CDOT)

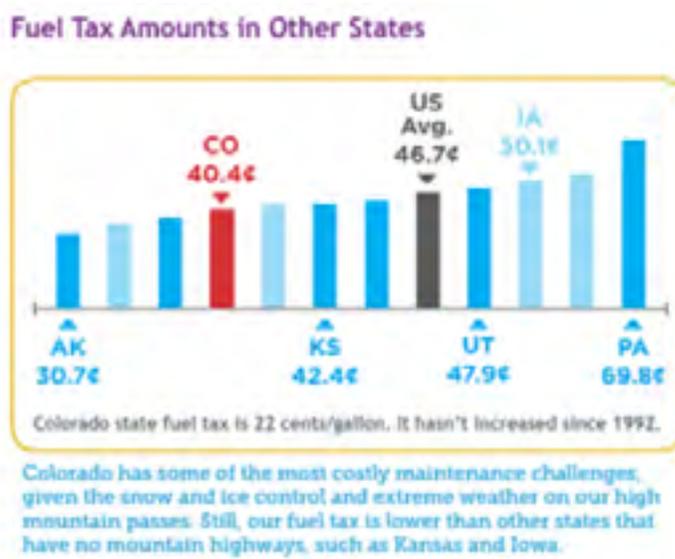


Figure 3 shows that Colorado is one of only twelve states that have not raised their state gas tax in two decades or more. Between state and federal gas taxes and user fees, Figure 4 shows that the average Colorado driver contributes \$209 to CDOT's budget annually.

FIGURE 3: WHEN DID YOUR STATE LAST RAISE ITS GAS TAX? (SOURCE: ITEP)

When Did Your State Last Raise Its Gas Tax Rate?

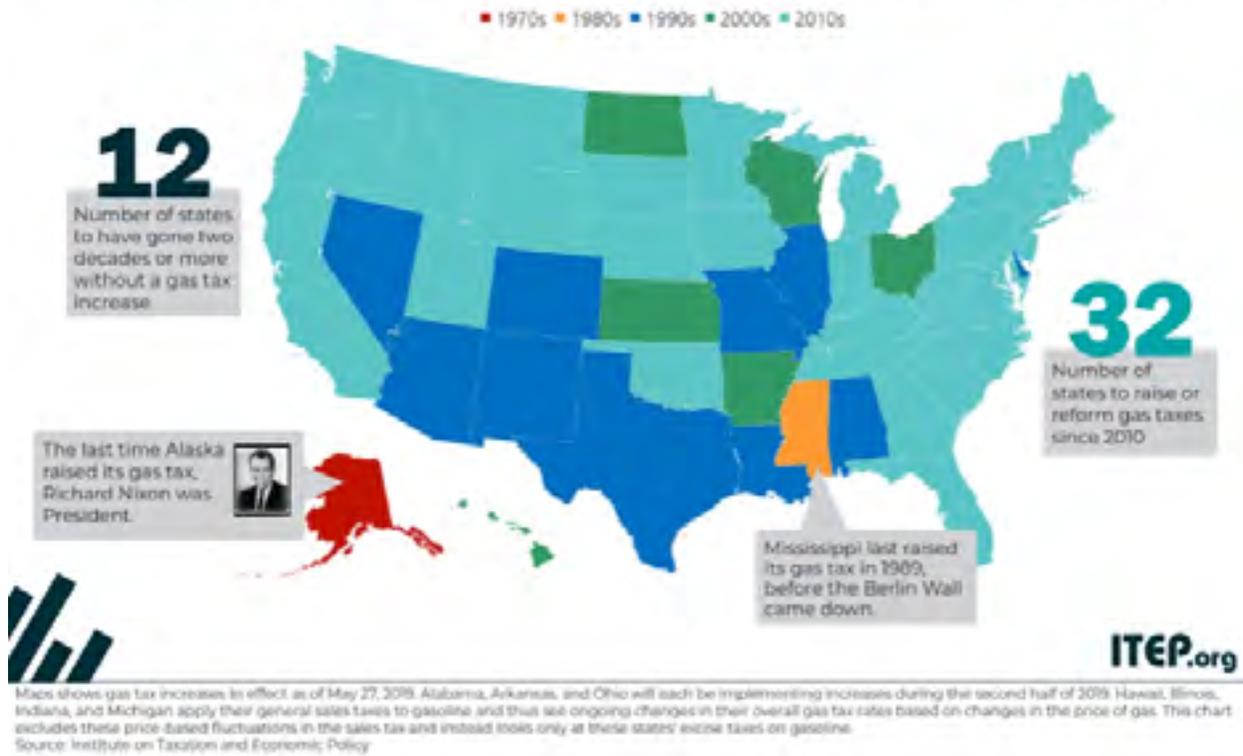
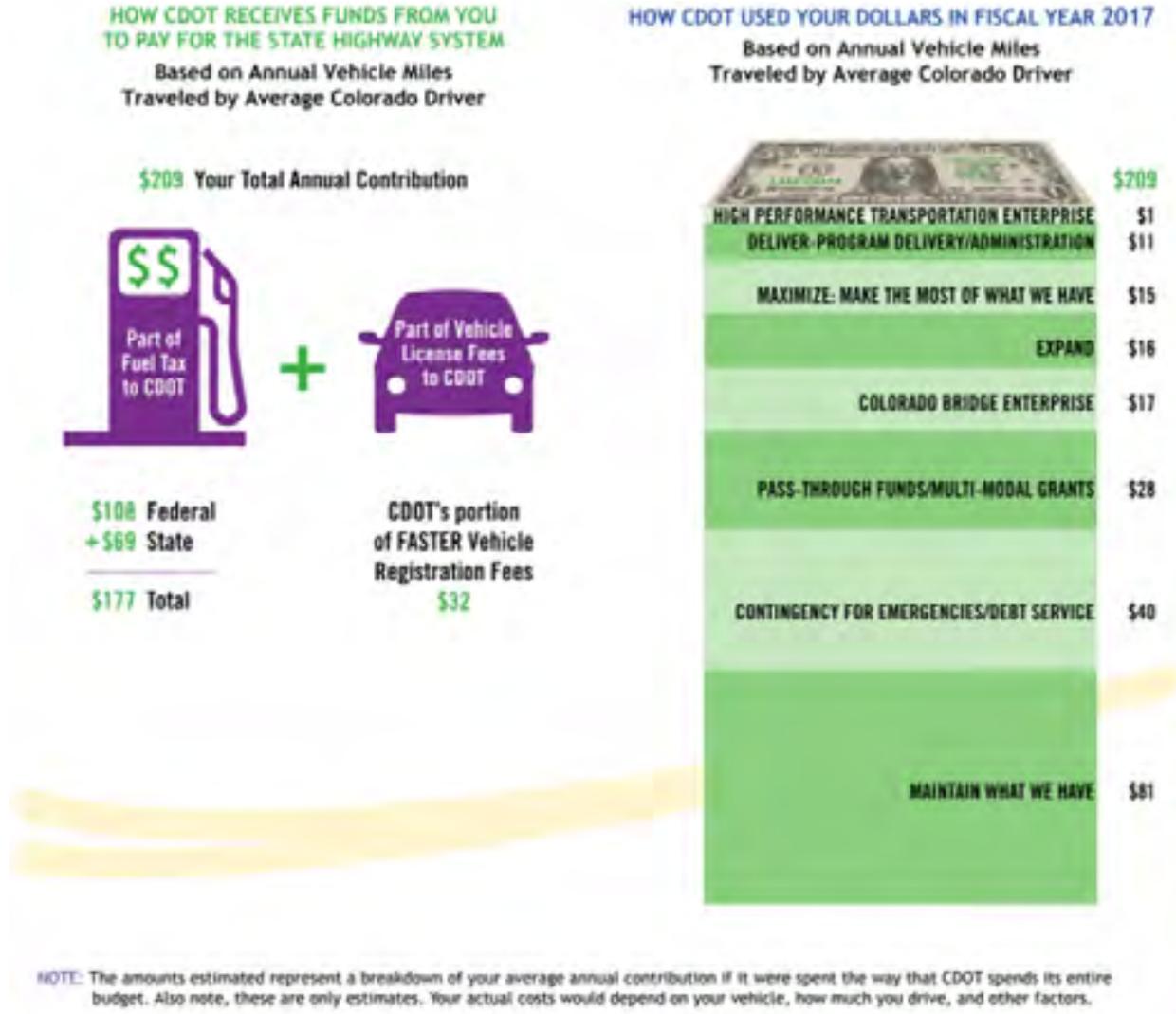


FIGURE 4: CDOT FUNDING INFOGRAPHIC (SOURCE: CDOT)



Because of the shortfall in transportation funding, some local municipalities have instituted local taxes to help meet the demands for transportation improvements. The Pikes Peak Rural Transportation Authority (PPRTA) was established in 2004 to raise local sales taxes for roadway construction, maintenance, operations, and transit. This sales tax raises over \$30 million annually for the communities of Colorado Springs, El Paso County, Green Mountain Falls, Manitou Springs and Ramah. The City of Colorado Springs also passed an additional city-wide sales tax that is set aside specifically for re-surfacing city streets.

The state of Colorado is in a unique position in the country with the passage of the Taxpayer Bill of Rights (TABOR) in 1992. This amendment to the state constitution requires any proposed new tax or tax increase be voted on by the state electorate. In November 2019, Proposition CC proposed allowing the state to hold onto revenues collected in excess of the TABOR formula and using it for transportation, K-12 education and higher education. Although the initiative garnered massive support from professional associations, unions, and government officials, it was rejected by voters. The inability of legislators to change tax policy and the unwillingness of voters to support measures increasing revenue has put Colorado's transportation system in a state of funding uncertainty.

FUTURE NEED

The Colorado 2040 Statewide Transportation Plan was adopted by the Colorado Transportation Commission in March of 2015. This plan projected \$46 billion in needs between 2016 and 2040, compared with a projected \$21.1 billion in available CDOT revenues over the same time period. This equates to a \$877 million gap each year until 2040.

Meanwhile, the state's population is projected to continue to grow to upwards of 7.8 million residents with 72.3 billion vehicle miles traveled in the state by 2040. CDOT has determined that improving travel time reliability is a more realistic goal than completely relieving congestion. CDOT's Transportation Systems Management and Operations division is charged with improving travel time reliability and safety along the state's highway system. Managed lanes, including High-Occupancy Vehicle (HOV) and toll lanes, are one tool currently being used in several areas of the state to improve travel time reliability. Tolloed express lanes are currently being constructed along I-25 through Douglas County and along C-470 to provide a reliable travel time to drivers who are willing to pay for this option. Managed lanes will also divert traffic away from the general purpose (free) lanes to improve the travel time for those highway lanes. Furthermore, CDOT is investing in multi-modal transit to reduce the number of personal vehicles on the state's roads to mitigate congestion. One example of this investment by CDOT is the Bustang regional bus service which provides transportation service between downtown Denver, Fort Collins, Colorado Springs and Grand Junction.

PUBLIC SAFETY

The total number of traffic fatalities in Colorado between 2012 and 2016 was 2,595. Traffic fatalities in the state, much like the nation in general, have increased in recent years with more substantial percentage increases from 2015 through 2017. In 2018, the number of traffic fatalities decreased from 2017 by approximately 2.5%.

TABLE 4: TRAFFIC FATALITIES IN COLORADO 2012 – 2016
(SOURCE: COLORADO TRANSPORTATION BY THE NUMBERS, TRIP REPORT 2018)

YEAR	FATALITIES
2012	472
2013	481
2014	488
2015	546
2016	608
2017	648
2018	632
Total	2,595

In line with the national average of 1.18 fatalities per 100 million vehicle miles traveled, Colorado's overall traffic fatality rate in 2016 was 1.17. The following year, the national fatality rate fell to 1.16 deaths per 100 million miles traveled. However, the state's fatality rate on non-interstate rural roads is more than double that on all other roads in the state (1.97 fatalities per 100 million vehicle miles traveled vs. 0.96).

The last "Crash Trend" analysis published by the Colorado State Police reported in 2014 that 19.4% of fatal and injury-prone crashes were caused by inattentiveness, 17.2% by excessive speeding, 13.8% by individuals driving under the influence (DUI), 12.8% by lane violation, 6.6% by failure to yield, and 29.9% by "other" occurrences. CDOT is employing several strategies to reduce traffic crashes and their severity. These strategies include implementing safety-specific infrastructure projects such as constructing wildlife fencing, rumble strips, and roadside guardrails; administering data-driven safety education and enforcement; and working with the motor vehicle industry to leverage connected and autonomous vehicle technologies.

RESILIENCE AND INNOVATION

Colorado has used several innovative designs and technologies to help relieve congestion and provide safer travel to the state's residents. Innovations in traffic congestion include improved traveler information to explain road closures and real-time detour suggestions. Colorado is also managing congestion through variable speed limits and managed lanes that can change with traffic volumes and conditions. Ramp meters, adaptive traffic signal control and transit signal priority are also being used. CDOT has installed remotely-controlled, Gazex avalanche mitigation and control systems that use specially constructed "exploder" nozzles to produce controlled avalanches. This system helps to prevent uncontrolled avalanches from blocking state highways. Colorado must remain innovative and continue to seek new designs and technologies to operate and maintain its highway system to meet growing and changing needs with limited resources.

CDOT has a program to provide a sustainable roadway network. Specific accomplishments that CDOT has achieved include using alternative fuel for their light vehicle fleet, installing electric vehicle traveler service signs, subscriptions to community solar gardens and using reclaimed asphalt pavement where appropriate.



ROADS



RECOMMENDATIONS TO RAISE THE GRADE

- **Increase funding at both the state and federal levels by raising the gas and diesel taxes and working towards implementation of a vehicle miles traveled tax.**
- **Increase local funding through use of sales taxes and location-specific efforts from regional transportation authorities, such as the PPRTA.**
- **Use life cycle costs assessments to clearly distinguish a project's true cost over its lifetime and to better evaluate the projects throughout the state that will provide the greatest benefit/cost ratio.**
- **Continue to invest in research to evaluate the benefits of technologies that improve congestion and safety such as autonomous vehicles, vehicle-to-infrastructure (V2I), and vehicle-to-vehicle (V2V) communications.**
- **Continue to implement managed lanes on corridors with recurring congestion.**
- **Adopt a “Hands-Free Law” to decrease traffic fatalities caused by inattentiveness (typically caused by distractions from personal communication devices)**

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SCHOOLS



RED BRICK SCHOOL BUILDING WITH AMERICAN FLAG WAVING.
SOURCE: BIGSTOCKPHOTO.COM



SCHOOLS

GRADE: D+

EXECUTIVE SUMMARY

The capacity and condition of Colorado's public schools have improved over the past five years. A number of new schools have been built. More recently, the Governor and state legislature have fully funded the Quality Basic Education (QBE) formula which benefits school facilities. More than \$1.14 billion in funding has been restored to the school system since 2015. Additionally, attention has been placed upon the future needs of schools, setting money aside for the inevitable growth to come. Colorado is slightly above the national average in terms of school construction capital outlays. The state spends \$19,502 per student on school construction, whereas the national average is \$19,454. This spending average stands to grow as the Colorado legislature voted to significantly increase available funding for school facilities and students on the FY 2019 appropriations bill.

CONDITION AND CAPACITY

In 2015, the Colorado State Legislature authorized the Division of Capital Construction to conduct a reassessment of the 2009 Public School Financial Assistance Assessment, now called “Facility Insight.” Public school facilities throughout Colorado are continuously assessed to determine their condition and adequacy for use. These surveys are a resource for schools for capital planning and funding. According to the Colorado Department of Education, “the school condition analysis includes all the major building systems – roof, plumbing, heating, etc. The adequacy survey examines how well the buildings function for their intended purpose.”

Since the reassessments began in 2016, 73 of 179 school districts have been fully assessed, while assessments for an additional 53 have been started but are not fully complete. Each school and its facilities are given a Facility Condition Index (FCI) score. The higher the FCI (on a scale of 0 to 1), the poorer the condition of the school facilities. The FCI score is considered in the allocation of Building Excellent Schools Today (BEST) grants (further discussed in the Funding section below). The average age and FCI of schools across Colorado can be found in Table 1 below.

TABLE 1: COLORADO AVERAGE SCHOOL AGE, SIZE (IN SQ FT), AND FCI

	State Totals			
	COUNT	SIZE	AVG. AGE	FCI*
School Buildings	2,834	128,865,336	39	0.37
Other Buildings	4,735	14,379,771	33	0.00
Sites	1,690	364,511,072.00	46	0.46
School Campuses	1,822	-	-	-

Source: CDE Facility Insight Dashboard

Most of the \$13.9 billion in capital construction needs facing schools are due to condition rather than capacity needs. As Colorado’s student population grew from 899,112 students in 2015 to 910,280 in 2017, the total number of schools also increased by 31 (from 1,857 to 1,888). Capacity needs can impact schools in high growth areas and in older schools that were not designed to accommodate newer classroom technologies, such as computer labs. Capacity thresholds are determined locally in each school district.

School districts across the state have even seen a decline in enrollment that has led them to defer expansion or new construction. At the end of the 2018-2019 school year, although Colorado counted a .1% increase in enrollment for the state, Jefferson County, Colorado Springs 11, Aurora Public Schools, and Pueblo 60 all saw enrollment drop by 500 students per district.

FUNDING

School funding is a complex issue and funding mechanisms and opportunities vary widely throughout the state. For the 2017-2018 school year, \$9.32 billion was spent on Colorado public schools, averaging to about \$10,191 per student. In the 2016 Annual Survey of School System Finances, Colorado ranked 37th in the nation for per pupil spending.

Furthermore, in the state of Colorado, school operating budgets are publicly funded primarily through property taxes, state taxes, local specific ownership taxes, and funding from the state general fund. This public funding puts schools on the same footing as other infrastructure components, and, in competition for the limited sources of funding. On average, less than 24% of a school's overall budget is allocated to capital construction and maintenance.

Since 2008, the state Capital Construction Assistance fund has received approximately \$880 million in revenue. Most of that revenue, approximately 69%, comes from State Land Trust Fund proceeds with the next largest portion from excise tax on marijuana products, accounting for 23%. The remaining 8% comes from lottery proceeds and interest. These state funds are typically matched with locally derived funds from property taxes or local bonds.

One of the biggest selling points for voters to legalize recreational marijuana in Colorado in 2012 was Amendment 64's inclusion of text that mandated tax revenues to go to public schools. Despite the passing of Amendment 64, the "pot tax" has not been the "silver bullet" to fix Colorado's school facility funding challenges as it promised. Only marijuana excise taxes — the tax on wholesale marijuana between a grower and a shop — are allocated for school infrastructure improvements. Over the past few years, the amount has fluctuated as Colorado continues to refine distribution of marijuana revenues. In 2017 and 2018, capital construction funding for schools from the excise tax was only allotted a capped amount of \$40 million. However, in 2017 a bill was passed to increase this amount to 90% of the revenues. In fiscal year 2019, \$58 million was brought in by excise marijuana taxes, \$52 million of which was reserved for public school infrastructure improvements. Although \$52 million is a significant sum for the average Coloradan, it pales in comparison to the estimated \$13.9 billion public schools were estimated to need in 2009 for infrastructure improvements. Figure 1 below illustrates the distribution of tax revenues from the sale of marijuana in fiscal years 2018-2019.

FIGURE 1: FY 2018-2019 MARIJUANA TAX REVENUE DISTRIBUTION



Source: Colorado Department of Education Marijuana Tax Revenue and Education Fact Sheet

Since reassessments began in 2016, roughly \$2.6 billion in capital needs have been identified. This equates to an approximately 46% increase in needs when compared to 2012 for the schools that have been assessed so far.

In most of the United States, local property taxes are the primary source of funding for public schools. However, the Gallagher Amendment adopted in 1982 severely hinders Coloradan schools looking to leverage local taxes. The amendment changed Colorado's property tax laws in many ways including freezing ratios and reducing assessment values, which has "disproportionately adversely impacted" the poorest schools in the state. According to Building a Better Colorado, "Coloradans only pay 1/4th as much as they used to pay in property taxes on their homes due to the Gallagher Amendment." The bottom line is that, with the Gallagher Amendment in place, local funding for schools will continue to erode until Colorado reaches the unsustainable point where the state and not the local tax-base will have to become responsible for the majority of school funding.

Colorado's BEST program was established in 2008 to allocate funding from the state Capital Construction Assistance Fund to provide "funds to rebuild, repair or replace the State's most dangerous and most needy K-12 facilities". The BEST grants, combined with district matching funds and other financing, have funded \$2.1 billion in projects since its inception in 2008. However, the program is oversubscribed, and has only been able to meet 45% of requests.

Examples of projects that received BEST grants range from the complete replacement of a school to more basic, but much needed, renovations. Mountain Valley School in Saguache, where "nearly every building system has failed", and "plumbing fixtures such as urinals can no longer be held in the wall" was awarded over \$27 million to replace the "school buildings with a new, safe, secure and healthy facility" (The Washington Post). Smaller examples include those like Community Prep Charter School in Colorado Springs, which was awarded approximately \$50,000 to upgrade an existing elevator system. Every grant recipient is required by statute to match funds based on a series of factors, from the district's funding abilities to per pupil spending. In the prior examples, Mountain Valley had a minimum calculated match of 29%, but received a waiver that lowered the required match to 12% (\$3.7 million), while Community Prep was required to match 61% (\$77,000).

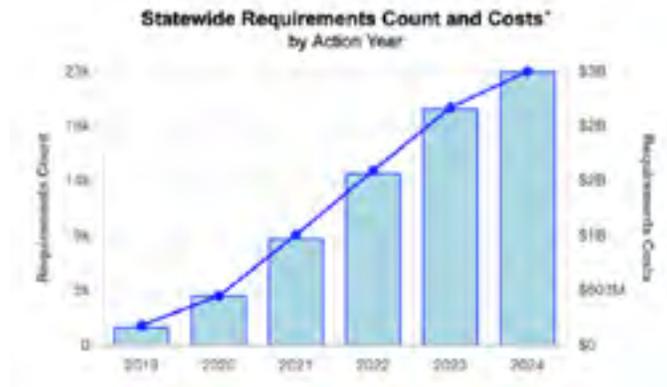
OPERATIONS & MAINTENANCE AND FUTURE NEED

The "State of Our Schools" Report by the Center for Green Schools analyzes operations and maintenance (O&M) and capital construction expenditures against needs trends across the state. In the Byers School District, which educated 563 students in 2016, approximately \$410,000 was spent in O&M from 2011-2013, compared to a recommended \$668,000, leaving a 39% funding discrepancy. Byers' annual capital construction investment from 1995-2013 was only 43% of what was needed. Denver School District, home to over 83,000 students, had a 27% gap in O&M spending and was only able to invest 38% of the funds needed for capital projects over the 2011-2013 time frame.

Colorado is unique in that funding discrepancies are not rural vs. urban, as evidenced above, but rather are driven by the tax bases within a district. Aspen School District 1 is able to spend nearly \$11,000 more per student annually than the neighboring Lake County School District.

Current and projected statewide required infrastructure costs for assessed schools can be found in Figure 2 below.

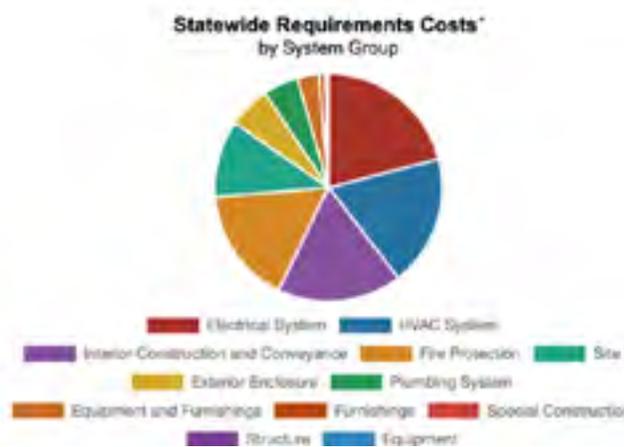
FIGURE 2: REQUIRED AND PROJECTED INFRASTRUCTURE COSTS FOR ASSESSED SCHOOLS



Source: CDE Facility Insight Dashboard

Schools such as Manzanola Elementary in Southeastern Colorado have caught the eye of Governor Jared Polis and even the national news due to its serious state of disrepair. A Washington Post article on the school describes the 95-year-old school’s “gaping cracks” in the walls, a lack of heat in the winter, and the presence of radioactive substances in the drinking fountain water. Many other schools face similar issues, with electrical and HVAC systems, interior construction (such as classroom renovation or adding security measures), and fire protection needing the most attention (see Figure 3 below). While schools in Aspen and Telluride flourish with state-of-the-art performance centers and technology in the classroom, those attending Manzanola Elementary struggle to get by due to funding shortages that desperately need to be addressed.

FIGURE 3: COLORADO SCHOOLS OPERATION AND MAINTENANCE NEEDS COSTS



Source: CDE Facility Insight Dashboard

PUBLIC SAFETY & RESILIENCY

Security and school-related safety measures are a major concern among students, parents, teachers, staff, and the general public. Colorado, a state devastated by five fatal school shootings, including the Columbine High School massacre in 1999, and a recent 2019 shooting at STEM School in Highlands Ranch, has provided over \$35 million for school security since the Stoneman Douglas High School shooting in Florida in February 2018.

Resiliency in schools is a property of both the school's infrastructure (the building) and the community itself. One of the issues relating both of these factors is the use, often unplanned, of the school buildings for shelters following an event. Colorado schools are subject to natural hazards including wind, snow, flooding and earthquakes. According to the FEMA P-1000 report, "a recent study of websites for every Colorado school district found a substantial rural-urban divide in terms of the information shared on the websites. Most rural schools had no emergency information available, at all, on their sites."

The St. Vrain Valley School District's resiliency was put to the test in September 2013 when flash flooding devastated the small community of Lyons, Colorado. Although the local elementary and middle/high schools escaped major damage, over 700 students were displaced by the inaccessibility of the area. However, because the School District had an updated Emergency Operations Plan in place before the disaster, classes resumed only nine days later at a make-shift school in a neighboring community. Students were able to return to their original schools in early December. Without the preparedness of the school district, the children of Lyons "could have faced many negative academic and emotional consequences as a result of being displaced and separated from their familiar school environment".



RECOMMENDATIONS TO RAISE THE GRADE

- **Require an Operation and Maintenance Plan for every school in Colorado to prioritize improvement efforts. The National Center for Education Statistics provides guidance for preventative maintenance, such as creating effective cleaning regimens, establishing an energy policy, and considering life-cycle costs with every new project.**
- **Mandate an O&M report process that includes a follow-up report for all non-routine maintenance activities to ensure activities have been adequately completed so facility assessments for the Facility Insight Program can be updated.**
- **Enhance efforts to educate voters on the limitations of the Gallagher Amendment and its constraints on funding for schools to bring it to the ballot for repeal.**
- **Redirect a significant amount of retail marijuana taxes to school infrastructure and the BEST program.**



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SOLID WASTE



AN IMAGE OF BLUE WASTE TRANSFER BINS AT A LANDFILL FACILITY. SOURCE: BIGSTOCKPHOTO.COM



SOLID WASTE

GRADE: C-

EXECUTIVE SUMMARY

Coloradans generated about 8.87 million tons of municipal solid waste (MSW) in 2018, of which approximately 80% was deposited in landfills — an amount that has plateaued in recent years. Municipal solid waste includes everything that is thrown into a trash can or recycling bin. Much of the transport and disposal of MSW is user-funded and managed by the private sector, and therefore is sufficiently funded. Capacity at this point in time is sufficient. However, of concern is that only 17.2% of MSW is diverted to recycling and composting facilities, instead of landfills. This diversion rate is much lower than the national diversion rate of 35.6%. There is a need to change the public’s perception of how solid waste is generated, managed, and potentially used as a resource. The solid waste sector in Colorado could benefit from more understanding that much of what is routinely discarded may, in fact, be reusable.

CONDITION & CAPACITY AND OPERATION & MAINTENANCE

In 2018, Colorado disposed of 8.86 million tons of MSW, compared to 8.34 million tons in 2017. The recent population growth in Colorado had been thought to be the reason for the large amount of waste produced, but when broken down into trash produced per person, Coloradans are still producing more waste than the majority of the country. The total MSW produced in Colorado translates to 6.8 pounds per person per day, with 5.6 pounds going to landfills and 1.2 pounds being recycled or reused. The national average is currently 4.4 pounds per day.

Although sometimes seen as a “green” state, Colorado’s recycling rates rank in the bottom half of the country. As of 2019, the national diversion rate was 35.6% while Colorado’s rate was 17.2%, an increase from 2017 with a rate of 12%. Before the increase this past year, recycling rates had been on the decline since 2012 when the state saw its highest rate in the last decade of 26.1%. As of 2017, the state had 178 recycling and 32 composting facilities. Information on these facilities can be difficult to find due to the lack of data collected throughout the state. As of this writing, there are 27 cities in Colorado that track a residential or citywide recycling rate. Meanwhile, there are difficulties for rural recycling programs such as higher transportation costs, lower material generation and tax base, and low population which limits curbside collection programs.

The state is attempting to address the low diversion rate by setting its first ever waste diversion goals. The current goal is to bring Colorado’s rate up to the national average by 2026. Beyond this, the hope is to reach a 51% diversion rate by 2036 for the Front Range region of the state, while the statewide goal is 45% by 2036.

There are currently 60 landfills operating throughout the state. The majority of larger landfills located in more populated areas are owned by private companies, while smaller landfills, primarily outside the Front Range, are owned and managed by local governments. In the more populated portions of the state, curbside pickup is the most common form of waste removal. In small towns, such as in the mountains, eastern plains, and more rural areas outside of the Front Range, citizens are responsible for transporting their own waste to the proper facilities. This is an area to potentially direct future funding and work to improve the convenience for citizens in rural areas to dispose of their waste and have better access to recycling and composting facilities.

With limited resources, the state is working to maintain and inspect all of its closed landfills. In 2018, the Closed Municipal Solid Waste Landfills Initiative began to inventory all landfills throughout the state that were closed after 1967 to get them in compliance with closure and post-closure requirements. These requirements include post closure monitoring of the landfill cap, groundwater monitoring and, as applicable, monitoring leachate and landfill gas. While it is understood this initiative is still in the beginning stages, there is not yet accurate data indicating how many landfills have been inventoried.

At the time of this manuscript, the capacity of Colorado’s landfills varies across the state. In Larimer County, the landfill will need to be closed by the end of 2024 when it reaches full capacity. There are many landfills that still have more than 100 years of life left, and even others applying for expansions that would allow them to continue for many years past their current capacity. Although there are areas of the state with a significant amount of potential space for MSW to be placed in landfills, Colorado should look to promote new uses for the waste to improve sustainability and resiliency.

FUNDING AND FUTURE NEED

The waste disposal industry operates largely at the local level with organizations, private sector companies and public or quasi-government organizations providing solid waste collection and/or disposal in Colorado. Exact numbers are hard to locate, and data collection could be an area where local agencies and governments invest.

The continued operation and maintenance of landfills and recycling facilities is generally self-funded through trash collection fees. In Denver, however, users are not charged for their trash collection. Other front range cities charge an average user around \$25 a month for curbside pickup. In some areas this includes recycling, while for others the service occurs at an additional cost. The City and County of Denver is currently working towards a pay as you go system which could help increase funding for recycling and composting facilities.

Currently there is a lack of funding for solid waste research and related seed capital. Funds are needed to make recyclable materials more marketable, to find innovative ways to manage MSW for a useful purpose (i.e. waste to energy) and to create new technologies that provide alternative pathways for solid waste rather than entering a landfill (e.g. anaerobic digesters or plasma gasification). Although progress is slow in this arena, it is just beginning and warrants further exploration to expand these technologies. Perhaps pilot programs could be tested in which these technologies are used to supply heat or energy for a small campus or a portion of Denver. Denver is unique as it historically was heated using cogeneration or “district heat” and could be used to test small scale anaerobic digesters or plasma gasification facilities. Funding mechanisms are also sorely needed to help transition Coloradans, local governments and the waste industry into recognizing MSW as a resource to be utilized than waste to be disposed.

As it relates to proper closure and maintenance of closed landfills, there may be a need for additional funding for the Colorado Department of Public Health and Environment (CDPHE) inspections. Much of the state oversight is funded through landfill licensing fees. The low diversion rate of recycling has been linked to the low tipping fees at landfills around the state. This means it is cheaper to utilize landfills instead of recycling facilities. Moving forward, decreasing recycling costs, or creating better incentives for municipalities to recycle, could increase the state’s diversion rates.

China, previously one of Colorado’s largest buyers of recyclable goods, began turning away recycled waste from America in 2018 to focus on cleaning up its own country. This leaves a gap in the market; there are now huge opportunities for companies to step up and begin to increase the amount of recycling facilities in Colorado. It is also now more important than ever to inform the public of what can be reused and recycled and how they can lower their consumption and total waste output.

PUBLIC SAFETY AND RESILIENCE

Non-hazardous solid waste facilities are regulated by federal and state agencies, specifically the CDPHE, Hazardous Materials and Waste Management Division. Their statutes regulate many of the common issues observed with landfills including location restrictions, liner requirements, leachate collection and treatment systems, groundwater monitoring requirements, and closure and post-closure care. Also of consideration is the need to evaluate groundwater surrounding landfills for emerging contaminants such as PFAS and PFOS to mitigate their impacts and prevent migration into drinking water sources.

Landfills throughout Colorado are currently particularly susceptible to natural disasters such as flooding and earthquakes, which can have impacts on groundwater, the surrounding environments, and public health in nearby areas. The management of MSW in landfills is also dependent on a fully functioning transportation infrastructure; without good roads, bridges or rail, solid waste collection may occur less frequently and effectively, posing threats to public health.

It is critically important that MSW management consider the overall resilience and sustainability of the industry. This includes maintaining the functionality of the landfills Colorado currently has as well as maintaining and improving recycling facilities. Beyond extending the life of the existing state landfills, the state needs to evaluate what ends up at landfills. As the state continues to grow in population, our reliance on landfills is not a sustainable option and, as a result, we should be looking to alter how we see MSW and how it is managed. Such options could include providing volume reserved to accommodate debris from natural disasters or, as discussed, working towards a higher diversion rate.

INNOVATION

Some Colorado trash companies are putting in extra work and money to make recycling a better option for the state. One example is Alpine Waste & Recycling, which shut down early in 2019 for a \$2.3 million makeover. The changes have allowed the facility to increase sorting speed by 33% and the amount of recycling it can handle by 31%.

Colorado NextCycle Program is also trying to help the state meet its new diversion rate goals by supplying grants to teams working on innovative solutions. Currently, the program has chosen nine different teams to receive \$5,000 grants to assist with research and development of their ideas and business plans. These teams will soon be submitting their refined business plans to compete for market-dedicated grants. One of the ideas presented includes building a processing plant to transform hemp and cannabis waste into fiber to use in a multitude of applications, while another aims to create a steel shredding machine to allow for in-house shredding of steel mattress coils.

In addition to these new ideas, investment in waste-as-resource alternatives such as anaerobic digesters, plasma gasification or technologies that convert plastics into fuel or energy should be the types of projects the state is looking for as the waste sector seeks to move forward.



RECOMMENDATIONS TO RAISE THE GRADE

- **State legislation should promote, fund, enhance, and facilitate the development of resource recovery facilities, including those for recycling, composting, reuse, and energy recovery, as well as policies that promote waste reduction.**
- **State legislation should look to launch a recycling market development initiative to attract and expand recycling businesses. The state should look to bring new “end market” businesses such as remanufacturers to the state, which will keep materials here in our local economies, create jobs for Coloradans, and reduce the pollution impacts of transporting materials out of state.**
- **Promote development of cost-effective recycling and sustainable waste handling options for municipalities, specifically in communities where scale and/or the use of older outdated systems make the process less affordable.**
- **Fund research for alternative uses of waste, including examining approaches used in other countries, specifically Denmark. Denver is unique as it historically was heated using cogeneration or “district heat” and as a result could be modeled after Denmark, which has installed relatively small community-based trash burning power generation plants that supply energy and heat. One of the largest waste-to-energy systems can generate up 25 megawatts of electricity and district heating for 120,000 or more homes.**
- **Evaluate the “Zero Waste” plans which look to eliminate MWS from entering landfills that have been implemented by Boulder, Fort Collins and others in the state to see what issues are preventing this goal.**
- **Change the way Coloradans think of solid waste beyond “garbage” or “trash,” to understand that “waste is not waste until it is wasted” through public education programs. The materials Coloradans routinely discard are potential resources.**



SOLID WASTE



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TRANSIT



COMMUTER TRAIN FROM DENVER UNION STATION TO DENVER INTERNATIONAL AIRPORT. SOURCE: BIGSTOCKPHOTO.COM



TRANSIT GRADE: C-

EXECUTIVE SUMMARY

In general, Colorado's transit networks have made consistent strides over the years, despite funding shortfalls. Parts of Colorado are home to award-winning rural transit agencies like the Roaring Fork Transportation Authority, which service a growing winter tourism industry. Meanwhile, ridership is growing on the Bustang, Colorado's state-owned and operated interregional bus system. In the Denver-Boulder metropolitan area, approximately 6.5% of workers take transit provided by the Regional Transit District (RTD). However, transit is not without its challenges. RTD's light rail ridership declined by 4.5% from 2014 to 2016, following a national trend. According to Colorado Public Interest Research Group, Colorado had a statewide funding gap of \$574 million per year for rural and urban transit. Facing funding shortfalls, some agencies and the state are forced to cut bus service, which in turn decreases ridership and increases operating costs. Robust and sustainable funding from the state is critical to the long-term health of transit in Colorado, which helps combat congestion, improves air quality, and provides mobility services to an aging population.

FUNDING

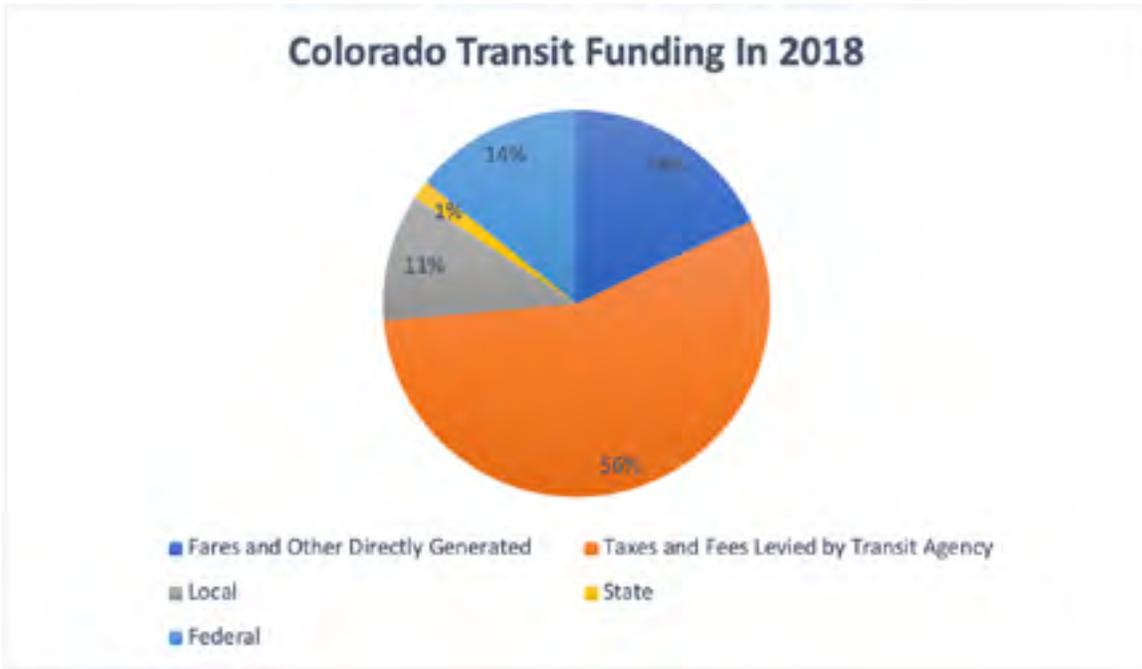
The money that is invested into Colorado transit comes from several sources, including federal, state, and local government funding and farebox revenue. While several federal agencies provide grants that invest in transit across Colorado, the majority of federal money comes from the Federal Transit Administration (FTA). This revenue is provided through a number of programs, including State of Good Repair Grants, the Bus and Bus Facilities Formula, and others.

The majority of state transit funding comes through the Funding Advancement for Surface Transportation & Economic Recovery (FASTER) program. FASTER provides a flat funding amount of \$15 million per year, which gets distributed to local transit agencies and statewide projects. Funding is provided to FASTER from the state gas tax of 22 cents per gallon, which hasn't been raised since 1991. The stagnant funding, coupled with a similarly stagnant amount of federal support, must work in concert to address growing state needs.

Additionally, local governments in Colorado provide a significant percentage of the overall transit funding. Local sales and property taxes, tourism or gas taxes, and vehicle registration fees, all serve as collection mechanisms used by local governments to fund transit throughout Colorado. Local government investment in transit is vital to the sustainability of Colorado's transit network.

Finally, farebox revenue, or revenue collected on behalf of passengers, provides an important source of revenue for transit agencies.

FIGURE 1: COLORADO TRANSIT FUNDING IN 2018 (SOURCE: TRANSIT.DOT.GOV)



Funding, particularly at the state and federal levels, is insufficient for total transit needs. Based on research conducted by the Colorado Public Interest Research Group, Colorado had a statewide funding gap of \$574 million per year for rural and urban transit. The Colorado Department of Transportation (CDOT) and local transit agencies have added capacity, and in some areas, improved service levels, but stretching available funding has its limits. Additional revenue to keep existing infrastructure and quality of service in good condition is imperative, especially as Colorado's population grows and congestion worsens.

CAPACITY & CONDITION

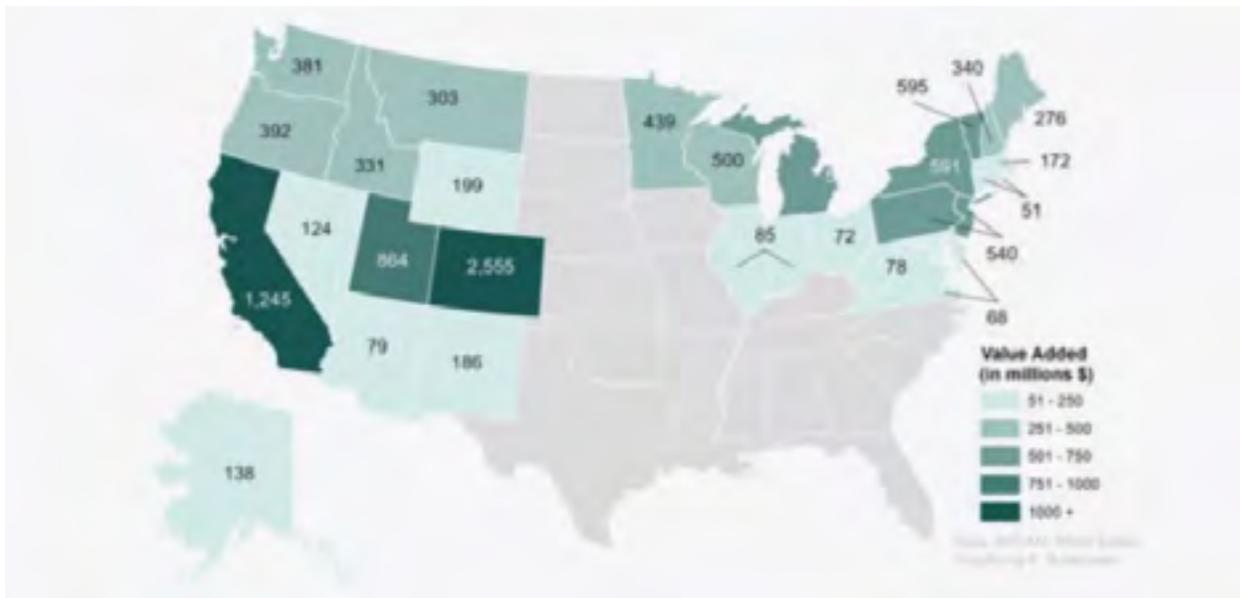
Colorado is performing slightly above the national average when it comes to transit miles traveled and ridership across the entire system. According to the 2017 FTA National Transit Database, Colorado ranks 18th in overall transit ridership in the United States. In 2016, Coloradans logged more than 14 million rural transit trips, which leads the nation. As Coloradans move further outside of urban centers, the need for regional transit services has and will continue to increase.

In every metropolitan area in Colorado, the regional bus transit network is seeing increased demand. Since the creation of Bustang in 2015, Colorado's state-owned and operated interregional bus system, "ridership has increased by more than 300% and provided service to more than 450,000 passengers". The overall network of regional buses operates lines that service the population from Grand Junction to Burlington and from Trinidad to Fort Collins. However, limited regional bus schedules impact transit agencies' abilities to meet the demands of a broad range of trips within Colorado.

Transit agencies also provide a significant service, not only to locals, but tourists as well. Colorado tourism provides 171,000 jobs, generates \$6.3 billion in revenue, and boasts the 8th largest share of leisure tourism in the United States. With 25% of tourists coming into Colorado to enjoy outdoor activities in the winter and summer, an efficient transit network plays a significant role in the Colorado tourism economy.

For example, the Roaring Fork Transportation Authority (RFTA) provides bus service to Glenwood Springs, Aspen, Snowmass Village, Carbondale and more. The bus network connects over 70 miles of relatively rural communities, supporting locals' and tourists' transportation needs. RFTA is the largest rural transit system in the U.S. and was voted "The Best Mass Transit System of North America" by Mass Transit Magazine. Additionally, transit agencies like Summit Stage, which offers free and reduced transportation to ski resorts, town centers, and lodging, annually moves 1.9 million riders. As the number of Colorado tourists trends upward, the need to expand transit services for this growing industry also increases.

**FIGURE 2: ECONOMIC VALUE ADDED BY WINTER TOURISM, 2016
(SOURCE: PROTECT OUR WINTERS)**



While the regional transit metrics are promising, light rail in the Denver metropolitan area is struggling. RTD's light rail network is the eighth largest rail system in the country, comprised of 58.5 miles of track, nine stations, and 66 total vehicles. Unfortunately, light rail ridership declined by 4.5% from 2014 to 2016, following a national trend. Declining ridership trends come after continued expansion of the network by RTD to reach more people. Since 2016, RTD has opened four additional rail lines and extended several others. When considering light rail and commuter rail, RTD's network now covers 98.5 miles of track and 71 active stations, and work is underway on an additional metro line that will connect Denver, Commerce City, Northglenn, Thornton and Adams County and the extension of others to Lone tree.

Despite these additions, the decline in light rail ridership highlights issues that present challenges to Colorado's transit system. Some areas of the Denver metropolitan area are sparsely populated, and the lack of density presents "first and last mile" connection challenges for those looking to take light rail and other forms of transit. Additionally, changing neighborhood demographics and the growing popularity of Transportation Network Companies, like Uber and Lyft, are thought to be adversely impacting transit ridership. In order for Colorado's transit systems to attract ridership and improve efficiency, transit agencies will need to come up with solutions that make transit more accessible and reliable.

FIGURE 3: POPULATION AND REGIONAL TRANSIT RIDERSHIP (SOURCE: CITY AND COUNTY OF DENVER)

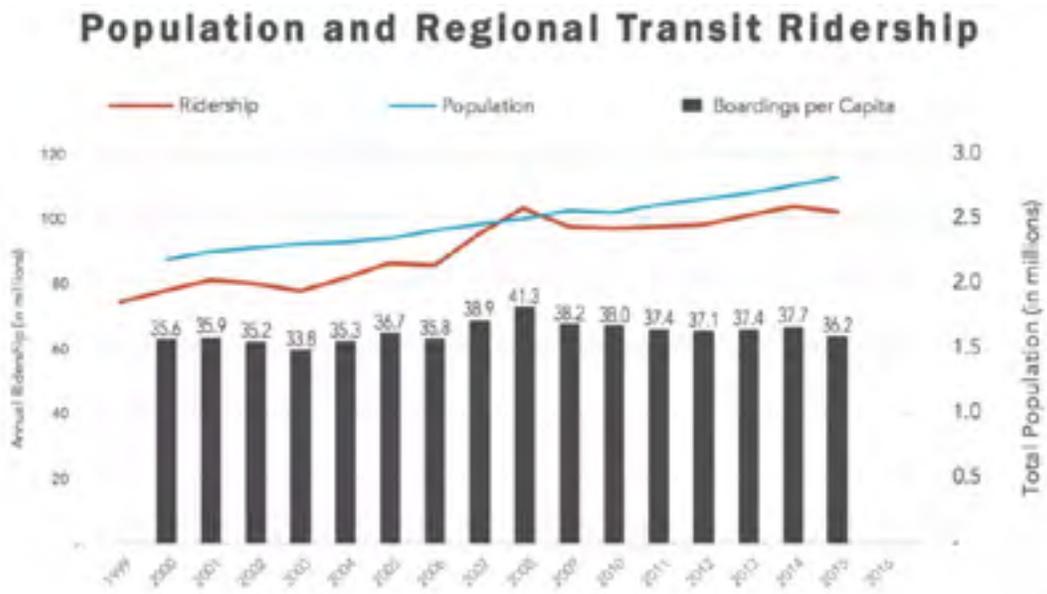
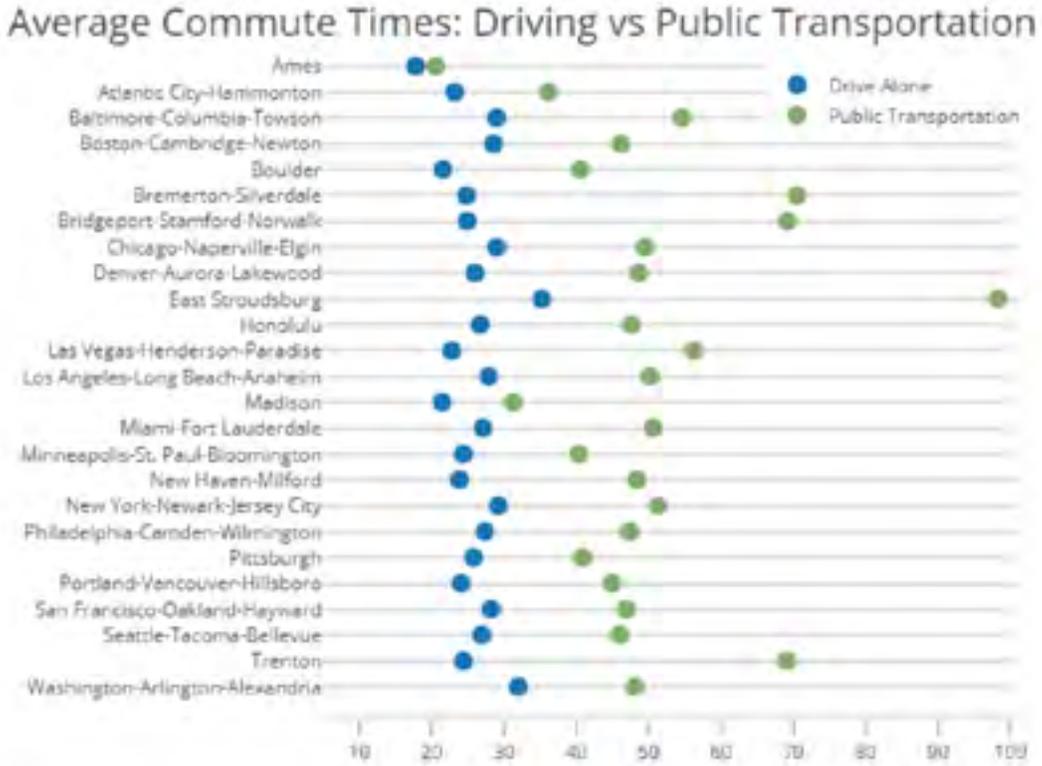


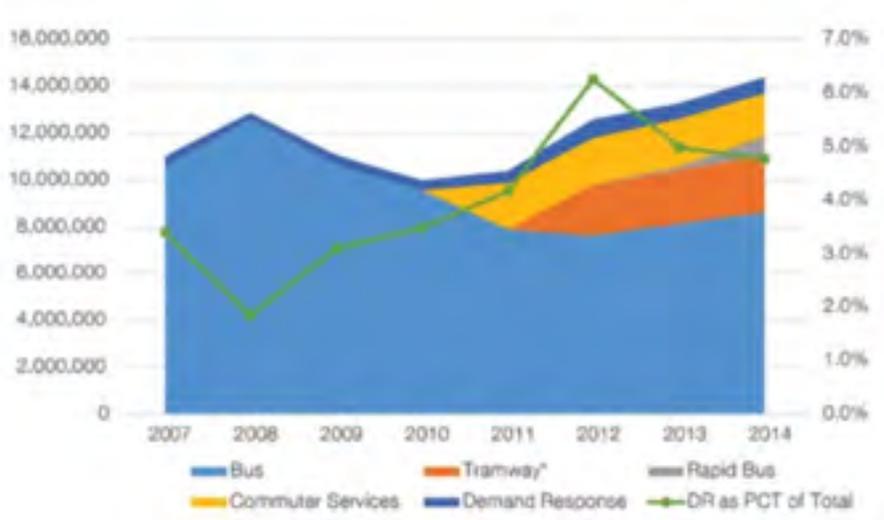
FIGURE 4: RIDING TRANSIT TAKES ALMOST TWICE AS LONG AS DRIVING (SOURCE: GOVERNING: THE STATES AND LOCALITIES)



Some rural areas are also struggling to provide adequate transit services to a growing number of riders. The vastness of rural areas desiring transit coverage contributes to transit deserts, which are areas where there is relatively high demand for transportation but a relatively low supply of transportation and supporting infrastructure. In areas like Morgan County, where the county utilizes public vans to transport passengers, the County Express transit agency “logged 1,489 trips in May with 1,534 riders who traveled a total of 16,019 miles.” As of 2018, the County Express operates 62 shuttle buses and vans, covering over 9,000 square miles of northeastern Colorado. The County Express is just one of many rural transit agencies that will continue to see an increase in demand from rural residents who need effective transit options.

Meanwhile, some rural areas are grappling with aging fleets and must contend with replacing buses in the midst of strapped budgets. Based on data from 53 out of 55 tier II Colorado transit agencies (agencies with <100 vehicles), out of 1,086 revenue vehicles, 27.7% are not in a state of good repair (SGR) and 301 vehicles are beyond their useful life benchmark. However, when considering tier II transit agencies’ total facilities, only 5.5% are not in a SGR.

FIGURE 5: PASSENGER TRIPS BY MODE – RURAL COLORADO 2007-2014 (SOURCE: NATIONAL TRANSIT DATA)



OPERATIONS & MAINTENANCE

Maintaining a high-quality transit fleet while keeping operation and maintenance costs low is vitally important in an environment where transit funding is scarce. Based on FTA’s National Transit Database data from 2017, Colorado ranks 31st in the nation in transit costs per hour, 29th in the nation in revenue fares per total operating expense, and 18th in the nation in cost per passenger mile.

PUBLIC SAFETY

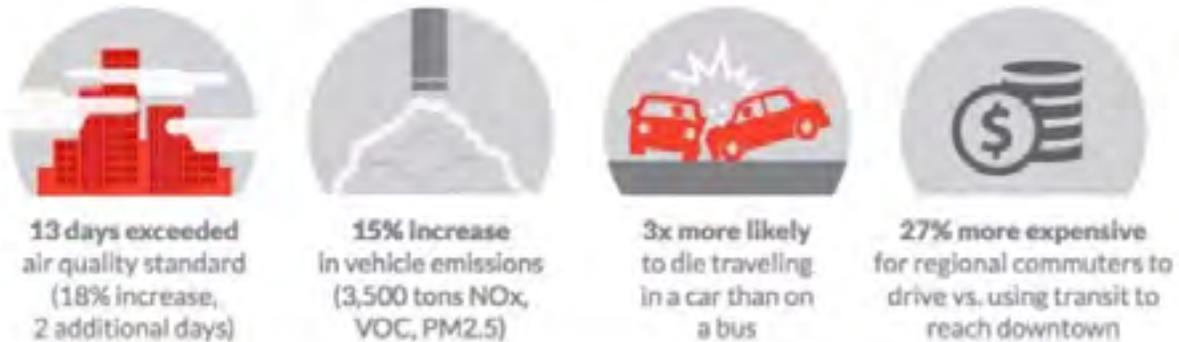
Transit in Colorado remains one of the safest modes of travel. Considering the millions of miles traveled, transit in Colorado has accounted for seven fatalities and serious injuries in 2018, according to the National Transit Association database. Furthermore, there were only 18 injuries to transit employees and operators. As our aging population increases, more and more elderly individuals will need to rely on safe modes of transportation. Oftentimes, especially in rural areas, transit is the only means of getting to medical appointments and doctor visits.

FIGURE 6: TRANSIT INFOGRAPHIC (SOURCE: REGIONAL TRANSIT DISTRICT)

More people drove in the Metro Denver region in 2015 than in 2010.



Transit use is better for the environment, safer for people, and less expensive.



RESILIENCE AND INNOVATION

As the transportation landscape continues its rapid transformation, Colorado transit must utilize innovative methods to move more residents, while remaining flexible to changes in technology and increasingly frequent and severe impacts from extreme weather. RTD was one of the first and largest transit agencies to utilize electric vehicles in its fleet, by purchasing 36 electric buses that service the downtown Denver area. In addition, CDOT is using \$14 million from the Volkswagen Settlement Trust to purchase 28 new buses that will serve Denver, Boulder, Colorado Springs, Fort Collins, Eagle County and Gunnison Valley. The adoption of more electric buses positions RTD to make progress toward the state's goal of reducing greenhouse gas emissions, while adding to the transit infrastructure.

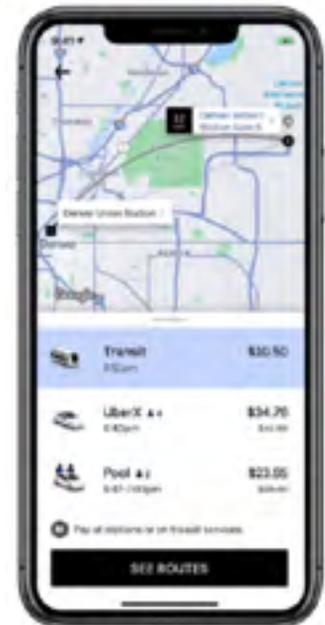
Furthermore, Colorado is exploring ways that autonomous vehicles (AV) can complement the state's transit agencies and fill gaps in service. Starting in January of 2019, RTD deployed the first AV bus in the state that connects passengers to several stops along a predetermined route. This project is possible because of a collaborative effort between RTD and Panasonic, in their attempt to create a Smart City Hub. Along with providing transportation, RTD is also attempting to get the public comfortable and familiar with the use of AV technology. While the scope of this accomplishment is relatively small, it is contributing to a proof of concept to help solve much larger transit issues in the future.

FIGURE 7: CITY OF DENVER AUTONOMOUS VEHICLE (SOURCE: RTD-DENVER, 61AV)



Lastly, rather than competing against Transportation Network Companies, transit agencies in Colorado are working with them to strengthen the state’s transit system. Uber, in coordination with RTD, allows users to purchase transit tickets, and “get real-time information and end-to-end directions right in the app.” This collaborative effort will make the use of transit more user-friendly and broadly accessible to the public.

FIGURE 8: TRANSIT OPTION ON THE UBER APP (SOURCE: RTD-DENVER, UBER COLLABORATION)





RECOMMENDATIONS TO RAISE THE GRADE

- In order to make the bus network more efficient, continue creating dedicated bus lanes, barrier-separated bus lanes, and transit signal priority.
- While light rail is an important factor in Colorado's transit network, its success is directly tied to the efficiency of the bus network. Therefore, channel transit funding into Colorado's bus network by improving bus infrastructure.
- Considering the popularity of regional and inter-city transit services, implement the State Transit Plan by creating additional regional bus routes and adding more regional buses thereby linking more Colorado communities together.
- Revise state law to allow state transportation funding to address various modes of transportation rather than only highway investments.
- To continue to be a national leader in rural transit ridership, provide a consistent annual state investment in the operation, maintenance, and expansion of rural transit.
- Continue researching the possibility of an inter-regional high-speed rail along I-25 and I-70. Since the cost of such a system would be significant, at \$21-30 billion, it behooves Colorado to ensure that investment dollars are spent wisely. However, if Colorado's population estimates prove to be true, the cost of building an inter-regional high-speed rail system will only grow if we wait for increased demand to be present before it is built.



TRANSIT



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WASTEWATER



ROUND BASIN WHERE THE WASTED
WATER IS BEING FILTERED
SOURCE: BIGSTOCKPHOTO.COM



WASTEWATER

GRADE: C-

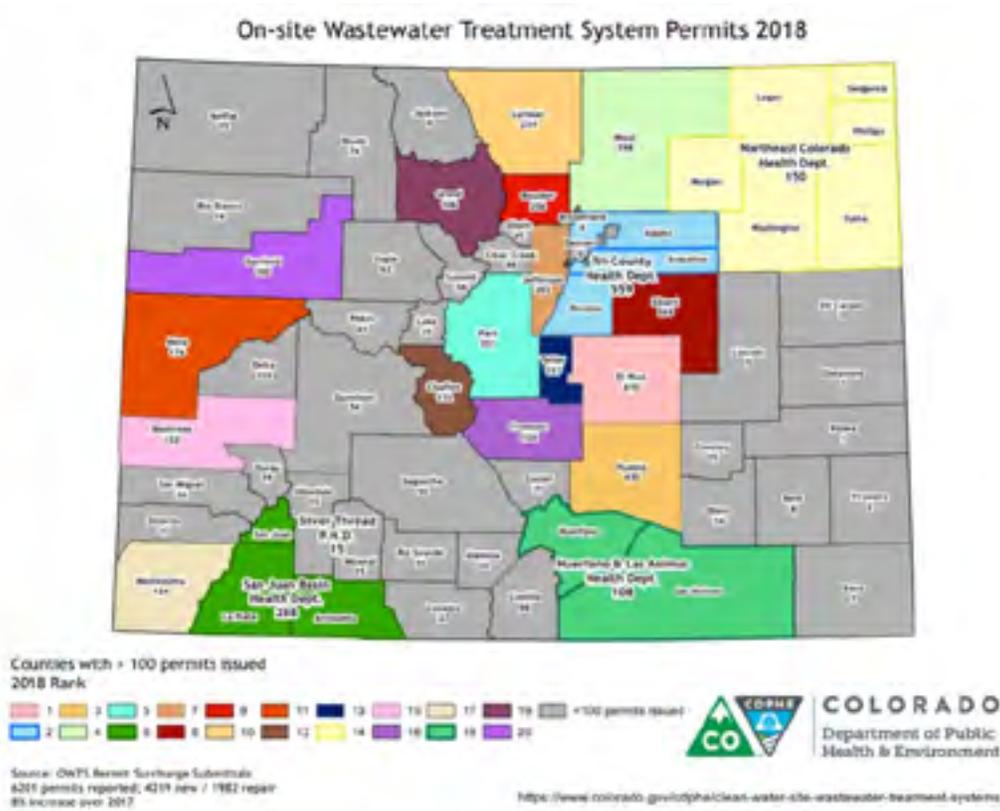
EXECUTIVE SUMMARY

Wastewater infrastructure is an often overlooked element of the infrastructure puzzle due to the lack of visibility and the public's common practice of taking the benefits of this infrastructure for granted. In Colorado, there are an estimated 16,000 miles of public sewers and approximately 10,000 miles of private lateral sewers. With population on the rise in Colorado and regulatory requirements continuing to tighten, improvements to maintain and replace aging systems and to improve treatment quality are needed. Funding for operation, maintenance, and construction of sewers and treatment plants remains at a deficit, with wastewater utility rates unable to cover associated costs and state and federal funding faring much the same. The U.S. Environmental Protection Agency (EPA) estimates that over a 20-year period, Colorado's wastewater systems will require \$4.69 billion to upgrade and maintain systems in a state of good repair. Fortunately, some utilities are increasing their levels of investment. Meanwhile, innovative use of treated wastewater provides an opportunity to increase available treated water to supplement the state's water supply, reducing water scarcity.

CONDITION AND CAPACITY

Colorado's largest metropolitan areas are served by only nine medium and large wastewater systems located in Pueblo, Colorado Springs, Littleton/Englewood, Denver, Boulder, Fort Collins, and Greeley. The population is trending toward centralized wastewater treatment systems with approximately 6,200 septic or private, on-site, wastewater systems noted in the state. The number of septic systems has grown by approximately 8% in recent years, although when compared to the state's overall population growth, the number is not seen as significant. The infographic, courtesy of the Colorado Department of Public Health and Environment (CDPHE), depicts Colorado's septic systems by county.

FIGURE 1: COLORADO SEPTIC SYSTEMS BY COUNTY



There are an estimated 16,000 miles of public sewers and approximately 10,000 miles of private lateral sewers in Colorado, per the Center for American Progress' 2012 and 2018 national surveys. Much of the collection system throughout the state is hampered by infiltration and intrusion (I&I), a process by which groundwater or stormwater enters into a wastewater collection system through damaged or worn pipes and appurtenances. Although there is no publicly available data for Colorado's rates, it is estimated that over 45% of flow into treatment plants is due to I&I. One problem caused by I&I is a higher than designed-for flow rate that can overwhelm lift stations and treatment facilities. The increased flow rates can also lead to decreased mechanical equipment performance and shortened equipment lifespans. The 2012 EPA Clean Water Needs Survey (CWNS) indicated that \$422 million was needed to address I&I and rehabilitation or replacement of wastewater pipelines.

Many of Colorado's wastewater treatment facilities were designed and constructed between 1950 and 1970, with numerous expansions and upgrades since that time. According to CDPHE, the average design life for wastewater treatment and conveyance facilities is 50 years, indicating that Colorado's aging facilities are nearing or are past due for investments in major overhauls or replacements. In preparation for needed upgrades, wastewater utilities have taken steps forward with planning and design. In fact, between 2016 and 2019, CDPHE has reviewed approximately 125 applications for wastewater facility design projects of all types and sizes. However, funding availability for the needed improvements remains a challenge.

Similar to drinking water, Colorado remains on solid footing regarding treatment plant capacity with a population of roughly 5.696 million producing around 1.6 billion gallons of wastewater per day. Treatment plant capacity collectively exceeds daily flows with an estimated 2.7 billion gallons per day in capacity available. One of the only treatment facilities in the state that has been contested as running at full capacity is a temporary EPA plant at Gold King Mine, built to clean a Superfund site on the Animas River. *For more on Superfund sites and cleanup efforts in Colorado, see the Hazardous Waste chapter.*

OPERATIONS & MAINTENANCE AND FUNDING

Wastewater infrastructure in Colorado is funded through a variety of mechanisms. These include the State Revolving Fund, CDPHE, the United States Environmental Protection Agency (USEPA), the United States Department of Agriculture (USDA) Rural Development, Colorado Department of Local Affairs, Colorado Water Conservation Board, Economic Development Administration Department of Commerce, National Rural Water Association, CoBank, Rural Community Assistance Partnership, U.S. Department of the Interior, Colorado Enterprise Fund, Army Corps of Engineers, and the Small Business Administration, as well as rate-based systems.

At this time, the primary source of funding remains the rate-based system. Utility rates in place across the state are not adequately meeting the wastewater infrastructure funding needs, and as such, projects needed to expand capacity, improve efficiency, and increase effluent and receiving water quality are being delayed.

The rate-based system requires end users to pay approximately \$4.51 per thousand gallons with a monthly minimum of \$12.32 in the city and county of Denver. Rates across the majority of wastewater utilities throughout the state are in a similar range. A tiered structure is used, such that large producers of wastewater pay a proportional fee for use of the wastewater service and infrastructure. For a three person household averaging 100 gallons of wastewater per day per person, Denver's rates would yield a wastewater utility bill of \$52.91 and compares to the national average of \$41.75 as noted by the National Association of Clean Water Agencies (NACWA).

Colorado Springs Utilities recently released the results of their industry-wide rate study and budget from 2019. A similar approach has been taken by several wastewater utilities throughout the state in which rates and spending on new projects have increased.

Despite a general uptick in revenue and spending, systems continue to require maintenance and replacement as they age. According to the EPA, \$4.69 billion is needed in Colorado over the next decade. Although new forms of funding have recently been unveiled by the federal government, namely the Water Infrastructure Finance and Innovation Act (WIFIA), Colorado has not yet been able to make use of the option.

Project funding through Public Private Partnerships (P3s) remains a topic of conversation within the state, although challenges to implement such project delivery remain. It is noted that beneficial reuse of conditioned methane from the digestion of wastewater solids presents an opportunity for P3s, with at least one project in current development in Colorado.



FUTURE NEED

The 2012 EPA CWNS indicated that Colorado wastewater utilities reported needs of \$800 million for secondary treatment and \$1 billion for advanced treatment for facilities serving populations greater than 10,000 individuals. While there is a lack of more recent data from the CWNS, these numbers demonstrate long-standing needs that stretch into the future.

While Colorado's population continues to grow at an average rate of nearly 10,000 individuals per month, without needed investments, the state's wastewater infrastructure can only withstand this pace of growth for a short time; capacity will begin to play a more dominant role in driving increased spending.

Beyond the anticipated shortfall in capacity, treatment plants must take strides in complying with state and federal regulations. The government regulatory process, even with input from the wastewater community, has yielded ever-changing effluent quality requirements which can take years to develop and implement. These regulatory actions catalyze research and the implementation of new technologies at wastewater utilities. However, without managers and operators from the wastewater community involved in the process, implementing new technologies and bringing treatment plants into compliance may be expected over an unrealistic timeframe.

Over the past three years, medium and large wastewater treatment plants throughout Colorado have primarily performed upgrades that improve nutrient removal, namely ammonia, nitrogen, and phosphorus, all of which are known to compromise the aquatic health of receiving waters. Of the wastewater treatment facilities across the state with greater than one million gallons per day (MGD) flows, 21 of 47 have been permitted for upgraded performance. The remaining treatment plants are noted to be working with the state to plan, design, and implement the required upgrades.

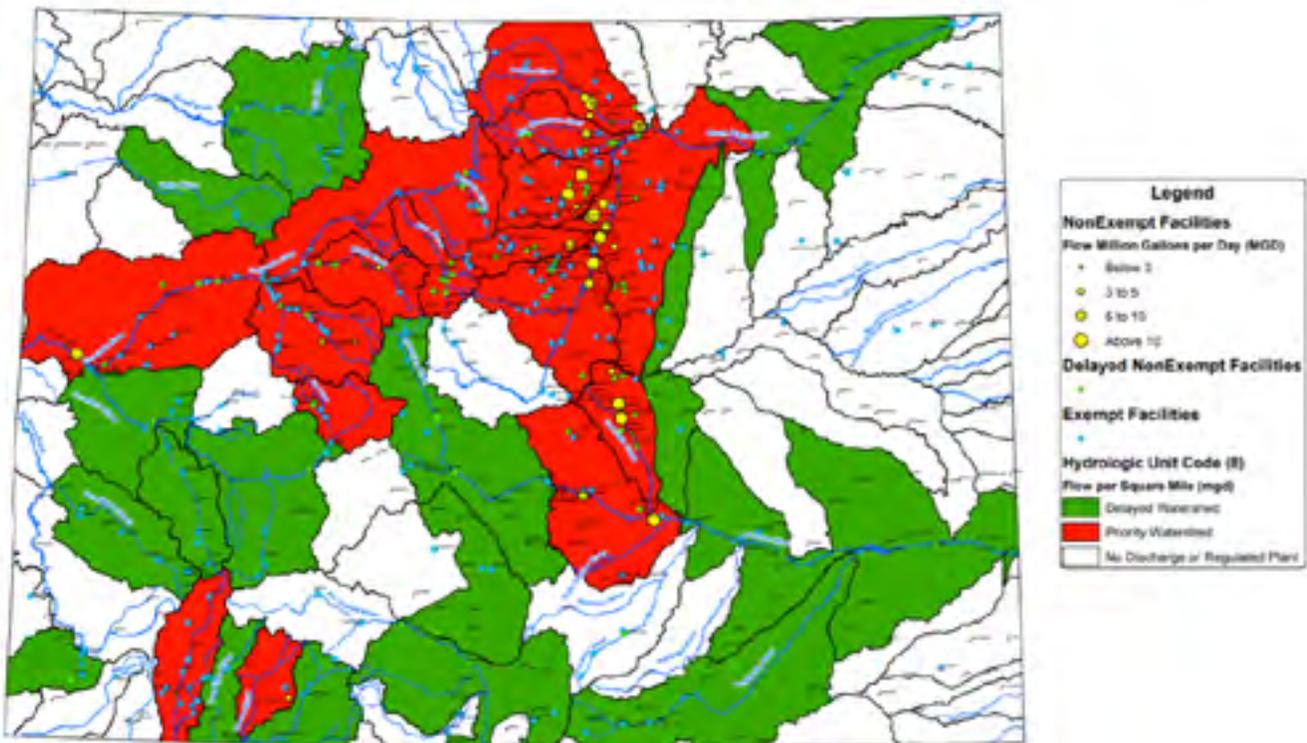


PROCESSED AND CLEANED SEWAGE FLOWING OUT FROM WATER RECLAMATION FACILITY TO A RIVER
SOURCE: BIGSTOCKPHOTO.COM

PUBLIC SAFETY

While the state has not recently reported any major public safety incidents, changing weather patterns increase the risk of flooding at wastewater treatment facilities due to their locations on river and stream banks. Refer to Figure 2 below for an illustration of facilities across the Northern Front Range on rivers and in watersheds.

**FIGURE 2: “STATUS OF WASTEWATER TREATMENT FACILITIES UNDER REGULATION #85”
(TO ILLUSTRATE EXTENT OF FACILITIES ALONG RIVERS AND IN WATERSHEDS)**



Flooding could contribute to combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs). However, these incidents do not pose significant threats for wastewater utilities across the state because modern design standards that separate wastewater and stormwater collection systems from treatment plants have been widely implemented.

RESILIENCE & INNOVATION

It is clear that innovative technology and alternative uses for treated wastewater will play a vital role in improving the resiliency to limited statewide water resources. As drinking water scarcity continues to pose a threat to Colorado's residents, various alternatives for wastewater treatment plant effluents are being considered or implemented. These options include direct potable reuse, indirect potable reuse, and non-potable reuse. Defining the aforementioned further: direct potable reuse uses advanced treatment processes to treat wastewater to drinking water standards, indirect potable reuse treats groundwater or surface to drinking water standards after it has been mixed with treated wastewater, and non-potable reuse treats groundwater or surface water to non-potable water standards after it has received treated effluent. An example of this innovation that, depending upon its final consumptive purposes, can be either indirect potable or non-potable reuse, is aquifer recharge; it involves injecting treated wastewater effluent into aquifers where the water can be withdrawn at a later point.

Non-potable reuse can be seen in action just outside of Denver where the Metro Wastewater Reclamation District (MWRD) and Denver Water participate in non-potable reuse. MWRD's treated wastewater effluent is discharged from the wastewater plant into the receiving waters of the South Platte River upstream of the intake for Denver Water's non-potable water treatment plant. Once the water from the river is diverted to the non-potable treatment plant, it is further treated and primarily used for irrigation throughout the City of Denver.

Despite a recent demonstration of direct potable reuse within the state, WaterReuse, an organization dedicated to beneficial reuse of wastewater, notes that there currently are no direct potable reuse projects in place in Colorado. The organization also reports that efforts to develop a regulatory framework necessary to adapt innovative reuse practices and technologies began in 2018, but may not be complete until sometime in the 2020s.

As the population continues to rise in the state, strategic planning and management of treated wastewater will continue to grow in importance. Forward thinking in regards to the state's ability to generate and beneficially reuse treated wastewater will serve to protect public safety by increasing Colorado's resiliency to periods of drought through the provision of an additional source of water.



RECOMMENDATIONS TO RAISE THE GRADE

- **Increase investment in wastewater infrastructure from state and federal government, private industry, or both.**
 - **Innovative approaches to funding including public-private partnerships and design-build-operate-maintain project delivery methods may provide avenues for generating larger capital improvement or operation and maintenance budgets.**
- **Continue to increase rates for commercial, industrial, and residential users where appropriate, such that more operation and maintenance and construction costs are able to be covered.**
 - **Bottom line costs for much-needed improvements in wastewater infrastructure simply cannot be met with 2019 rate schedules. Expanding outreach to improve public perception regarding wastewater treatment and how to fund projects may provide an increased ability to raise revenues at utilities across the state. However, municipalities should ensure subsidies and payment plan programs for low-income communities that cannot afford a rate raise.**
- **Continue to develop and implement technologies geared towards improving wastewater treatment with a focus on improved efficiency, sustainability, and nutrient and emerging contaminant removal.**
 - **Treatment process automation and control through the use of leading-edge instrumentation and programming lends itself toward reduced energy costs, longer equipment life, and improved effluent quality.**
- **Continue to pursue alternative uses for treated wastewater including direct potable reuse, indirect potable reuse, non-potable reuse, and groundwater or aquifer recharging.**
 - **Continued pursuit of a regulatory framework, approval, and oversight to pave the way for additional implementation of beneficial reuses of treated wastewater.**



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