

Background Paper
Economic Assessment of the Impact of
Proposed Douglas Mountain Ranch Mine
On Environment and Health

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Executive Summary

I first visited Empire, Colorado 23 years ago with my husband on our honeymoon. I immediately fell in love with the community. I should note that I have a Ph.D. in Economics. The final ten years of my career were spent evaluating projects for a US development agency, the Millennium Challenge Corporation. For many years before that, I was Lead Economist at the International Bank for Reconstruction and Development (World Bank).

The Douglas Mountain Ranch and Preserve requested a permit for a sand-and-gravel excavation and processing operation approximately one-half mile southeast of the town of Empire. The immediate objection to a gravel pit near Empire, Colorado was the fear that new gravel pit activity would create the same type of environmental destruction as the gravel mining operation at the Walstrum Quarry that is clearly visible from I-70 at the base of Floyd Hill. While it would be unfortunate for visitors expecting to see beautiful mountain landscapes to be met by a gravel pit instead, this is the least of the Friends of Clear Creek's concerns.

This economic assessment of the potential societal costs of the proposed gravel pit argues that there are a number of very serious risks associated with such a sand-and-gravel mine. The argument is not a standard cost-benefit analysis due to uncertainty about future impacts in each area of concern. In addition, indirect costs may not be fully mitigated by regulation even if all environmental and health regulations are meticulously followed. Regulations are not always up to date and sufficiently strong. And mistakes can be made. Once patterns of wildlife migration are disturbed, there may be no recourse to maintaining thriving herds. A single mistake could destroy one of Colorado's most important watersheds, destroying our natural resources and our economy.

We examine both the benefits and costs of sand and gravel mining and find that potential negative impacts under risk and uncertainty outweigh any benefits to highway construction from locating the mine at the Douglas Mountain Ranch site.

Potential Benefits of Sand and Gravel Mining: Increased economic activity and population growth in Colorado and the Denver area will naturally result in increased demand for sand and gravel for the construction and repair of roads and highways. The proposed gravel pit operation is forecast to produce 500,000 tons during each of the first three years and one million tons annually thereafter over 20 years. The bulk of the material mined is slated for construction in the Denver area. Recent research concludes, however, that accounting for the social costs associated with extraction, a mine that is farther away could actually be more cost effective. Further, the proposed gravel pit would not have a multiplier effect on the local

economy, as it would neither increase local employment nor add to business activity.

Risks to Vulnerable Wildlife: The bighorn sheep is Colorado's official animal and the symbol of Colorado Parks and Wildlife (CPW). The Georgetown bighorn sheep herd is one of the largest and most important in the United States. Even with mitigation measures in place, the risk of unforeseen consequences to protected Colorado wildlife is high. In addition to bighorn sheep, Peregrine falcons and elk herds are at risk. It is impossible to forecast to what extent vulnerable wildlife populations will or will not recover once habitat and migration patterns are disturbed. In the case of bighorn sheep, one single gravel mine could cancel years of careful planning instituted by the CPW and the US Forest Service to support the iconic Georgetown Bighorn Herd.

Risks to Vulnerable Water Resources: Even if the best mitigation measures are implemented, there is a non-zero risk of pollution and poisoning of Clear Creek watershed resources. As we know from past mining incidents, clean up is a very expensive process -- this is what helped create the Superfund for Clear Creek in 1983. Such a negative externality would ruin recreational industries such as fishing and rafting and present health hazards for household water use from the Clear Creek watershed, including nearby communities such as Golden. Colorado surely does not want to be another Flint, Michigan.

Vulnerability to Health Risks: Adverse health impacts from particulates and pollution result from gravel pits and would injure the most vulnerable populations in Clear Creek County -- children and the elderly. With more episodes of respiratory illness, children miss school days and report poorer test scores. While we cannot say how effective the mine's plan to reduce dust and particulates would be, or exactly which communities will suffer, we can say with certainty that any increase in illness or death is not worth the risk. In addition, with potential health risks, the Easterseals Rocky Mountain Village is likely to shut down, causing a substantial loss in revenue and services for Clear Creek County communities. Furthermore, the possibility of ensuing lawsuits could be expensive for both Clear Creek County and the mine owners and operators.

Real Estate Vulnerability: Current property owners in Empire could not have anticipated the shocks to property values that are attendant to sand and gravel pits. As a consequence, they are financially vulnerable to its impact. Median assessed property values in Empire, which are lower than Clear Creek averages, would fall by nearly 13 percent from \$213,199 to \$178,910 should the gravel pit be implemented. Total losses to Empire property owners in total would be in the range of \$4.4 million to \$7.2 million.

Additional Costs of Traffic Congestion: The expected average flow of 310 daily vehicle round-trips back and forth from Denver to Exit 232 on I-70 from mine operations -- primarily very heavy gravel dump trucks, will substantially increase

highway repair costs and greatly add to current congestion. Additional highway taxes from DMRM's trucks will not pay for the damage. Worsening congestion will present a risk to outdoor recreational tourism, including winter sports, constraining today's expanding economic activity in Summit and Grand Counties. This risk is too large to ignore, while its full effects may only become apparent after the damage is done – and cannot be undone.

Challenges of Rehabilitation: Restored mining sites are generally not as stable as they were before mining, even with the best of intentions. And they may be much worse off ecologically. This suggests that the justification for mining projects must be evaluated carefully in terms of total potential societal costs and uncertainties before going ahead. Unsuccessful reclamation combined with a series of risks leading to unintended consequences is the worst of all possible worlds.

While the risks of externalities to wildlife, water resources, health, real estate and traffic congestion cannot be estimated with precision, they are real and have potential negative outcomes that are additive with each contingency. The consequences of multiple sites of risk and vulnerability may well be costly for Colorado as a whole. If even one, let alone several negative outcomes occur, we will have failed our communities, our economy, and our environment.

Gravel pit locations could be developed with fewer externalities if they were situated (i) away from Colorado's most vulnerable wildlife and water resources, (ii) away from small vulnerable communities, and (iii) away from major interstate tourism routes. At this point mine owners and operators would be the only winners if the sand and gravel mine were approved. The losers would be Colorado wildlife and the environment, Clear Creek residents, travelers on I-70, CDOT, and Colorado tourism.

Analysis

Introduction

I first visited Empire, Colorado 23 years ago with my husband on our honeymoon. I immediately fell in love with the community. My husband, Albert Gillespie, first visited 61 years ago when his uncle Billy Bronson bought a summer home in Empire. It has been a family gathering place ever since. My husband has been looking forward to retiring in Empire for the past 40 years. When we purchased a vacation home thirteen years ago, we were thrilled to become part of this beautiful, healthful, welcoming mountain community. In 2013, we moved from our first house on Sunny Ave to our current address on North Main Street.

I should note that I have a Ph.D. in Economics. The final ten years of my career were spent evaluating projects for a US development agency, the Millennium Challenge Corporation. For many years before that, I was Lead Economist at the International Bank for Reconstruction and Development (World Bank). In both organizations the interaction of economic and environmental expertise was crucial in assessing the direct and indirect social costs of proposed projects.

The Douglas Mountain Ranch and Preserve (aka Douglas Mountain Ranch Mine - DMRM) requested a permit for a sand-and-gravel excavation and processing operation approximately one-half mile southeast of the town of Empire. This report, prepared in conjunction with Friends of Clear Creek, focuses on two of the documents (and annexes) submitted by the operators and their consultants, referred to as DMRM-July 2018 and DMRM-September 2018.¹

In recent years, constituents of many Colorado communities have been fervently opposed to the development of gravel pits close to their homes and schools. This has been the case in many other states as well, and for our neighbors in Canada. Like Empire, communities are not against development but rather against potential negative impacts and externalities that are a likely result of gravel mines.²

Perhaps the immediate objection to a gravel pit near Empire, Colorado was the fear that new gravel pit activity would create the same type of environmental destruction as the gravel mining operation at the Walstrum Quarry, owned and operated by Alfred Frei and Sons since 1982, that is clearly visible from I-70 at the base of Floyd Hill (see Photograph 1).

¹ The first document is titled "Douglas Mountain Ranch, March 2018, Revised July 2018,

² For example, Empire residents have been delighted to welcome Downstream Adventures sponsoring whitewater rafting trips on Clear Creek.

DMRM promised that Douglas Mountain would visually shield the mining operation from the south side and the location would provide a buffer on the north, so that the town of Empire, in general, would not see the site.³ However, DMRM also acknowledged that there would be areas not buffered or blocked from view. In particular, they state that residences on slopes or mountains above the project area are not “bufferable.” Those at these elevated locations would always be able to see the site from their property.⁴ Yet traffic from I-70 Exit 232 to and from Empire also has a clear view of the Douglas Mountain plateau!

Photograph 1: Walstrum Quarry



While it would be unfortunate for visitors expecting to see beautiful mountain landscapes to be met with a gravel pit, this is the least of the Friends of Clear Creek’s concerns.

Clear Creek County officials have recognized the benefits of growth in the *Clear Creek County 2017 Municipal Master Plan* and have outlined a development framework embracing eight guiding principles.⁵

³ DMRM-July 2018, page 19.

⁴ DMRM-July 2018, page 35.

⁵<https://www.co.clear-creek.co.us/DocumentCenter/View/929>

- Diversification - Support the efforts of the County to have a more diverse economic base.
- Employment – Support opportunities to expand the County’s job base.
- Supporting Local Governments and Sub-Areas – Support economic activity throughout the County, understanding the important role local governments and sub-areas play as economic centers.
- Tourism and Recreation – Support the role that tourism and recreation play in the regional economy.
- Mining and Resource Extraction – Support the continuation of mining and broadening the opportunities for resource extraction
- Transportation – Support systems that create a “backbone” for regional economic activity.
- Infrastructure – Support the development of infrastructure that facilitates economic development, and where it demonstrates a net benefit to the County.
- Investment – Support investments in economic development only where it demonstrates a net benefit to the County.

While Clear Creek priorities appear to be roughly in concert with those of the citizenry concerned, Clear Creek residents give environmental issues far greater prominence.⁶

It is important to recognize that not all principles and goals may be achievable simultaneously. The proposed DMRM is a clear example of a case in point where trade-offs need to be made. As we shall show, there are conflicts between the desire to encourage mining and resource extraction and the goals of improving regional transportation and encouraging tourism and recreation -- a prime attraction of Clear Creek County and the ski and vacation resorts further west. Finally, there is a conflict between the DMRM and supporting local interests of the town of Empire.

Our economic assessment focuses specifically on externalities -- costs that are not directly born by the project or business concerned. There are environmental and epidemiological costs that private companies do not bear unless they are mitigated, often as a result of government actions. In fact, the state of Colorado has numerous

⁶ According to the 2010 Clear Creek County Citizen Survey, “About 9 in 10 respondents thought it was “essential” or “very important” to keep the scenic beauty of Clear Creek County (92%), to protect air and water quality (92%) and to preserve natural areas, habitats and open land in the county (87%). Approximately three-quarters gave “very important” or “essential” ratings to preserving ‘small town’ character (76%) and enhancing public spaces, parks, and trails (73%). Roughly two-thirds reported that it was at least “very important” to reduce energy usage (66%), encourage renovation and improvement of existing commercial areas (66%), preserve historic homes and buildings (64%) and support responsible mining (63%).” <https://www.co.clear-creek.co.us/DocumentCenter/Home/View/1021>

standards that newly proposed mining operations are subject to, including noise, pollution, wildlife conservation, water, and site remediation to protect resident populations and fragile mountain environments. But not all externalities are necessarily reduced or completely eliminated.

Our economic assessment of the proposed DMRM is posed in terms of risk and vulnerability.⁷ In terms of risk, we assess what would happen if desired outcomes are not obtained – in other words, the possibility that Colorado mining standards do not fully control negative externalities and that unforeseen consequences result. We may even be faced with the now well-know possibility of a Black Swan – an unpredictable or unforeseen event with extreme consequences.⁸ In terms of vulnerability, we are looking at the degree to which a population or environment is unable to cope with and/or recover from the impact of an unanticipated risk.

In making an economic assessment of the potential societal costs of the proposed DMRM sand and gravel mine under uncertainty (risk), the following areas are addressed

- The Benefits of Sand and Gravel Mining
- Risks to Vulnerable Wildlife
- Risks to Vulnerable Water Resources
- Health Risks and Vulnerability
- Real Estate Vulnerability
- Additional Costs of Traffic Congestion
- Challenges of Rehabilitation, and
- Lessons Learned about Risk and Vulnerability

The argument made is not a standard cost-benefit analysis due to uncertainty in each area of concern. Further, indirect costs may not be fully mitigated by regulation even if all government rules are meticulously followed. For example, the fact that the DMRM is located close to Empire raises an additional issue of risk and vulnerability, as many Empire property owners will face reduced real estate values upon the sale of their properties. In addition, as Clear Creek County is a gateway to one of Colorado’s most important industries – outdoor recreation, direct mine regulation cannot erase the risk to tourism caused by increased traffic congestion on I-70. The final section of the report summarizes our findings and identifies winners and losers.

⁷ The World Bank uses a similar framework in the consideration of its projects. For example see the current project page on the World Bank’s website: <https://openknowledge.worldbank.org/discover?scope=%2F&query=vulnerability&submit>

⁸ Black Swan terminology became popularized with the 2008 Great Recession, as most economic analysis had not predicted the precipitous stock market crash.

The Benefits of Sand and Gravel Mining

Sand and gravel are used for the construction and repair of roads and highways. Increased economic activity and population growth naturally result in an increased demand for this product. Thus, it is no surprise that Empire Aggregates is interested in the Douglas Mountain Ranch site for a sand-and-gravel pit, as Colorado has been one of the fastest growing states in the country, with the Denver area mirroring Colorado's growth on the whole. Since 2016 Colorado has added somewhat over 77,000 new residents, increasing the state's population to more than 5.6 million. Denver added nearly 10,000 residents from July 2017 to July 2018, with its population reaching nearly 705,000 residents. (Those strong figures notwithstanding, a recent Denver Post analysis suggested that growth in Colorado had slowed from 2.8 percent in 2015 to below two percent in 2018.⁹)

According to DMRM–September 2018, the gravel pit mining operation will follow the production schedule provided in Table 1, indicating that the mine will produce 500,000 tons during each of the first three years of start-up and one million tons annually thereafter over 20 years, totaling 10.5 million tons of gravel between 2018 and 2031.¹⁰ At one million tons production, DMRM estimates income of \$1,780,515,¹¹ of which \$598,900 would be from road base and \$1,181,615 from crushed stone.¹² The permit area requested is 68 acres.¹³

Sales of construction aggregates in the United States have been forecast to expand at a 2.9 percent annual rate through 2019 to 2.8 billion metric tons, recovering from the steep declines that occurred as a result of the 2007-2009 economic recession. In 2015, the latest data available from the United States Geological Survey, there were 254 active construction sand and gravel operations in Colorado and 385 active pits. In addition, there were 118 portable processing plants. These operations produced 33.8 million tons of sand and gravel in 2015 and 35.8 million metric tons in 2017, an

⁹ Jon Murray, Denver Post, March 22, 2018, on line.

¹⁰ Unfortunately, the totals on Table 1 do not add up either in terms of years or production. Further, DMRM-July 2018 indicates that a minimum estimate of 15 million tons of sand and gravel would be removed over a period of at least twenty years.

¹¹ DMRM–July 2018, Appendix 2.

¹² Crushed stone is made from rocks that have been broken down by machines called crushers, giving the stones more angular surfaces. Gravel, on the other hand, is produced by the natural processes of weathering and erosion, and typically has a more rounded shape versus the angular surfaces of stone. Crushed material would be used as a base to lay concrete.

¹³ See DMRM–September 2018, Exhibit A. However, this figure is internally contradicted in the Introduction of the same document that states that the total permit area is to be 68.2 acres. The revised July 2018 document specifies that there are two project areas of which 3.5 acres will be the access road and 70 acres will be for the construction materials operation. Remaining acres of the total 161-acre parcel will be for properties and undisturbed areas.

increase of 2.8 percent over a two-year period. The U.S. has the highest usage rate of crushed stone of any country in the world, when measured as a percentage of total aggregates demand, accounting for 55 percent of sales in 2014, according to the study.¹⁴

Table 1: Projected DMRM Production Schedule

Description	Mining Time		Material Quantity	
	Initial mining of the site. Production ramp up as the pit comes online.	2018-2020		1500000
Mining and reclamation under full operation. Mining proceeds north and west from the initial cut in the southeast corner of the site	2020-2029		9000000	Tons
Final reclamation of the site. Revegetation of last portions of disturbed ground and removal of all portable equipment from the site. Two years of vegetation monitoring prior to release of bond.	2029-2031		4000000	Tons
Total	20	Years	10,500,000	Tons

The DMRM documents indicate that the bulk of the material mined will be used for construction in the Denver area.¹⁵ Typically gravel mining operations prefer to have their final product delivered close to the source as sand and gravel are low value products and expensive to transport due to their weight. Likely this is one reason why the site close to Empire is attractive to the developers.

However, recent research evaluating transportation costs against negative externalities concludes: “when accounting for the social costs associated with extraction, attaining gravel from a mine that is a greater distance away may be more cost effective.”¹⁶ In other words, “This research thus challenges the common perception that the low unit-value of gravel in combination with its high transportation cost necessitates its extraction in close proximity to its market.”

Further, stone quarry mining may use less space and have less of a negative impact on Colorado’s mountain scenery.¹⁷ Aggregates from recycled sources also have been

¹⁴ <http://www.acgmaterials.com/study-u-s-aggregates-market-hit-2-8-gt-2019-2/>

¹⁵ See DMRM-July 2018, p 12.

¹⁶ Campbell, Brett Afton. 2014. “Aggregate Resource Extraction: Examining Environmental Impacts on Optimal Extraction and Reclamation Strategies,” Masters Thesis, Agricultural and Resource Economics, University of Alberta, p. 60.

¹⁷ <http://coloradogeologicalsurvey.org/mineral-resources/industrial-minerals/aggregate/>

used more frequently in recent years, particularly in large urban areas.¹⁸ Aggregate production away from residential areas is clearly desired by communities in Colorado, as evidenced by objections from citizen groups, such as Friends of Clear Creek.¹⁹

New businesses in a community often have a multiplier effect for the local economy by increasing employment and paying higher wages than would otherwise apply. In that regard, DMRM–July 2018 suggests that the proposed mine will benefit Clear Creek County as “local operators, employees and contractors will use local businesses (restaurants, gas stations, etc.) and generate county tax revenue.”

This is unlikely, however, as only 20 potential employees will operate the DMRM, scarcely creating significant employment generation or a significant increase in commerce for Clear Creek.²⁰ There is little reason for truck drivers to fill-up on the way to the mine or stop for refreshment. Trucks can easily make a round trip to Empire Junction from Denver without making any purchases on the way.²¹ Gas stations in Dumont, Idaho Springs, Empire, and Georgetown are not likely to benefit – nor could they necessarily accommodate the seriously expanded truck traffic.

While the provision of construction materials is crucial to upgrade our roads and highways, DMRM is not necessarily the best or only way to achieve that goal given the risks, vulnerabilities and negative externalities discussed below. Furthermore, the DMRM is unlikely to provide substantial employment or other economic benefits to Empire or Clear Creek County.

Risks to Vulnerable Wildlife

The fundamental goal of the Colorado Division of Wildlife (CDW), and for Colorado as a whole, is to secure wildlife populations so that they do not require additional protection. Colorado’s wildlife requires careful and increasingly intensive management to address environmental concerns and safeguard recreational opportunities. CDW indicated that the proposed location of the DMRM could

¹⁸ Nonetheless, recycled aggregates cannot be completely substituted for natural aggregates in all applications. <https://pubs.usgs.gov/of/2000/ofr-00-0258/ofr-00-0258so.pdf>

¹⁹ “As northern Colorado grows, so do clashes over proposed gravel pits.” October 17, 2017. <https://www.coloradoan.com/story/news/2017/10/27/northern-colorado-proposed-gravel-pits-johnstown-laporte/804432001/>

²⁰ By contrast, the Walstrum Quarry now employs about 40 full-time workers. <https://www.pitandquarry.com/gallery-albert-frei-sons-walstrum-quarry/>

²¹ There would be no benefits to Empire as there is not sufficient parking for huge trucks to get fuel and/or refreshments. Empire’s facilities primarily cater to family tourism and local diners.

adversely impact three potentially endangered species: (a) the bighorn sheep herd, (b) the Peregrine falcon-nest buffer, and (c) the winter elk range.²²

The bighorn sheep is Colorado's official animal and the symbol of Colorado Parks and Wildlife (CPW). The Georgetown bighorn sheep herd is one of the largest and most important (Table 3). It is often used by CPW as a source population for sheep introduction throughout the state and in other states, as well.²³ CPW indicated that the DMRM would have significant impacts on the migration, lambing, and wintering habitats of the local herd if significant measures were not taken.

CPW and the US Forest Service have spent considerable time and effort in applying measures to ensure that the Georgetown bighorn sheep herd will prosper. In 2009, the CPW published an extensive Bighorn Sheep Management plan describing steps to be taken over the subsequent ten years to protect the herds.²⁴

In 2014, the US Forest Service specifically introduced measures to boost the bighorn sheep population near Empire by clearing brush, thinning trees and potentially instituting a burn so that the bighorn sheep population could migrate more easily. Bighorn sheep rely on visual communication to maintain herd dynamics and avoid predators. The proposed Blue Creek Bighorn Sheep Improvement Project west of Empire was to include treatment of up to 495 acres.²⁵ In a similar vein, CDOT commissioned a study to investigate the feasibility of constructing wildlife overpasses for I-70 to mitigate ecological damage along the I-70 mountain corridor.²⁶

These measures indicate the importance given to the Georgetown Bighorn Sheep population, clearly a Colorado state priority due to its iconic significance. Bighorn sheep are valued for their environmental importance as well as for opportunities provided for hunting and wildlife viewing. By contrast, DMRM indicated in their discussions with CDW that the herd did not occupy the meadow to be mined and suggested minor changes to ensure that the sheep did not come into collision with vehicles.²⁷ According to analysis by Clear Creek County: "In warm months they graze on mountain slopes and in colder months they move down into the valleys."²⁸ The question is what is the risk to the herd should measures undertaken by DMRM be unsuccessful.

²² https://docs.wixstatic.com/ugd/a614ea_1fae5810903b438ab94dd95b8d5bcf4c.pdf

²³ <https://www.fs.usda.gov/detail/arp/news-events/?cid=STELPRD3836202>

²⁴ <https://cpw.state.co.us/Documents/WildlifeSpecies/Mammals/ColoradoBighornSheepManagementPlan2009-2019.pdf>

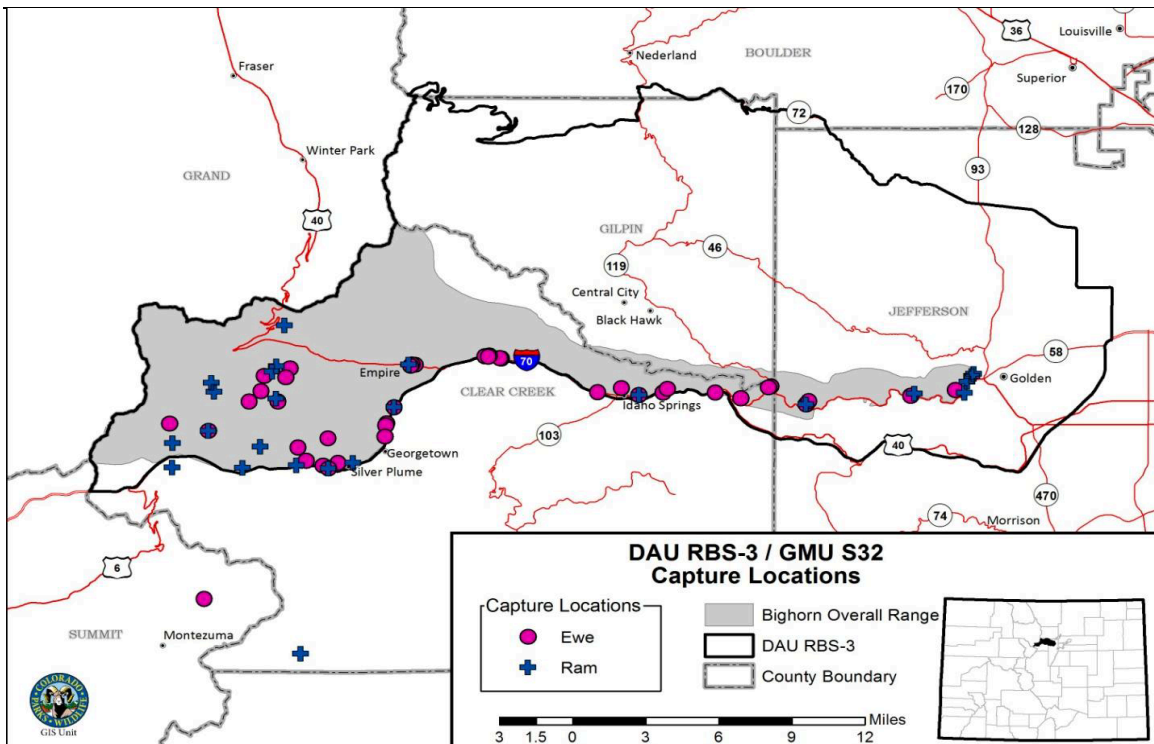
²⁵ <https://www.co.clear-creek.co.us/AgendaCenter/ViewFile/Item/1433?fileID=924>

²⁶ <https://www.codot.gov/projects/i-70mountaincorridor/documents/I70wildlifeoverpassscreeningreport.pdf>

²⁷ Interestingly, there is a sign on the access road to I-70 directly across from the proposed DMRM indicating a big horn sheep crossing.

²⁸ <https://www.co.clear-creek.co.us/DocumentCenter/View/2528>

Table 3: Georgetown Bighorn Sheep Herd Locations and Capture Sites, 2006



Source: <https://cpw.state.co.us/Documents/WildlifeSpecies/Mammals/Bighorn-Sheep-Georgetown-TechReport.pdf>

Similarly, CDW indicated concern about the negative impact of mine operations during the Peregrine falcon breeding season from March 15 through July 31. DMRM reported that the mine was nowhere near the falcon nests. Nonetheless while falcons nest on heights, they hunt in adjacent open meadows, forested tree top areas and around lakes and rivers and shrub lands.²⁹ Consequently, the DMRM would be removing hunting grounds, which would obviously impede the ability of the falcons to nest.

In terms of elk herds, hunter harvest is the primary method for maintaining the herd population at acceptable levels. The greatest threat to this management plan is the potential loss of hunter access to elk due to land development. Clearly, to the extent that elk migration patterns are disrupted, elk management is also disrupted. To address the CDW concern about elk winter migration, DMRM responded that between December 1 and April 15, operational traffic would be restricted to 10:00 AM to 3:00 PM. It is not clear why DMRM believes that elk would not keep migrating during those hours.

In view of other wildlife objectives for bighorn sheep and Peregrine falcons, the

²⁹ <http://www.rmbo.org/pif/bcp/phy87/cliff/pefa.htm>

balance between herd containment, hunter recreational opportunities, and wildlife concerns would appear to take precedence over the DMRM. Once again these are serious issues of unanticipated risk created by a sand and gravel pit at the DMRM site. Even with mitigation measures in place, the possibility of unforeseen events is high. A Black Swan could be possible, as it is impossible to predict what vulnerable wildlife populations will do once patterns of habitat and migration are interrupted. In the case of bighorn sheep, a single gravel mine alone could cancel out years of careful planning and extensive support instituted by the CPW and the US Forest Service to support the Georgetown Bighorn Herd.

Risks to Water Resources

The Clear Creek watershed is characterized by beautiful mountain scenery and outdoor recreation. Clear Creek is valued for its fisheries, and is utilized extensively for kayaking, rafting, swimming, and small-scale, recreational placer mining. It also provides the water supply for a number of Colorado communities. These uses are all heavily dependent upon acceptable water quality. As Clear Creek flows through the watershed, it dissolves naturally occurring minerals and, in some cases, radioactive materials from rock surfaces and the riverbed. Rockslides or landslides, runoff from forested areas, animal activity, or human activities all may affect water quality in Clear Creek.

The 2014 Upper Clear Creek Watershed Plan Update³⁰ indicates that contamination from past mining and milling operations is significant in Upper Clear Creek as ambient (non-storm event) metal concentrations exceed standards established to protect aquatic life. Certain stream segments in Clear Creek are not achieving water quality standards for trace metals and are listed as impaired.

In 1983, because of mining-related water quality problems, the US Environmental Protection Agency (EPA) established the Clear Creek/Central City Superfund Study Area and placed it on the National Priority cleanup list (see also the Colorado Department of Public Health and Environment's listing). This was the beginning of a series of activities around the Clear Creek Watershed that have continued up to today.³¹

The Clear Creek Watershed Foundation (CCWF), a non-profit organization incorporated in 1997, was a result of this original EPA Superfund initiative. The Foundation conducts studies and implements programs to improve the quality of Clear Creek and its tributaries. Projects have included abandoned mine remediation, stream habitat improvement, outreach and education. The Foundation operates under an action memorandum from the EPA, designating it as a Good Samaritan

³⁰ https://www.colorado.gov/pacific/sites/default/files/CCWatershedPlan_02-06-14_FINAL.pdf

³¹ <http://clearcreekwater.org/about-ccwf/>

Action Agent. The Foundation conducted a number of cleanup projects that have improved water quality in Clear Creek with funding from the EPA, the U.S. Forest Service and the Colorado's Water Quality Control Division. In particular, the Foundation awarded a grant of around \$500,000 to implement restoration on the Lower North Empire Creek controlling runoff from severely impacted, virtually un-reclaimable, upland mined lands to the west of the Creek.³²

The City of Golden is an active member of the Upper Clear Creek Watershed Association that also derived from the EPA Superfund initiative. Golden's drinking water source is predominantly from Clear Creek and its tributaries.³³ A number of other Colorado cities (Georgetown, Idaho Springs, Black Hawk, Arvada, Northglenn, Thornton and Westminster) also use Clear Creek water or water from tributaries of Clear Creek for their domestic household water supply. To ensure that tap water is safe to drink, the Colorado Department of Public Health and Environment (CDPHE) has regulations that limit the amount of certain contaminants in the treated water provided by public water systems such as Golden's.

CDOT is involved in keeping Clear Creek waters clean, as well. The formation of the Sediment Control Action Plan (SCAP) for the reach of the I-70 tributary to Clear Creek is a collaborative partnership between CDOT, local mountain communities and other parties interested in the Clear Creek watershed.³⁴ The SCAP is a voluntary effort by CDOT to address sediment-related water quality issues. The 2017 Sediment Control Plan for the Upper Clear Creek Corridor notes that reductions in sediment loading due to SCAP will reduce in trace metal and nutrient loading³⁵ in Clear Creek.³⁶

Clear Creek is used extensively for water-based tourism; there has been major growth in white-water rafting over the past decade. Yet, last summer has shown how fragile this industry is with drought causing some business to operate in other parts of Colorado and others to close early in the season. Since the late 1990s, three intense droughts have buffeted the state's \$193-million rafting industry.³⁷ Google

³² <http://clearcreekwater.org/news/2017/9/27/ccwf-awarded-grant-for-lower-north-empire-project>

³³ <https://www.cityofgolden.net/media/WaterQualityReport2017.pdf>

³⁴ Sediment loading in upper Clear Creek is two to three times higher than might be expected from bed load conditions, and sediment loading in lower Clear Creek is three to five times higher than would be expected from bed load conditions.

³⁵ Nutrient loading is the process where too many nutrients, mainly nitrogen and phosphorus, are added to bodies of water and can act like fertilizer, causing excessive growth of algae.

³⁶ <https://www.codot.gov/projects/i-70-old-mountaincorridor/documents/clear-creek-scap-final-report.pdf>

³⁷ https://www.washingtonpost.com/national/rafters-anglers-worry-as-colorados-famed-whitewater-becomes-low-water/2018/08/09/aeb9a36c-9b7a-11e8-8d5e-c6c594024954_story.html?noredirect=on&utm_term=.afc1f4a584c6

maps lists 14 rafting companies up and down Clear Creek, including Downstream Adventures Rafting in Empire. Rafters look to the excitement of the trip, the scenery and pure clear water. Should pollution ruin Clear Creek, the industry would quickly shift to other counties as more major rivers start in the Rocky Mountains of Colorado than in any other state in America.

Fishing in Clear Creek is a major sport. Any changes in these waters could easily upset the streams ecological balance and ruin the industry. Low water levels in 2018 hurt fishing as well as rafting. This led to diminished livelihoods, for fishing guides as well as outfitters. With some water levels at 25 percent of the historical average, wildlife managers instituted voluntary closures to fishing from 2:00 P.M. to midnight on several sections of Clear Creek.³⁸

The proposed DMRM is situated just north of Clear Creek. The West Fork of Clear Creek flows to the immediate north of the property and joins Clear Creek just past the proposed DMRM. The literature on risks to water sources from gravel pits is extensive. While the DMRM is not directly on a stream, possible potential damage to Clear Creek waterways is certain if there is seepage from the mining operation. In particular, the following negative impacts can take place:

“Extraction of gravel from a stream alters the sediment budget creating the potential for channel instability, increased turbidity, and degradation of habitats.... Wetlands may be altered or lost by erosion, the lowering of the water table, relocation of the stream channel, or by moving gravel into wetland areas. In stream gravel mining may be linked to loss of fishery resources and wetlands, increased bank erosion, and damage to infrastructure caused by channel degradation. The extent to which this potential is realized depends on the hydrologic character, sediment load, and riparian condition of a stream.”³⁹

DMRM addressed the issue of water contamination in some detail in DMRM–September 2018,⁴⁰ indicating, in part, that: “During mining, runoff that occurs within the disturbed area will be routed to the active mining pit. No sediment is allowed to leave site and cloud any downstream waters as all water from the disturbed area will drain to the bermed active pit.” They indicate that in terms of surface water: “All surface water runoff that reaches the disturbed area will be trapped within the mining pit and not allowed to discharge... During most of the mine’s life this will be accomplished by the fact that the entire mining area will be significantly (>40 feet) below baseline grade.” Similar assurances are made that

³⁸ https://www.washingtonpost.com/national/rafters-anglers-worry-as-colorados-famed-whitewater-becomes-low-water/2018/08/09/aeb9a36c-9b7a-11e8-8d5e-c6c594024954_story.html?noredirect=on&utm_term=.e898e2872819

³⁹ <https://pubs.usgs.gov/fs/2002/0012/report.pdf>

⁴⁰ See Exhibit G.

area wells will not be adversely affected. These assurances need to be investigated further.

DMRM notes that in later years a portion of the mining will take place within a 100-year floodplain. Major floodplain mining impacts can occur if during flooding the stream creates a new channel through the pit. Physical impacts include bed degradation, bank erosion and channel widening, with these impacts often extending many miles away from the pit. Infrastructure such as road crossings and services that lie within the area may also be damaged or destroyed. Furthermore, mining in close proximity to a waterway where extraction has continued to a lower depth pose a greater risk than pits that are positioned further away from the waterway.⁴¹

DMRM indicates that there is no risk of pit capture by flooding because any flooding from the creek will flow across the reclaimed meadow before draining back to the creek. This is on the optimistic assumption that the reclaimed meadow will be in place and successful before any potential flooding can occur.

In 2015, Clear Creek Commissioner Timothy Mauck testified in Congress:⁴²

“Whitewater rafting alone has a total economic impact to the community of approximately \$23 million. Hunting and angling generate a total economic impact of nearly \$6 million to the county. This is not only the story of Clear Creek but also across Colorado and the nation. According to the National Shooting Sports Foundation, hunting and angling’s total economic impact is \$192 billion. Outdoor recreation in Colorado generates \$13.2 billion and employs more than 124,000 people. Across the country, it generates \$646 billion and 6.1 million jobs.”

As in the case for Colorado’s vulnerable wildlife population, shocks created by the DMRM are likely to cause damage to Clear Creek’s water resources. Even if the best mitigation measures are implemented by DMRM, there is a non-zero risk of pollution and poisoning of a unique and vulnerable Colorado resource. If such a risk came to pass, it would adversely affect recreational industries including fishing and rafting, and present health hazards to household use of Clear Creek waters for communities such as Golden. We already know from historic mining, clean up is a very expensive process. Colorado communities such as Golden surely do not want to become another Flint, Michigan.

⁴¹https://www.gbcma.vic.gov.au/downloads/Quarries_on_the_Goulburn_Floodplain/Jacobs_and_Moroka_2014_Review_of_floodplain_mining_and_risks.pdf

⁴² https://naturalresources.house.gov/uploadedfiles/testimony_mauck.pdf

Vulnerability to Health Risks

Significant increases in respiratory ailments are a concern for residents near sand and gravel mining. Mining, processing and transporting sand and gravel generate large quantities of silica dust, which is known to damage respiratory systems when inhaled. Studies of residential populations chronically exposed to dust show shortened life expectancy and high rates of cancer, infectious diseases, respiratory and heart disease, reproductive pathologies, adverse pregnancy outcomes, anemia, birth defects, and infant mortality. Children and the elderly, as well as groups with pre-existing lung or heart disease, are particularly vulnerable.

DMRM understands that the excavation and processing of sand and gravel has the potential to raise significant quantities of this type of dust if not adequately controlled. DMRM proposals outline a number of controls to minimize dust generation ensuring that the mine will stay in compliance with all state dust regulations.⁴³

However, the DMRM suggested methods are not necessarily the best. One study indicates that chemical dust suppressants are the most effective at controlling dust at the gravel processing site but that these methods are much more costly. The other control strategies that DMRM is suggesting, however, can work if they include increasing the frequency of water spraying, implementing the use of windbreak fencing, and re-vegetation.⁴⁴ Further review and more information about DMRM's methods of controlling dust would help us understand if they are using the best approaches possible.

Nonetheless, according to the Environmental Protection Agency, there is no evidence of a safe level of exposure or a threshold below which adverse health effects will not occur from gravel mining.⁴⁵ Exposure is influenced by proximity to the source, i.e., close proximity leads to higher exposure and higher risk. Other factors include winds and

⁴³ DMRM-July 2018 states: "Stockpiles and roads will be watered as needed to minimize dust. This will occur multiple times a day during the height of the summer and less frequently in colder or lower activity times of the year. All crushing and screening equipment will operate with spray bars to wet the material during processing and is a proven very effective method of dust control. Stockpiles of topsoil and overburden that will be in place longer than 120 days will be seeded with vegetation to prevent erosion and the spread of dust. Crushed gravel will be placed on areas of the site that are regularly trafficked including the access road. Due to the regularly changing nature of the interior of the site, no areas will be paved."

⁴⁴ Chang, Chang-Tang et al. 2012. "Fugitive Dust Emission Source Profiles and Assessment of Selected Control Strategies for Particulate Matter at Gravel Processing Sites in Taiwan," *Journal of the Air & Waste Management Association*, page 1268.

<https://www.ncbi.nlm.nih.gov/pubmed/21090554>

⁴⁵ <https://www3.epa.gov/airnow/particle/pm-color.pdf>

weather conditions. DMRM documents indict that any noise and dust escaping the mine site will blow towards I-70, not towards Empire. But this only implies that down-wind communities may incur greater health risks than Empire.

An analysis of wind speeds and the travel distance of particulates of different sizes shows that these particles can affect populations from a half a mile to 36 miles away, depending on wind speed and the size of the particulate. The proposed gravel pit is 3.8 miles from Dumont, CO, 8.9 miles from the Idaho Springs Visitor Center and 25 miles from Evergreen. Consequently, we must take seriously the conclusion that “dust can, and will, impact areas just about anywhere directionally downwind from a gravel pit’s operational activities, unquestionably posing health risks and bearing an impact on adjacent properties.”⁴⁶

The Easterseals Rocky Mountain Village (RMV) is located only one-half mile east of the proposed DMRM site.⁴⁷ Overall, an estimated \$100,000 of Easterseals \$1 million budget is spent locally. Easterseals RMV serves over 800 children and adults with disabilities during the summer.

Easterseals RMV is used as a retreat facility during the off-season and, as such, is an important part of the local Clear Creek County community. The facility hosts local government, business, and social events including I-70 corridor workshops, County Commissioner functions, Communities That Care⁴⁸ meetings, weddings and conferences. Easterseals RMV offers discounted rates for these events and in some cases offers its facilities without charge, for example, the use of their climbing tower by the local volunteer fire department.

Easterseals campers are particularly vulnerable to health risks caused by gravel pit dust and vehicular pollution. It is quite possible that Easterseals might close their beautiful mountain facility due to the increased risk of respiratory disease for its vulnerable camper population. Closing the facility would rob nearby communities of a vital economic resource and would adversely impact all of Clear Creek County, as well.

According to the non-profit Utah Physicians for a Healthy Environment, “Residents near gravel pits experience a steady layering of dust on and in their properties, a

⁴⁶ “Respiratory and Allergic Immune Response Impacts of Gravel Pit / Quarry Operations on Adjacent Land / Properties”

<http://www.citicite.com/files/Uploads/1220/Dust%20Particulant%20Distance%20Travel%20and%20Impacts%20on%20Adj%20Properties,%20incl%20Resp%20&%20Allergic%20Immune%20Responses.pdf>

⁴⁷ <http://www.easterseals.com/co/our-programs/camping-recreation/rocky-mountain-village.html>

⁴⁸ Communities that Care is a Colorado Department of Health and Environment youth substance abuse program. <https://www.colorado.gov/pacific/cdphe>

good indicator of inhalation and exposure ... Because of greater physical activity, higher metabolic rates, and hand to mouth actions, young children will be more exposed than adults via both inhalation and ingestion.”⁴⁹ The doctors assert that Utah’s regulation of gravel pits is grossly inadequate.

Research findings on the impact of dust particulates on populations are extensive. Of particular interest to us, William A. Calo et al. compared the prevalence of general respiratory symptoms and heart disease in two communities in Puerto Rico, one exposed to particulate matter from quarries and diesel exhaust and another without such exposure.⁵⁰

The prevalence of nasal allergies (16.8%), bronchitis (7.1%), and sinusitis (12.3%) observed in the study were significantly higher among the residents of the community exposed to mining than prevalence reported for Puerto Rico (nasal allergies = 5.0%, bronchitis = 4.2%, and sinusitis = 7.7%). The prevalence of respiratory conditions among residents of the community not exposed to gravel mining was similar or lower than the overall prevalence in Puerto Rico. These findings are consistent with epidemiological studies that reported a higher likelihood of respiratory diseases as a result of exposure of particulates in communities near quarries.⁵¹

A host of studies connect air pollution to respiratory illness and school absenteeism. For example, Ransom and Pope reported that particulate pollution has a strong impact on school absences.⁵² Other studies concluded that carbon monoxide has a stronger impact on absenteeism than particulate pollution.⁵³ Zweig and Ham went beyond absenteeism using data from a longitudinal health study for southern California and estimated that a 10 percent decrease in outdoor PM₁₀, PM_{2.5}, or NO₂⁵⁴ would raise math test scores by 0.15 percent, 0.34 percent, or 0.18 percent, while a 10 percent decrease in outdoor PM_{2.5} increases reading scores by 0.21 percent.⁵⁵

⁴⁹ <http://uphe.org/wp-content/uploads/2015/10/Gravel-Pit-Flyer.pdf>

⁵⁰ William A. Calo et al. 2014. “Clinical Conditions Associated with Environmental Exposures: an Epidemiologic Study in Two Communities in Juana Díaz, Puerto Rico”, *P R Health Sci J*. 2009 June ; 28(2): 126–134.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3885176/>

⁵¹ For example see:

<http://www.oxfordcounty.ca/Portals/15/Documents/Public%20Health/Beachville/Literature%20Review%20-%200CPH%20Aug%2028%20227.pdf>

⁵² Ransom, Michael R and C. Arden Pope III, 2013. “Air Pollution and School Absenteeism: Results from a Natural Experiment” Department of Economics, Brigham Young University, Provo, Utah.
http://conference.iza.org/conference_files/environment2013/ransom_m1284.pdf

⁵³ Currie, Janet, et al., 2007 “Does Pollution Increase School Absences?” NBER Working Paper 13252 <https://www.nber.org/papers/w13252>

⁵⁴ PM₁₀ is less of an immediate health concern than PM_{2.5} given that it does not penetrate the very lowest part of the lungs. However, it is still small enough to enter the lungs and cause

Increases in respiratory ailments from the DMRM would affect the most vulnerable populations in Clear Creek County – children and the elderly. While we cannot say for certain how much the DMRM might increase respiratory disease in Clear Creek County, research findings are clear that there is a non-zero risk to health from gravel pit particulates. While we do not know to what extent the DMRM’s mitigation plan to reduce dust and particulates will be effective, or which communities will suffer, we can say that any increases in illness or death among children and the elderly are not worth the risk.

The average cost of the treatment for bronchitis in a doctor’s office is \$75.00 per visit, while the treatment of chronic bronchitis and COPD averages \$1,484 to \$2,911 annually.⁵⁶ In 2000, monthly lung-cancer treatment during the first six months of care for a 72-year old ranged from \$2,687 (no active treatment) to \$9,360 (chemo-radiotherapy).⁵⁷ Given continued escalation in health care costs, expenses for the care of respiratory illness in 2018 are now higher.

While Clear Creek County could monitor increases in respiratory illness among the most susceptible members of the population, and even ensure that medical expenses will be reimbursed for those without adequate insurance, these mitigation measures cannot reverse damage to the health of the population. Furthermore, the possibility of ensuing lawsuits could be expensive for Clear Creek County and the DMRM.

Real Estate Vulnerability

Empire residents are vulnerable to reductions in real estate prices for their properties should the DMRM sand-and-gravel operation be approved. Extensive economic research has shown that properties next to gravel pits and quarries are less desirable due to noise, traffic congestion, environmental factors and health concerns. We have estimated conservatively that median assessed property values in Empire would fall by 12.7 percent from \$213,199 to \$178,910 due to the DMRM.

Our analysis uses the results from a study based on a statistical technique known as the ‘hedonic pricing’ that compares the values of properties close to a gravel pit to properties with no gravel pit in the vicinity.⁵⁸ Studies using this technique have

irritation of your eyes, nose, and throat. NO₂ primarily gets in the air from the burning of fuel.

⁵⁵ <http://www.econweb.umd.edu/~ham/test%20scores%20submit.pdf>

⁵⁶ <https://www.ncbi.nlm.nih.gov/pubmed/12628879>

⁵⁷ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3150743/>

⁵⁸ Hedonic pricing adjusts selling prices of properties for normal factors such as number of rooms, square footage, lot size and other attributes that make a home more or less desirable for prospective buyers. It also can adjust property prices for factors related to location,

produced similar findings assessing reductions in property values for other environmental disturbances.⁵⁹

All prospective gravel pit studies on changes in property values must use estimates based on prior research and apply those findings to the dis-amenity in question.⁶⁰ Many studies of the impact of gravel pit operations on property prices, like this one, use the findings shown in Figure 1 below.⁶¹ Real-estate losses are highest for properties closest to the mine and are generally capped at three miles distance, the point at which the negative impact recedes.⁶² Research has shown that prices continue to stay lower than they would have been, at least until remediation is completed.⁶³

In Empire, 166 properties are at risk of selling-price reductions, ranging from 4.9 percent to 35 percent depending on location. These 166 properties are currently valued by Clear Creek County at \$35.5 million. With the DMRM gravel pit, the 166 properties would be worth \$4.4 million less. Actual losses to Empire properties are likely to be greater, however, as property assessments are lower than selling prices.⁶⁴

Real estate data for all Empire properties sold in 2017-2018, using actual sales prices, and properties currently on the market, based on best estimates by real estate agents, suggest that current market prices may be on average 65 percent higher than assessed prices. This would mean that the true loss to all property owners due to the proposed DMRM gravel mine would be \$7.2 million. The likely

including distance to hazardous materials such as gravel pits, landfills, highways, railroad tracks, lead pollution, noxious industrial odors and similar dis-amenities.

⁵⁹ For example, see Hite, Chen, Hitzhusen and Randall.

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=290926

⁶⁰ The first and most frequently cited case study of this type is by G. Erickcek, W.E. Upjohn Institute for Employment Research (2006), on the economic impact of a proposed gravel mine in Richland Township, Michigan

https://research.upjohn.org/cgi/viewcontent.cgi?referer=https://www.google.com/&https_redir=1&article=1225&context=reports

Also see: <http://www.petoskeygravelpit.com/>.

⁶¹ Diane Hite, 2006. "Summary Analysis: Impact of Operational Gravel Pit on House Values, Delaware County, Ohio," Auburn University.

http://www.accpg.org/docs/Gravel%20Pit%20Interim%20Zoning/Storey%20Pit/exhibit_b.pdf

⁶² Approximate reductions in property values were calculated by distance from the proposed DMRM gravel pit using Google Maps software for groups of properties within three miles of Empire Junction Road. This leads to conservative property-value reductions, as this point is at the far edge of the gravel pit

⁶³ Case Center for Spatial Economics. 2009. "The Potential Financial Impacts of the Proposed Rockford Quarry.

http://wcrpc.org/FinancialImpacts_RockfordQuarryCanada.pdf

⁶⁴ With the exception of those properties that were updated based on recent sales.

range of reductions in property values in Empire due to the proposed gravel pit would be \$4.4 to \$7.2 million.

Figure 1



Source: Based on Hite, from Case Center for Spatial Economics. 2009. "The Potential Financial Impacts of the Proposed Rockford Quarry.

http://wcvrpc.org/FinancialImpacts_RockfordQuarryCanada.pdf

Assuming that the Clear Creek property tax assessment methodology does not change, the county tax base would increase slowly as reassessments kick in from sales. Because families no longer buy only one house to last a lifetime, re-computation would take place relatively quickly over the 20-year mining horizon.⁶⁵ Most of the 166 properties affected by the DMRM will be sold before rehabilitation of the Douglas Mountain Ranch plateau. Only the few current property owners who hold on to their property for the next 20 years will avoid facing a loss relative to the no-mine scenario.

Nonetheless, Clear Creek County will still gain tax revenue when Empire properties are sold – just not as much. Clear Creek can hardly afford to face reduced property taxes anywhere in the county as the 2019 budget projects a \$1.8 million fall in property-tax revenue despite projected five-percent annual increases in both

⁶⁵ The National Home Building Association estimates that the average buyer expects to stay in a home for only 13 years. Other sources suggest shorter housing tenure.

residential and commercial property taxes.⁶⁶ This may be the reason that some favor permitting the DMRM.

Based on estimates provided in DMRM-July 2018, using Colorado Department of Revenue methodology, property taxes for the proposed sand and gravel pit are projected to come to \$34,550 annually based on one-year production of one million tons of gravel (assuming current prices and expenses).⁶⁷ While this is more than the value of lost property taxes from Empire, it represents a relatively small addition to tax revenue in comparison to other metrics. Consequently, we do not believe that a potential increase in tax revenue from the DMRM is worth the cost of the losses to Empire property owners.

Why should we care? Empire property owners have become *vulnerable* because the negative shock to real estate investments from the proposed DMRM could not have been anticipated. Primary residences represent the largest asset most households own.⁶⁸ In 2018, nearly two-thirds of Americans were homeowners. Even among families with less than the median income, over 50 percent owned their own homes.

Empire is not a wealthy town. The median price of properties affected by the proposed gravel pit is only \$214,000, compared to a median price for Clear Creek County of \$297,000. Is it equitable for the residents of Empire to face losses due to the DMRM, while the pit operation itself is estimated to bring in \$1.8 million annually from projected sales?

One equitable policy to mitigate this vulnerability would be to have Clear Creek County compensate Empire residents for sales-price losses at the time of sale. Another avenue for remediation would be to have the DMRM establish an escrow fund for property-loss reimbursement. Of course, the surest way to avoid having vulnerable Empire property owners penalized for the negative externalities created by a mine operation would be to not approve the DMRM.

Additional Costs of Traffic Congestion

Additional road traffic is the normal result of the need to truck aggregates from mine to construction site. The DMRM's submitted documents anticipate 310 vehicle round-trips per day while the mine is in operation, of which 280 will be dump trucks picking up and carrying sand and gravel from the pit to a point at or near

⁶⁶ Clear Creek Courant, October 17, 2018, p. 8.

⁶⁷ Clear Creek County is also expected to gain revenue from mineral rights to the property, but this revenue has not been estimated to date in available documents. Certainly a fair decision of the economic consequences of permitting mining can only be made with full revenue coming to the county under consideration.

⁶⁸ The study is based on the highly regarded Federal Reserve Board's 2016 Survey of Consumer Finances (SCF).

Denver. This represents a significant increase in traffic up and down the I-70 Corridor between Empire (Exit 232) and Denver (or points close to the city). There are a number of negative externalities from this traffic that affect both Clear Creek County and counties to the west, the recreational powerhouses of the Colorado economy.

Specifically, DMRM submissions indicate that mining activities would be in operation from 7:00 AM to 7:00 PM Mondays through Friday and from 8:00 AM to 5:00 PM on Saturdays. Hauling operations could be expected to take place from 5:00 AM to 3:00 PM, that is, 10 hours a day.⁶⁹ (But this may not be all, as the DMRM documentation also states that hauling could be extended to 24 hours a day and seven days a week.) This level of operation implies that there would be 31 vehicles coming or going into the mine every hour or, alternatively, a lineup of vehicles entering or exiting the Exit 232 ramps of I-70 every two minutes. DMRM suggests that traffic will not be consistent across all 'operational hours', with peak traffic maximizing at 20 truckloads of gravel hauled out per hour or, based on round trips, traffic coming in and out of the Exit 232 every one and one-half minutes.⁷⁰

Immediate Costs of Increased Traffic

The costs of DMRM operations are wear and tear on I-70 over many years, as well as on the access road to and from the DMRM to I-70. Highway wear and tear from vehicular traffic increases according to the fourth power of the weight of the vehicle, in other words one heavy truck causes much more highway damage than one passenger car.⁷¹ According to my calculations, one round trip of a gravel dump truck would create roughly the same wear and tear as 270,000 average 4,000-pound cars.⁷² Simply stated, the wear and tear of an additional 87,000 vehicle trips annually back and forth to Denver would cause a significant increase in road damage, particularly for the access ramps to and from Exit 232 off I-70.⁷³

⁶⁹ These figures imply that when the mine is in full operation, producing one million tons of sand and gravel per day, each truckload of output would be carrying nearly 23 tons of gravel back to the Denver area per trip.

⁷⁰ DMRM-September 2018 indicates that between December 1 and April 15, operational traffic would be limited to 10:00AM to 3:00 PM, or five hours a day, to 'protect the elk range'. It would appear that traffic during the 10-hour working days during the summer and fall would be even more congested to reach the proposed annual target of one million tons.

⁷¹ <https://www.pavementinteractive.org/reference-desk/design/design-parameters/equivalent-single-axle-load/>

⁷² Research has also suggested that road damage increases to the sixth power of the load on weaker surfaces.

⁷³ DMRM-July 2018 disingenuously states: "In terms of costs, the majority will be the same or less for the county. This includes road impacts, as all of the reservoir development traffic that will use state roads maintained by CDOT."

The costs of repairing additional damage would intensify the current financial struggles of the Colorado Department of Transportation (CDOT). One truck traveling back and forth from the DMRM would travel about 82 miles round trip and use approximately 12.6 gallons of diesel, as compared to the average car consuming around 3.5 gallons of gas for the same trip. In view of price differentials between diesel and gasoline, and current federal and state taxes on both products, the ratio of truck revenue to automobile revenue would be a little over four to one. In sum, while gravel dump trucks pay more in highway taxes per mile than passenger vehicles, the differential in tax receipts does not make up for the differential in wear and tear on the highway.

As troubling, road taxes do not fund the majority of CDOT expenditures. In 2017, Federal gas taxes accounted for 42 percent of CDOT revenues and state gas taxes for 20.7 percent of a total budget of \$1.55 billion. General revenues financed 5.1 percent of CDOT expenditures. Thus additional pressure for road maintenance and rehabilitation is unlikely to cover the costs of additional traffic on the road.

In part due to constant federal and state fuel tax rates, Colorado highways have been under financial pressure for many years. CDOT finances have been further exacerbated by improvements in fuel efficiency without concomitant reductions in highway wear and tear. According to an independent report, 40 percent of major urban roads and highways in Colorado are in poor or mediocre condition due to inadequate state and local funding.⁷⁴

Congested and deteriorating roads are costing Colorado drivers \$7.1 billion annually in lost time and productivity, needed repairs and crash-related expenses.⁷⁵ CDOT officials estimate the state has a \$9 billion backlog in transportation needs. If maintenance continues to be postponed, conditions will deteriorate further along the I-70 corridor, leading to higher, unreimbursed vehicle operating-costs for all travelers. Driving on rough roads already costs every Colorado driver \$468 annually in additional vehicle operating costs. These are uncompensated expenditures as a result of the externalities of operating a gravel pit on a route already subject to congestion.

According to a 2018 study, highway maintenance in Colorado per state-controlled-mile was \$36,695, slightly more than the expected annual estimated \$34,550 payment to Clear Creek by DMRM in property taxes.⁷⁶ Colorado's costs came in 33rd out of the 50 states measured in the study, considerably higher than the average cost of \$28,020 per mile. The DMRM would increase CDOT costs for maintenance even more.

⁷⁴http://www.tripnet.org/docs/CO_Transportation_by_the_Numbers_TRIP_Report_2018.pdf

⁷⁵http://www.tripnet.org/docs/CO_Transportation_by_the_Numbers_TRIP_Report_2018.pdf

⁷⁶ <https://reason.org/policy-study/23rd-annual-highway-report/maintenance-disbursements-per-mile/>

Due to increased return-trip dump-truck traffic from Denver to Empire, cars driving along I-70 will incur increased vehicle operating costs, lost time, wasted fuel and the costs of increased traffic accidents. Since 2010 traffic fatalities in Colorado increased significantly from 450 in 2010 to 468 in 2017. Preliminary data suggest that deaths were reduced in 2018, however.⁷⁷ With greater truck traffic from the DMRM, these very recent reductions in traffic deaths could be reversed on the I-70 Mountain Corridor.

Risks to Outdoor Recreation

Clear Creek County is the gateway for outdoor tourism in Colorado. Some 84.7 million tourists visited Colorado in 2017, up from 82.4 million in 2016. That 2.8 percent increase in visitors was 40 percent higher than the national average. Much of Colorado's tourism is outdoor recreational (Table 2). The total economic output associated with outdoor recreation in 2017 was \$62.5 billion dollars, contributing \$35.0 billion dollars to the Colorado Gross Domestic Product. Tourism represented 18.7 percent of the Colorado labor force and paid \$21.4 billion dollars in wages and salaries. Recreation activities contribute \$9.4 billion dollars in federal, state and local tax revenue.⁷⁸

DMRM gravel-truck traffic would use the only interstate connection from eastern to western Colorado. I-70 experiences heavy traffic and subsequently high delays particularly during winter, but in summer as well, when travelers are returning from mountain ski areas to the Denver area. I-70 frequently serves 50,000 vehicles per day and close to 5,000 vehicles per hour during peak hours.⁷⁹ Weekend travelers returning to Denver often encounter significant traffic jams with hours-long delays.⁸⁰

Seventeen of the 26 major ski resorts in Colorado are immediately accessible by I-70.⁸¹ The industry contributed roughly \$5 billion to the state economy and supported 46,000 jobs.⁸² Colorado Ski Country USA reported that skier visits at its

⁷⁷ https://www.codot.gov/library/traffic/safety-crash-data/fatal-crash-data-city-county/Colorado_Historical_Fatalities_Graphs.pdf

⁷⁸ http://cpw.state.co.us/Documents/Trails/SCORP/2017EconomicContributions_SCORP.pdf

⁷⁹ http://tft.eng.usf.edu/tft50/tft50_papers/P15_Marlina.pdf

⁸⁰ Prolonged time sitting in traffic jams can have negative health effects from stiff necks to increased risk of urinary tract infections, and blood clots. In addition, noise pollution caused from traffic congestion has been linked to negative health outcomes.

⁸¹ The Mountain Resort Region and Western Slope ski resorts are: Aspen Highlands, Aspen Mountain, Arapahoe Basin, Beaver Creek, Breckenridge, Buttermilk, Copper Mountain, Echo Mountain, Keystone, Loveland, Powderhorn, Ski Cooper, Snowmass, SolVista, Sunlight, Vail, and Winter Park/Mary Jane.

⁸² Chris Linsmayer, public affairs director for Colorado Ski Country, USA.
<https://www.snowsports.org/top-states-skiers-arent-think/>

24-member ski resorts reached 7.1 million during the 2017-18 winter season, slightly ahead of its five-year average but two percent lower than the year before. Colorado ski areas face serious competition from states like Utah and Montana, not to mention East and West Coast areas. Summer sports now keep Colorado ski areas busy, as well.

Table 2: Outdoor Recreation Industry

Activity Groups	Activities in Group
Trail/Road	Walking, Jogging/Running (outdoors), Hiking/Backpacking, Horseback riding, Road biking, Mountain biking, Off-highway vehicle (OHV) or 4-wheeling/motorcycling
Water-based	Swimming (outdoors), Power boating, Water/Jet skiing, Sailing, Canoeing/Kayaking, Whitewater rafting, Stand up paddle-boarding
Winter	Skiing (alpine/tele)/snowboarding, Sledding/tubing, Snowmobiling, Snowshoeing or cross-country skiing
Wildlife-related	Hunting, Fishing, Ice fishing, Bird Watching, Wildlife viewing (excluding bird watching)
Other Outdoor	Developed/RV camping, Tent camping, Picnicking, Target or skeet shooting, Rock climbing, Team or individual sports (outdoors), Playground activities

Source:

http://cpw.state.co.us/Documents/Trails/SCORP/2017EconomicContributions_SCORP.pdf

Colorado SCORP: “The 2007 Economic Contributions of Outdoor Recreation in Colorado.”

The proposed DMRM will increase traffic congestion by creating serious bottle necks in both directions, coming and going from ski and recreational resorts on the other side of the Eisenhower Tunnel, such as Breckenridge and Vail, as well as ski and recreation areas accessible from Route 40, including Winter Park and Granby. Greater congestion is likely to reduce resort revenues in every season.

This outcome is not one that is usually considered in gravel-pit economic assessments, as tourism impacts are largely focused on the immediate communities affected by the gravel pit. Locating a gravel pit on the primary access road to a growing recreational area can have a far greater adverse economic impact than in locations that are insulated from economic activity outside their boundaries.

The impact of the risk to highway congestion and increased highway repair costs will only become truly apparent after the damage is done. The risk to tourism from additional traffic congestion on I-70 would reach beyond Clear Creek, reducing commercial revenue for Summit and Grand Counties.

Challenges of Rehabilitation

Colorado has developed reclamation requirements over the years to ensure that land is restored at the completion of mining operations.⁸³ Mining operations are required to file reclamation permit applications with the Division of Minerals and Geology (DMG), post a reclamation bond to guarantee reclamation and obtain a permit prior to mining. Reclamation and environmental concerns for surface and open-pit mining are site specific and depend upon the size of the operation, depth of excavation, method and location of stockpiled materials, exposure or proximity to ground water tables, and potential impacts to surface water quality and quantity. The Mined Land Reclamation Board has the authority to revoke a permit and forfeit the reclamation bond where a pattern of violation has been identified.

Reclamation reports are filed annually for all land covered by a reclamation bond. These reports include the number of newly disturbed, backfilled and graded acres, as well as topsoil replaced and seeded. The DMG will release an operator from reclamation liability only when it is demonstrated, through on-site inspection and other information, that the mine site has met the conditions of the Reclamation Plan. When a site is ready for release, DMG terminates the permit and returns the reclamation bond.

DMRM has provided information about their proposed site reclamation in both DMRM–July 2018 and DMRM–September 2018. The earlier document stressed that while a reservoir would be built, it would not be fully designed until 15 years hence – e.g. after the mining was completed. As part of the reservoir development, there would be public access for fishing -- with a pier, a boat launch, and/or sufficient shoreline access. Additionally, a public trail from the proposed Clear Creek greenway along the north side of the West Fork of Clear Creek would connect the reservoir to other trails, complete with a pedestrian crossing across the creek. The report specifies that because the mine will have lowered the meadow, public access would be facilitated.

The discussion of the reclamation proposals in DMRM–July 2018 is deceptive, however, as it presents the reservoir as the *ultimate* objective of the gravel pit. Of course, the primary objective of the gravel pit is the gravel pit itself – a profitable business. Any post-mining rehabilitation is part of the reclamation process to mitigate the environment in a way that would please the county.

The later report, DMRM–September 2018, indicates that post-mining use will be for rangeland restoration. (The report also states, however, that they are still applying for a reservoir permit with open space and potential residential development.) The

⁸³ The following two paragraphs summarize material in Colorado Division of Minerals and Geology, “Mined Land Reclamation in Colorado: An Overview”, <http://hermes.cde.state.co.us/drupal/islandora/object/co%3A3463>

rangeland proposal includes descriptive information on re-vegetation, site drainage, and weed control. The proposal indicates that the reclamation efforts will be successful when sufficient vegetation is established and sufficient to prevent erosion and noxious weeds are not present 'in significant quantities'. The final details of this proposal would form the agreement with DMG for the reclamation bond.

Environmental science literature, however, is less sanguine than the DMRM about the potential for successful rehabilitation. Environmental scientists believe there are significant risks in any environmental rehabilitation strategy. While we know more about rehabilitating our environment than gold and silver miners did in the nineteenth and twentieth centuries, mistakes we are paying for still, rehabilitation remains a risky and expensive undertaking.

The risks to imperfect rehabilitation for the proposed gravel pit are great given the possibility of unintended consequences. According to a key review article by Hildebrand, Watts and Randal, "Perspective: The Myths of Restoration Ecology" in *Ecology and Science*:

"Many government policies concerning development and extractive resource use already assume the ability to mitigate ecosystem damage through the restoration of degraded land or creation of new habitats. However, many restorations are not successful either in structure (Lockwood and Pimm 1999) or function (Kentula 1996, Zedler and Callaway 1999) when compared with reference ecosystems."⁸⁴

Several problems and myths are addressed.⁸⁵ One overarching issue raised is the inability to recognize and address uncertainty. This is consistent with the emphasis in this report on the role of risk in gravel pit operations. In addition, the article stresses that ecological restoration is trying to accomplish in a matter of years what takes decades or centuries under natural conditions.

The first myth addresses the idea that ecosystems develop in a predictable fashion toward a specified, static, end point or climax. Most landscapes are a mosaic of different vegetation types and identifying a single state is not realistic for most systems. The second myth addresses the idea that the ecosystem process follows a repeatable trajectory. Uncertainty is implicitly ignored. Failure to accept uncertainty and the dynamic nature of ecological environments can lead to the traps of the previous myth. The third myth assumes that there is a need to demonstrate the rapid recovery of disturbed lands in order to have insurance or mitigation performance bonds returned quickly. As most restorations include plantings to get the ball rolling and stabilize the terrain, it is logical to try to advance the process, and this is why the practice is so common. Even when successful, certain ecological

⁸⁴<https://www.ecologyandsociety.org/vol10/iss1/art19/?fbclid=IwAR052Bi16WIS3WLSt48HUKokLT5ReBSUQ7voy510nELfLhljX5yJm58B5QY>

⁸⁵ See article referenced for an extensive bibliography of research studies.

processes present more difficult challenges and may take years or decades. The last myth is to reuse unsuccessful approaches because they may have worked sometime and somewhere in the past.

The positive side of much rehabilitation is that restoration rarely leaves mining sites worse off than they would have been without rehabilitation, even when the rehabilitation does not fully meet its stated goals. Faint praise! Nonetheless, ignoring uncertainty can result in surprise and failure. One size does not fit all even when situations appear very similar. Nonetheless, government regulations often provide incentives for one size to fit all. These uncertainties suggest that the justification for a mining project must be evaluated in terms of total societal costs and that the risks and vulnerabilities inherent in any rehabilitation should be carefully accounted for.

Lessons Learned about Risk and Vulnerability

This economic assessment specifically focuses on externalities -- costs that are not directly borne by a business or project. Externalities can be assessed in terms of risk and vulnerability. Risk relates to uncertainty about desired outcomes. For example, Colorado standards may not fully control externalities due to insufficient regulatory controls and/or weak compliance on the part of mine operators. Vulnerability relates to the way in which a population or environment is able to cope with and/or recover from the impact of an unanticipated risk.

Based on our research, we have reached the following conclusions for each area of concern:

Risks to Vulnerable Wildlife: Even with mitigation measures in place, the risk of unforeseen consequences is high. A Black Swan event may occur, as it is impossible to forecast to what extent vulnerable wildlife populations will or will not recover once habitat and migration patterns are disturbed. In the case of bighorn sheep, one single gravel mine could cancel years of careful planning instituted by the CPW and the US Forest Service to support the iconic Georgetown Bighorn Herd.

Risks to Vulnerable Water Resources: Even if the best mitigation measures are implemented by DMRM, there is a non-zero risk of pollution and poisoning of Clear Creek watershed resources. As we know from past mining incidents, clean up is a very expensive process -- this is what helped create the Superfund for Clear Creek in 1983. Such a negative externality would ruin recreational industries such as fishing and rafting and present health hazards for household water use from the Clear Creek watershed. Colorado surely does not want to be another Flint, Michigan.

Vulnerability to Health Risks: Adverse health impacts from the DMRM would impact the most vulnerable populations in Clear Creek County – children and the elderly. Children with more episodes of respiratory illness would miss more school days and

would likely have poorer test scores. While we cannot say how effective DMRM's plan to reduce dust and particulates would be, or which communities would suffer negative impacts, we can say that with certainty that any increase in illness or death among children and the elderly is not worth the risk. Furthermore, the possibility of ensuing lawsuits could be expensive for Clear Creek County and the DMRM.

Real Estate Vulnerability: Because current property owners in Empire could not anticipate negative shocks to their property values from a sand and gravel pit, they are vulnerable to its implementation. Median assessed property values in Empire, which are lower than Clear Creek averages, would fall by an estimated 12.7 percent from \$213,199 to \$178,910 should the DMRM be permitted. Total losses to Empire property owners in total would be in the range of \$4.4 million to \$7.2 million.

Additional Costs of Traffic Congestion: The average expected flow of 310 additional daily vehicle round-trips back and forth from Denver to Exit 232 on I-70, primarily very heavy gravel dump trucks, will increase highway repair costs and add to congestion. Additional highway taxes from DMRM's trucks will not pay for the damage. Worsening congestion will present a risk to outdoor recreational tourism, constraining today's expanding economic activity in Summit and Grand Counties. This risk is too large to ignore, although its full effects may only become fully apparent once the damage is done.

Challenges of Rehabilitation: Restored mining sites are generally not as stable as they were before mining, even with the best of intentions. And they may be much worse off ecologically. This suggests that the justification for mining projects must be evaluated carefully in terms of total potential societal costs and uncertainties before going ahead. Unsuccessful reclamation combined with a series of risks leading to unintended consequences is the worst of all possible worlds.

Who are the Vulnerable: Individuals, businesses, government and the environment are all vulnerable to the risks discussed above.

Property owners will face reduced real estate sales prices; families exposed to mine dust may be subject to serious respiratory ailments, incapacitating the very young and very old disproportionately; motorists face greater traffic congestion with increased vehicle operating costs, possible adverse health impacts and even death. Vacationers will travel far astray for recreational pursuits.

Businesses will face reduced revenues, particularly those engaged in outdoor recreational tourism, due to increased traffic; damage to wildlife habitats and water systems may similarly reduce the revenue of enterprises supporting hunting, fishing, and white water rafting. Business losses will extend to Summit and Grand counties where the bulk of Colorado tourism dollars for skiing and outdoor activities flow.

Economic losses to government include reductions in Empire property taxes compared to collections absent the DMRM. While gravel-pit property taxes and mineral rights will likely make up the difference, the expanded need for highway maintenance will increase costs substantially without a compensatory increase in highway tax revenue. Finally, the costs of damage to wildlife, water systems, and incomplete remediation will be borne by CPW, federal government agencies, Clear Creek County and non-profit organizations.

The only externality that can be assessed with some precision is the immediate certainty that property values located within three miles of the DMRM will decline. But there are ways to compensate the property owners affected. Either Clear Creek County could directly compensate owners upon the sale of their property or DMRM could provide a bond to do so. Some property owners, however, will feel that living next to a gravel pit reduces the amenities of living in Empire far beyond any compensation they would receive.

While the risks of externalities to health, traffic congestion, wildlife and the environment cannot be estimated with precision, they are real and have potential negative outcomes that multiply with each contingency. The consequences of multiple sites of risk and vulnerability may well be costly for Colorado as a whole. If even one, let alone several negative outcomes occur, we will have failed our communities, our economy, and our environment.

One example we do not want to follow is that of Cerrillos, New Mexico. In the mid-1990s, a small gravel sifting operation located one mile north of Cerrillos was partnered with a larger gravel operator.⁸⁶ Soon heavy industrial traffic overwhelmed the peace and quiet of village life. The community opposed the expanded project indicating that it impinged on quality of life with four D's – dust, diesel, decibels and danger. Finally, county commissioners suspended the operation because it was discovered that the operator did not have the water rights required for the operation and that they had over mined the mine zone by at least 10 acres. It would be much easier not to permit the DMRM operation than to force Empire residents to fight its impact once the negative impacts became all too apparent.

Gravel pit locations could be developed with fewer externalities if they were situated (i) away from small vulnerable communities, (ii) away from major interstate tourism routes, and (iii) away from Colorado's most vulnerable wildlife and water resources. At this point DMRM would be the only winner if the sand and gravel mine were approved. The losers would be Clear Creek residents, travelers on I-70, CDOT, Colorado tourism, and Colorado wildlife and the environment.

⁸⁶ <http://www.raintreecounty.com/Recycle.html>