Notice

Weir International, Inc. (WEIR) was retained by Arch Resources, Inc. (Arch) to prepare this Technical Report Summary (TRS) related to Arch's Leer Mine. This report provides a statement of Arch's coal reserves and resources at its Leer Mine and has been prepared in accordance with the United States Securities and Exchange Commission (SEC), Regulation S-K 1300 for Mining Property Disclosure (S-K 1300) and 17 Code of Federal Regulations (CFR) § 229.601(b)(96)(iii)(B) reporting requirements. This report was prepared for the sole use of Arch and its affiliates and is effective as of December 31, 2021.

This report was prepared by full-time WEIR personnel who meet the SEC's definition of Qualified Persons (QPs) with sufficient experience in the relevant type of mineralization and deposit under consideration in this report.

In preparing this report, WEIR relied upon data, written reports and statements provided by Arch. WEIR has taken all appropriate steps, in its professional opinion, to ensure information provided by Arch is reasonable and reliable for use in this report.

The accuracy of reserve and resource estimates are, in part, a function of the quality and quantity of available data at the time this report was prepared. Estimates presented herein are considered reasonable. However, they should be accepted with the understanding that with additional data and analysis available subsequent to the date of this report, the estimates may necessitate revision which may be material. Certain information set forth in this report contains "forward-looking information", including production, productivity, operating costs, capital costs, sales prices, and other assumptions. These statements are not guarantees of future performance and undue reliance should not be placed on them. The assumptions used to develop the forward-looking information and the risks that could cause the actual results to differ materially are detailed in the body of this report.

WEIR and its personnel are not affiliates of Arch or any other entity with ownership, royalty or other interest in the subject property of this report.

WEIR hereby consents (i) to the use of Arch's Leer Mine coal reserve and resource estimates as of December 31, 2021, (ii) to the use of WEIR's name, any quotation from or summarization of this TRS in Arch's SEC filings, and (iii) to the filing of this TRS as an exhibit to Arch's SEC filings.

Qualified Person: /s/ Weir International, Inc.

Date: February 11, 2022

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1.0 EXECUTIVE SUMMARY

Weir International, Inc. (WEIR) was retained by Arch Resources, Inc. (Arch) to prepare a Technical Report Summary (TRS) related to Arch's currently operating Leer Mine. This report has been prepared in accordance with the United States Securities and Exchange Commission (SEC), *Regulation S-K 1300 for Mining Property Disclosure* (S-K 1300) and 17 Code of Federal Regulations (CFR) § 229.601(b)(96)(iii)(B) reporting requirements.

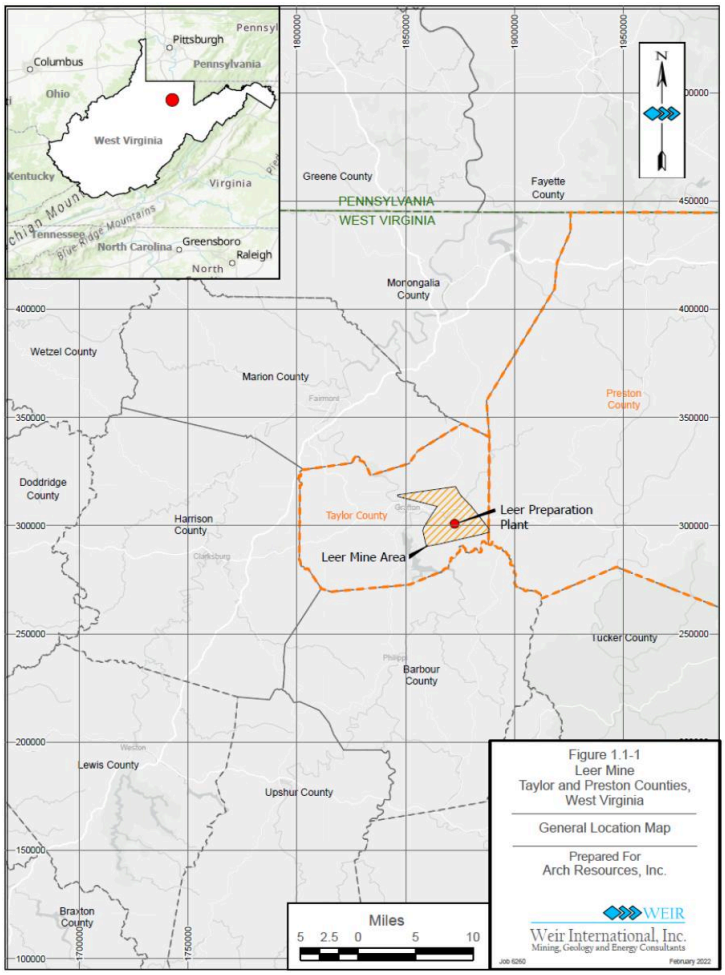
1.1 PROPERTY DESCRIPTION

The Leer Mine is located approximately 25 miles south of Morgantown, West Virginia, primarily in Taylor County, with minimal extension into Preston County, within the Northern West Virginia coal field of the Northern Appalachia Coal Producing (NAPP) Region of the United States (see Figure 1.1-1)

The Leer Mine reserve boundary comprises approximately 26,300 acres. Within that boundary, Arch controls the Lower Kittanning Seam through five coal leases covering approximately 880 acres, with the remaining approximate 25,130 acres of Lower Kittanning Seam owned by Arch through nine coal deeds. An additional 270 acres of the Lower Kittanning Seam are currently uncontrolled by Arch.

The Leer Mine permit area includes approximately 12,635 acres of controlled mineral property (i.e. Arch owns or leases mineral rights). The proposed extension of the Leer Mine permit area will include approximately 5,600 acres of controlled mineral property.

Figure 1.1-1 General Location Map



1.2 GEOLOGICAL SETTING AND MINERALIZATION

The strata of the Tygart Valley River in Taylor, Barbour and Preston Counties, West Virginia consists of Pennsylvanian Age sedimentary strata of the Monongahela Group, the Conemaugh Group and the Allegheny Formation. The Monongahela Group includes the Sewickley, Redstone and Pittsburgh coal seams. The Pittsburgh Seam has been extensively surface and underground mined at higher elevations in the Tygart Valley River region. The Conemaugh Group coal seams include the Elk Lick, Harlem, Bakerstown, and Brush Creek. No known large-scale mining has taken place within the Conemaugh Group coal seams in the Tygart Valley River region. The Allegheny Formation includes the Upper and Lower Freeport, Johnstown Limestone, Upper and Lower Kittanning and the Clarion coal seams. The Upper Freeport, Upper Kittanning, Lower Kittanning, and Clarion seams have been previously mined in the Tygart Valley River region. All other coal seams of the Allegheny Formation in the area occur in limited areal extent and are generally of insufficient thickness for mining.

The principal minable coal seam on the Leer Mine Property is the Lower Kittanning Seam. The Lower Kittanning Seam occurs in a larger area, with a higher seam thickness than all other listed seams in the formation. The Leer Mine is actively mining the Lower Kittanning Seam. The Lower Kittanning Seam reserve extends northeast from Grafton, West Virginia toward Thornton, West Virginia. The reserve area is approximately 6.5 miles in length and approximately 4.0 miles wide. The Lower Kittanning Seam consists primarily of a single horizon of coal with a bone coal parting. Drillholes show seam thickness ranging from 0.0 to 10.5 feet. The seam thins (< 3.0 feet) to the south and east of the Leer Mine LOM Plan and to the north and east of the northern extension of the Leer Mine LOM Plan.

The mineable coal seam is typically low-ash, high thermal content, high volatile A rank bituminous metallurgical coal product. Parting does occur within the property and generally is between one and three feet thick. The parting does not affect the end product since the coal is washed. The seam is generally continuous but is absent in areas outside the Leer Mine LOM Plan. These sub-crops of the Lower Kittanning seam are usually from sandstone washouts.

1.3 EXPLORATION

Historical exploration at the Leer Mine has relied exclusively upon continuous core drilling performed by competent contract drilling companies. Coreholes at the Leer Mine Property are typically 3.76-inch diameter (yielding 2.5-inch diameter core samples). Exploration drilling

provides core samples of roof strata, the coal seam and floor strata. The geologist's seam thickness measurements are checked against the geophysical logs for thickness accuracy and to confirm core recovery. A hole with significant lost core or crushed core can result in misleading data. Drillholes with core recovery of less than 90 percent are noted and subsequently reviewed and potentially excluded from geological and coal quality modeling. WEIR did not exclude any holes for poor recovery, as all of the holes within the project area obtained core recovery of at least 90 percent.

Coal seam core samples are sent to laboratories for quality analyses. Caliper, density, gamma, resistivity, and sonic downhole geophysical logs are completed as drill site and hole conditions allow. Each drillhole collar location is surveyed for accurate map coordinate and elevation data.

Typically, three samples of roof and one sample of floor strata from each target seam are taken for strength testing where solid unbroken lengths of core exist. Specific tests ran on core samples include Uniaxial Compressive Strength, Brazilian Indirect Tensile strength, Bulk Density, Specific Gravity, and Point Load index strength. Samples are prepared at a laboratory where the samples are machined into cylinders according to the appropriate American Society for Testing and Materials (ASTM) specifications.

It is WEIR's opinion that the adequacy of sample preparation, security, and analytical procedures for drillholes that were drilled by Arch after acquiring the property is acceptable and that these methods meet typical industry standards.

The adequacy of sample preparation, security, and analytical procedures are generally unknown for drillholes that were drilled prior to Arch acquiring the property in 2011. However, the geologist's logs for these holes contain sampling descriptions and lithologic descriptions that are sufficiently detailed to ascertain that an experienced geologist supervised the drilling and sampling. It is unknown if coal quality analyses were performed to ASTM standards by qualified laboratories, as detailed in Section 8.0, however, this legacy drillhole information was included as the samples matched the coal seam intervals and reported similar quality data. Model verifications further support WEIR's high level of confidence that a representative, valid, and accurate drillhole database and geological model has been generated for the Leer Mine that can be relied upon to accurately estimate coal resources and reserves.

1.4 DEVELOPMENT AND OPERATIONS

The Leer Mine is a permitted underground longwall mine that commenced production of metallurgical coal in the fourth quarter of 2011. The longwall mining method has been successfully utilized in the NAPP Region, and in other coal producing regions of the United States, since the 1960s. Longwall mining has the highest mining recovery of modern-day underground mining methods. Longwall mining includes room and pillar continuous mining to develop main entries, longwall headgates and tailgates, and retreat mining production panels.

The Leer Mine is mining the Lower Kittanning Seam and parting interval within the seam utilizing continuous miners to develop longwall panels to be mined using a longwall mining system. The Leer Mine develops longwall districts (sets of adjacent longwall panels) with alphabetic designations. As of September 2021, the Leer Mine had completed mining in 18 longwall panels and was mining the 19th longwall panel (1 Left) in the 6th longwall district.

Historical coal production from the Leer Mine is summarized as follows:

- 4.275 million tons in 2019
- 4.185 million tons in 2020
- 4.370 million tons in 2021

A northern extension of the Leer Mine, Permit Revision 25, was approved on October 20, 2021.

The Leer Mine LOM Plan projects mining through 2035; an expected mine life of 14 years. Arch projects total mine production to range from 2.8 to 5.1 million clean tons when the longwall and continuous miner units are operating (2022 to 2034) and 2.9 million clean tons in 2035 after the continuous miner units cease production in 2034. It is important to note that the LOM plan is based on information provided by the company and does not contemplate development of surrounding reserves the company currently controls or contiguous reserves the company could acquire in the future, nor does it assume any productivity improvements, technological innovations and/or operating efficiencies that the company has achieved historically.

All Run-of-Mine (ROM) coal is washed at the Leer Preparation Plant. The preparation plant was designed with two identical processing circuits, which can be operated simultaneously or

one at a time. Each circuit can process 700 ROM tons per hour (tph) of raw coal for a total design feed rate of 1,400 ROM tph, although the preparation plant typically operates at 1,500 ROM tph (750 to 775 ROM tph per circuit). The preparation plant feed rate is adjusted based on the desired product quality, which often results in the preparation plant's processing rate to be higher than the design rate.

The Leer Mine produces a high quality, high volatile metallurgical coal. Historically, the market for metallurgical coal from the Leer Mine has been domestic metallurgical coal consumers and the global seaborne metallurgical coal market. Production from the Leer Mine is a high volatile A coal, as well as a middlings product.

High volatile metallurgical coal contains more than 31 percent volatile matter and is typically represented as high volatile A and high volatile B coal. A third class of high volatile metallurgical coal is referred to as high volatile C, which has calorific, sulfur and petrographic quality considerably less than high volatile A and B metallurgical coals. High volatile metallurgical coal, primarily high volatile A and B coals, serve both the domestic and global seaborne metallurgical coal markets. The Leer Mine sells a high volatile A metallurgical coal.

1.5 MINERAL RESERVE AND RESOURCE ESTIMATE

The Leer Mine coal resources, as of December 31, 2021, summarized below are reported as in-place resources and are exclusive of reported coal reserve tons. Resources are reported in categories of Measured, Indicated and Inferred tonnage and are in accordance with Regulation S-K Item 1302(d), summarized in Table 1.5-1 as follows:

Table 1.5-1 In-Place Coal Resource Tonnage and Quality Estimate as of December 31, 2021

			Average Coal	In-Place Resources (000 Tons)				Coal Quality (Dry Basis) Raw	
Mine Area	Seam	Area (Acres)	Thickness (Feet)	Measured	Indicated	Total	Inferred	Ash (%)	Relative Density (Lbs/CF)
Leer LOM	Lower Kittanning	2,195	4.39	2,400	11,600	14,000	4,900	20.8	90.48

Notes:

- Mineral Resources reported above are not Mineral Reserves and do not meet the threshold for reserve modifying factors, such as estimated economic viability, that would allow for conversion to mineral reserves. There is no certainty that any part of the Mineral Resources estimated will be converted into Mineral Reserves. Mineral Resources reported here are exclusive of Mineral Reserves.
- Resources stated as contained within a potentially economically mineable underground mine assuming a 3.0 feet minimum seam thickness, a high vol A coal product realizing a sales price of $110.18 per ton FOB Mine and operating cost of $72.49 per ton.
- Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding

The conversion of resources to reserves at the Leer Mine considers the effects of projected dilution and loss of product coal quality, projected mineral prices and operating costs, regulatory compliance requirements, and mineral control to determine if the saleable coal product will be economically mineable. The design of an executable mine layout that accommodates the planned mining equipment and provides a safe underground work environment is also considered.

The coal reserve tonnage representing the economically viable tonnage controlled and uncontrolled by Arch, and estimated in accordance with Regulation S-K Item 1302(e), is summarized in Table 1.5-2 as follows:

Table 1.5-2 Recoverable Coal Reserve Tonnage and Quality Estimate as of December 31, 2021

								Coal Quality (Dry Basis)	
								Raw	
Mine Area	Seam	Product Quality	Area (Acres)	Average Coal Thickness (Feet)	Clean Recoverable Tons (000) Reserves Proven	Probable	Total	Ash (%)	Relative Density (Lbs/CF)
Controlled									
Leer LOM	Lower Kittanning	High Vol A	8,910	5.23	18,050	26,300	44,350	19.30	89.91
Uncontrolled									
Leer LOM	Lower Kittanning	High Vol A	270	5.33	590	810	1,400	20.39	90.01
Total			9,180	5.23	18,640	27,110	45,750	19.31	89.91

Notes:

- Clean recoverable Reserve tonnage based on mining recovery of 42 percent for continuous miner mining, 100 percent for longwall mining, modeled preparation plant yield, and a 95 percent preparation plant efficiency
- Mineral Reserves estimated at a sales price of $110.18 per ton FOB Mine and operating cost of $72.49 per ton
- Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding
- Mineral Reserves are reported exclusive of Mineral Resources
- Coal quality listed includes coal that is to be processed into both the middlings product and the metallurgical product and does not represent actual shipped products, which can vary for many reasons, including variations in coal depositional characteristics, non-coal parting and OSD quality characteristics and preparation plant separation specific gravities. As part of the preparation plant processing, the poorer quality middlings product is removed from the remaining clean coal, resulting in a higher quality metallurgical product.

WEIR depleted LOM reserve tonnage using actual mine workings through September 30, 2021, and subtracted actual production, reported by Arch, for the remainder of the year to arrive at reserves as of December 31, 2021.

1.6 ECONOMIC EVALUATION

WEIR prepared a Preliminary Feasibility Study financial model in order to assess the economic viability of the Leer Mine LOM Plan. Specifically, plans were evaluated using discounted cash

flow analysis, which consists of annual revenue projections for the Leer Mine LOM Plan. Cash outflows such as capital, including preproduction costs, sustaining capital costs, operating costs, transportation costs, royalties, and taxes are subtracted from the inflows to produce the annual cash flow projections. No adjustments are made for inflation and all cash flows are in 2021 United States dollars. WEIR's study was conducted on an un-levered basis, excluding costs associated with any debt servicing requirements. In its assessment of Net Present Value (NPV), WEIR utilized a discount rate of 10 percent.

The Preliminary Feasibility Study financial model developed for use in this TRS was meant to evaluate the prospects of economic extraction of coal within the Leer Mine resource area. This economic evaluation is not meant to represent a project valuation. Furthermore, optimization of the LOM Plan was outside of the scope of this engagement.

The projected coal sales price is based on a high volatile A benchmark for Hard Coking Coal (HCC) of $167.50 per metric tonne. Once converted to short tons, adjusted for transportation and the inclusion of middling coal sales, the estimated LOM Plan FOB Mine price is $110.18 per ton.

The results of WEIR's Preliminary Feasibility Study demonstrated an after-tax NPV of $1.25 billion for the Leer Mine LOM Plan. Key operational statistics for the LOM Plan, on an after-tax basis, are summarized in Table 1.6-1 as follows:

Table 1.6-1 Key Operating Statistics

	LOM Plan
ROM Tons Produced (000s)	125,207
Clean Tons Produced (000s)	44,195
Preparation Plant Yield (%)	35.3
Marketable Tons Sold (000s)	44,408
	($ Per Ton)
Coal Sales Realization	110.18
Direct Cash Costs	50.94
Other Cash Costs	9.00
Non-cash Costs	12.55
Total Cost of Sales	72.49
Profit / (Loss)	37.69
EBITDA	50.24
CAPEX	6.99

A sensitivity analysis was undertaken to examine the influence of changes to assumptions for coal sales price, preparation plant yield, operating cost, capital expenditures, and discount rate on the base case after-tax NPV. The sensitivity analysis range (+/- 25 percent) was designed to capture the bounds of reasonable variability for each element analyzed.

The Leer Mine NPV is most sensitive to changes in coal sales price, operating cost, and preparation plant yield. It is less sensitive to changes in discount rate and capital expenditures.

1.7 ENVIRONMENTAL STUDIES AND PERMITTING REQUIREMENTS

As part of the permitting process required by the West Virginia Department of Environmental Protection (WVDEP), numerous baseline studies or impact assessments were undertaken by Arch. These baseline studies or impact assessments included in the permit are summarized as follows:

- Groundwater Inventory
- Surface Water Quality and Quantity
- Probable Hydrologic Consequences

The Leer Mine has been issued mining permits and associated NPDES permits by the WVDEP as shown in Table 1.7-1 as follows:

Table 1.7-1 Leer Mining and NPDES Permits

Permit Number	Permitted Surface Area (Acres)	Issue Date	NPDES Permit No.
U-2004-06, Revision No. 24	152.82	9/11/2020	WV1017764
O-2017-06, IBR No. 4	274.89	6/3/2020	WV1017764
	427.71		

The current permit numbers, bond amounts and reclamation liability for each permit is shown in Table 1.7-2 as follows:

Table 1.7-2 Leer Mine Permitted Area, Reclamation Liability and Bonds

Permit Number	Permitted Surface Area (Acres)	Reclamation Liability [1] ($000)	Bond No.	Bond Amount ($000)
U-2004-06	152.82	10,762	SUR0044268	7,424
O-2017-06	274.89	5,867	1066186	1,155
	427.71	16,629		8,579

[1] Represents the undiscounted cash flows to satisfy reclamation as of July 2020

Arch currently employs approximately 500 personnel at the Leer Mine and is projected to have a maximum employment of 508 personnel during the Leer Mine LOM Plan. The mine also creates substantial economic value with its third-party service and supply providers, utilities and through payment of taxes and fees to governmental agencies.

The Leer Mine is located in a rural and fairly isolated area of West Virginia. Arch received the Greenlands Award from the West Virginia Coal Association for developing, in 2011, the Tygart Valley Community Advisory Panel, which is a non-profit, volunteer entity serving as a forum for open discussion between representatives of the Leer Mine and the residents of the Tygart Valley Area.

The number of environmental violations issued is low for a coal mining operation the size of the Leer Mine.

Based on WEIR's review of Arch's plans for environmental compliance, permit compliance and conditions, and dealings with local individuals and groups, Arch's efforts appear to be adequate and reasonable in order to obtain approvals necessary relative to the execution of the Leer Mine LOM Plan.

1.8 CONCLUSIONS AND RECOMMENDATIONS

Among other U.S. underground mines, the Leer Mine is consistently ranked within the top quartile as measured by mine productivity (tons produced per employee hour worked, as reported by MSHA). Additionally, Arch has a long and successful operating history of resource exploration, mine development, and mining operations at the Leer Mine, with extensive exploration data including drillholes, in-mine seam thickness and elevation measurements, and in-mine channel samples supporting the determination of mineral resource

and reserve estimates, and projected economic viability. The data has been reviewed and analyzed by WEIR and determined to be adequate in quantity and reliability to support the coal resource and coal reserve estimates in this TRS.

The LOM Plan includes projected mining in a limited number of small areas that will be encountered in later years of the LOM Plan where Arch does not have mineral control. Most of these areas are expected to be acquired by Arch, in adequate time, before the areas are scheduled to be mined. However, if those areas cannot be acquired, adjustments could be made to the scheduled LOM Plan to avoid those areas.

The coal resource and coal reserve estimates and supporting Preliminary Feasibility Study were prepared in accordance with Regulation S-K 1300 requirements. There are 14.0 million in-place tons of measured and indicated coal resources, exclusive of reserves, and 45.8 million clean recoverable tons of underground mineable reserves within the Leer Mine as of December 31, 2021. Reasonable prospects for economic extraction were established through the development of a Preliminary Feasibility Study relative to the Leer Mine LOM Plan, considering historical mining performance, historical and projected metallurgical coal sales prices, historical and projected mine operating costs, and recognizing reasonable and sufficient capital expenditures.

The ability of Arch, or any coal company, to achieve production and financial projections is dependent on numerous factors. These factors primarily include site-specific geological conditions, the capabilities of management and mine personnel, level of success in acquiring reserves and surface properties, coal sales prices and market conditions, environmental issues, securing permits and bonds, and developing and operating mines in a safe and efficient manner. Unforeseen changes in legislation and new industry developments could substantially alter the performance of any mining company.

Coal mining is carried out in an environment where not all events are predictable. While an effective management team can identify known risks and take measures to manage and/or mitigate these risks, there is still the possibility of unexpected and unpredictable events occurring. It is not possible therefore to totally remove all risks or state with certainty that an event that may have a material impact on the operation of a coal mine will not occur.

WEIR assessed risks associated with the economic mineability of the Leer Mine to be low to moderate and adds that the majority of the risks can be kept low and/or mitigated with proper planning and monitoring of the mining operations.

WEIR recommends that any future exploration work and mineral property acquisition should include what has been historically implemented related to the following:

Geology

- Have an experienced geologist log core holes, measure core recovery, complete sampling. Geophysically log core holes to verify seam and coal thickness and core recovery.
- Geophysically log rotary holes to verify strata and coal thickness.
- Continue to prepare laboratory sample analysis at a 1.40, 1.50 and 1.60 specific gravity to better match the preparation plant specific gravity when processing a metallurgical coal.
- Continue collecting channel samples (include parting).

- Obtain a survey coordinate where a channel sample has been collected.
- Add additional drilling data points in the northern extension of the Leer Mine to increase the confidence of the resource area.

Mineral Property

- Acquire or obtain leases of uncontrolled properties at least two years before the projected mining date.

2.0 INTRODUCTION

2.1 REGISTRANT

WEIR was retained by Arch (NYSE: ARCH) to prepare a TRS related to Arch's currently operating Leer Mine. The Leer Mine is located approximately 25 miles south of the city of Morgantown, primarily in Taylor County, with minimal extension into a small area of Preston County, West Virginia (see Figure 1.1-1).

2.2 TERMS OF REFERENCE AND PURPOSE

This TRS was prepared specifically for Arch's Leer Mine. The Lower Kittanning Seam resources at the Leer Mine have been herein classified in accordance with SEC mining property disclosure rules under Subpart 1300 and Item 601 (96)(B)(iii) of Regulation S-K. Unless otherwise stated, all volumes, grades, distances, and currencies are expressed in United States customary units.

The accuracy of reserve and resource estimates are, in part, a function of the quality and quantity of available data at the time this report was prepared. Estimates presented herein are considered reasonable. However, they should be accepted with the understanding that with additional data and analysis available subsequent to the date of this report, the estimates may necessitate revision which may be material. Certain information set forth in this report contains "forward-looking information", including production, productivity, operating costs, capital costs, sales prices, and other assumptions. These statements are not guarantees of future performance and undue reliance should not be placed on them. The assumptions used to develop the forward-looking information and the risks that could cause the actual results to differ materially are detailed in the body of this report.

The Leer Mine is a permitted underground longwall mine that commenced production of metallurgical coal in the fourth quarter of 2011. A northern extension of the Leer Mine, Permit Revision 25, was approved on October 20, 2021.

For the Leer Mine, as an established producing mine, this TRS reports both mineral reserves and resources (exclusive of reserves). A proposed extension of the Leer Mine is planned for initial production in 2022 and both mineral reserves and resources (exclusive of reserves) are reported. Supporting the assessment of the economic mineability of reported reserves and

prospects of economically feasible extraction of reported resources, this report includes summary detail of a Preliminary Feasibility Study conducted relative to the Leer Mine.

WEIR's evaluation of coal reserves and resources was conducted in accordance with Regulation S-K 1300 definitions for Mineral Resource, Mineral Reserve and Preliminary Feasibility Study as follows:

- Mineral Resource is a concentration or occurrence of material of economic interest in or on the earth's crust in such form, grade or quality, and quantity that there are reasonable prospects for economic extraction. A mineral resource is a reasonable estimate of mineralization, taking into account relevant factors such as cut-off grade, likely mining dimensions, location or continuity, that, with the assumed and justifiable technical and economic conditions, is likely to, in whole or in part, become economically extractable. It is not merely an inventory of all mineralization drilled or sampled.
- Mineral Reserve is an estimate of tonnage and grade or quality of indicated and measured mineral resources that, in the opinion of the Qualified Person, can be the basis of an economically viable project. More specifically, it is the economically mineable part of a measured or indicated mineral resource, which includes diluting materials and allowances for losses that may occur when the material is mined or extracted.
- Preliminary Feasibility Study is a comprehensive study of a range of options for the technical and economic viability of a mineral project that has advanced to a stage where a Qualified Person has determined (in the case of underground mining) a preferred mining method, or (in the case of surface mining) a pit configuration, and in all cases has determined an effective method of mineral processing and an effective plan to sell the product.

2.3 SOURCES OF INFORMATION AND DATA

The primary information used in this study was obtained from the following sources:

- Geological data that was exclusively provided by Arch geology and engineering staff. The geological data includes drillhole information such as driller's logs, geologist's logs, both full and partial scans of geophysical logs, survey data, coal quality laboratory certificates, and MS Excel™ (Excel) versions of drillhole survey, lithology and quality

data. Additionally, WEIR was provided with modeled coal seam floor elevations and seam thickness contours, topography contours, in-mine seam measurement thicknesses, mine channel quality samples, and other base geological data.

- Mineral and surface ownership maps, and supplemental files were provided exclusively by Arch Land LLC, a subsidiary of Arch.
- Site visits by WEIR Qualified Persons (QPs) on August 17, 2021.
- Interviews between WEIR personnel and Arch personnel including
  - V.P. of Geology & Exploration
  - Manager of Geology, East
  - Director of Financial Analysis and Support
  - Mine Manager - Leer Mine
  - Manager of Engineering - Leer Mine
  - Business Manager - Leer Mine
  - Maintenance Manager - Leer Mine
- Historical production, productivity, staffing levels, operating costs, capital expenditures, and coal sales revenue provided by Arch.
- Life of Mine (LOM) projections and cost model provided by Arch.
- Coal processing and handling facilities plot plans and flow sheets.
- Health, safety, and environmental issues discussed during interviews between WEIR personnel and Arch personnel.
- Current mine permits, in addition to recent permit revisions and renewals provided by Arch.
- Current and projected mine plans, including production, productivity, operating costs, and capital expenditures required to sustain projected levels of production for the Leer Mine, provided by Arch, and which were all reviewed for reasonableness by WEIR.
- Market outlook and coal sales price projections provided by Arch
- Projected reclamation costs for mine closure activities provided by Arch.

A detailed list of all data received and reviewed for this study is provided in Sections 24.0 and 25.0 of this TRS.

2.4 DETAILS OF THE PERSONAL INSPECTION OF THE PROPERTY

WEIR personnel previously visited the Leer Mine on November 24, 2014. WEIR has also performed numerous annual audits of the Leer Mine reserves for Arch's annual SEC 10K filings.

WEIR initially held discussions with mine management on February 18, 2021, to review questions WEIR had relative to the property's geology, mine plans and operations. The management discussions included key topics as follows:

- Geology
- Property
- Infrastructure
- Mine Plan, Production and Productivity
- Preparation Plant
- Operating Costs and Capital expenditures
- Marketing
- Environmental and Compliance
- Risks and Uncertainties

Subsequently. WEIR personnel visited the Leer Mine on August 17, 2021. Areas of the mine visited included the following:

- Mine office and Bathhouse
- Warehouse
- Preparation Plant and Stockpiles
- Rail Loadout
- Refuse Impoundment
- Underground areas, including the 5 Right longwall, 4 East Mains (MMUs 001 and 005), 3 Left Gateroad (MMU 004), 4 Left Gateroad (MMU 002), and North Mains

In addition to observance of mine infrastructure, surface facilities and mining conditions, WEIR discussed the Leer Mine LOM Plan with mine management personnel.

2.5 PREVIOUS TRS

This TRS is the initial TRS to be filed related to the Leer Mine.

3.0 PROPERTY DESCRIPTION

3.1 PROPERTY LOCATION

The Leer Mine is located approximately 25 miles south of Morgantown, West Virginia, primarily in Taylor County, with minimal extension into Preston County, within the Northern West Virginia coal field of the NAPP Region of the United States (see Figure 1.1-1). The USGS 7.5-minute quadrangle map sheets are Fairmont East, Gladesville, Grafton, and Thornton.

3.2 PROPERTY AREA

The Leer Mine permit area includes approximately 12,635 acres of controlled mineral property. The proposed extension of the Leer Mine permit area will include approximately 5,600 acres of controlled mineral property.

The Leer Mine's surface facilities are located within the Leer Mine permit area, near central area of the mid-north boundary of the permit. The surface facilities include mine administration, engineering and operations offices, coal preparation plant, rail loadout, mine maintenance facilities, warehouse facilities, parking lots, preparation plant waste disposal, settling ponds, and the Leer Mine slope portal access. The total disturbed area for the Leer Mine surface facilities is approximately 200 acres.

3.3 PROPERTY CONTROL

The Leer Mine reserve boundary comprises approximately 26,300 acres. Within that boundary, Arch controls the Lower Kittanning Seam through five coal leases covering approximately 880 acres, with the remaining approximate 25,130 acres of Lower Kittanning Seam owned by Arch through nine coal deeds. An additional 270 acres of the Lower Kittanning Seam are currently uncontrolled by Arch. A table that describes the various property control contracts is shown in Table 3.3-1. Note that each individual contract may include more than one type of property control.

Table 3.3-1 Property Control

Document Type	Quantity
Coal Leases	10
Coal Deeds	12
Surface Leases	1
Surface Deeds	53
Right of Entry	1
Surface Use Agreement	1
Options to Purchase Property	5
Subsidence Rights	20

3.4 MINERAL CONTROL

Coal seam mineral rights are controlled by 10 coal leases and 12 coal deeds. All 10 leases have a minimum annual royalty payment ranging from $1,570 to $58,269. Each lease has a minimum royalty amount that must be paid annually in order to maintain the lease, with the exception of one lease, which has a one-time only minimum royalty payment. Arch's production royalty rates range from 5 percent to 10 percent of the GSP. Three leases have additional annual rental agreements. There are two tracts within Coal Deed LN-001-01 that are not 100 percent controlled; one tract is 92 percent controlled and the other is 83 percent controlled. One tract within Coal Deed TV-036 is 50 percent controlled. These three tracts total approximately 220 acres. The details of the mineral control contracts are listed in Table 3.4-1.

Table 3.4-1 Mineral Control

Arch Land File Number	Document Type	Seams	Expiration Date [1]
D-1	Deed	Lower Kittanning	N/A
L-1	Coal Lease	Lower Kittanning	Upon Exhaustion
L-2	Coal Lease	All seams	Upon Exhaustion
L-3	Lease	Upper Freeport and all seams below	Upon Exhaustion
D-2	Deed	All seams	N/A
D-3	Deed	All seams	N/A
D-4	Deed	All seams	N/A
D-5	Deed	All seams	N/A
D-6	Deed	All seams	N/A
D-7	Deed	All seams	N/A
D-8	Deed	All seams	N/A
D-9	Deed	All seams	N/A
D-10	Deed	All seams	N/A
Arch Land File Number	Document Type	Seams	Expiration Date [1]
L-4	Coal Lease	All seams	Upon Exhaustion
L-5	Coal Lease	All seams	Upon Exhaustion
L-6	Coal Lease	All seams	Upon Exhaustion
L-7	Coal Lease	All seams	Upon Exhaustion
L-8	Coal Lease	All seams	Upon Exhaustion
L-9	Coal Lease	All seams	Upon Exhaustion
L-10	Coal Lease	All seams	Upon Exhaustion
D-11	Deed	All seams	N/A
D-12	Deed	All seams	N/A

[1] Expiration dates on leases can be extended

3.5 SIGNIFICANT PROPERTY ENCUMBRANCES

The majority of the Leer Mine LOM Plan area is permitted. A permit revision to include the northern extension projected mining areas was submitted on May 3, 2021 to the WVDEP and was approved on October 20, 2021. Future permit revisions will be needed at the Leer Mine to add underground mining area and associated surface area for bleeder shaft sites. Small, isolated uncontrolled properties, primarily within the northern extension will need to be acquired, by

lease or purchase, to avoid the need to revise the mine plan. The tons associated with these uncontrolled properties have been included in the reserve estimates.

One property lease at the Leer Mine requires a payment to be made based on transport of other coal (i.e. coal not mined within that lease) across the lease boundary (wheelage). Wheelage payments related to mining longwall panels 18C through 26 began in October 2021 and are estimated to continue through February 2027.

Approximately 270 acres (2.9 percent) of uncontrolled property exist within the Leer Mine LOM Plan Reserve area. Approximately 11 acres (0.5 percent) of uncontrolled property exist within the Leer Mine exclusive resource area. Acquisition of these relatively small blocks of mineral resource is on-going by Arch and not dissimilar to other mine's property control tasks involving relatively small areas. Uncontrolled properties within a mine plan are not uncommon and are mitigated as needed or, in rare cases, the mine plans are adjusted to avoid the uncontrolled properties.

WEIR is not aware of any obstacles to obtaining necessary property rights, and reasonably believes that the chances of obtaining such rights in a timely manner are highly likely. Given prior successes in Arch's property acquisition efforts, and relatively small tonnage impacts for unsuccessful reserve property acquisitions, this risk appears relatively low, as well.

A list of Arch's permits is shown in Table 3.5-1, with a more detailed description of permits discussed in Section 17.3.

Table 3.5-1 Permit List

Permit Number	Permitted Surface Area (Acres)	Issue Date	NPDES Permit No.
U-2004-06, Revision No. 24	152.82	9/11/2020	WV1017764
O-2017-06, IBR No. 4	274.89	6/3/2020	WV1017764
	427.71		

A permit amendment will be required, by the fourth quarter of 2027, for Permit O-2017-06 to add the Rocky Branch Impoundment. In addition to the permitting actions, reclamation surety bonds will be required in accordance with West Virginia state regulations.

The Leer Mine does not have a history of significant regulatory fines or violations. The last violation for Permit Number U-2004-06 was on June 4, 2015, with an assessed fine of $700, and the last violation for Permit Number O-2017-06 was on October 9, 2013, with no fine assessed.

3.6 SIGNIFICANT PROPERTY FACTORS AND RISKS

Given Arch's controlled interests at the Leer Mine, which relate to property that is held, by and large, by Arch and private individuals, WEIR assesses there are no significant issues affecting access to the coal interests or the ability of Arch to execute the Leer Mine LOM Plan.

3.7 ROYALTY INTEREST

Arch holds no royalty or similar interest in property which is owned or operated by another party.

4.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

4.1 TOPOGRAPHY, ELEVATION, AND VEGETATION

The Leer Mine Property is located on the Appalachian Plateau. The topography of the property consists of steep slopes rising from the Tygart Valley River and its associated tributaries. The Tygart Valley River extends from Pocahontas County, West Virginia through Randolph, Barbour, Taylor, and Marion Counties. The property is located off the Three Fork Creek tributary of the Tygart Valley River near Grafton, West Virginia. The upper elevations consist of rolling terrain, with scattered knobs of higher elevation. The terrain drops off from the higher elevations, with steep slopes down to Three Fork Creek to the north, Tygart Lake to the west and south, and Little Sandy Creek to the southeast and east. There are scattered areas of relatively flat lying pastureland on the river and stream floodplain terraces. Maximum relief of the property is approximately 800 feet. Elevation ranges from 1,004 feet on Three Fork Creek to 1,872 feet on an isolated knob west of Little Sandy Creek, (USGS Thornton quadrangle). Topography and other features of the area are shown on Figure 7.5-1.

The Leer Mine Property consists mostly of unmanaged forestland and scattered pastureland. The forestland consists of typical West Virginia forest, with Oak/Hickory as the dominant forest-type group and a lesser percentage of the Maple/Beech/Birch forest-type group, (USDA Resource update FS-123).

4.2 PROPERTY ACCESS

The main road near the mine surface facilities is US Route 50, which runs east/west and is less than a mile north of the Leer Mine facilities. The mine access road (Tygart Drive) is approximately two miles west of the small town of Thornton, West Virginia, and approximately three miles east of Grafton, West Virginia. The nearest larger towns are Morgantown, West Virginia, located approximately 25 miles to the north, and Bridgeport, West Virginia, located approximately 16 miles to the west of the property.

The Mountain Subdivision rail line, owned and operated by the CSX Railroad (CSX), passes directly by the mine surface facilities, and has a separate rail loadout spur for the Leer Mine. There are dual main rail lines adjacent to the mine, which helps reduce rail line congestion.

The Mountain Subdivision rail line extends from Cumberland, Maryland to Grafton, West Virginia. CSX also owns and operates a rail yard at Grafton, West Virginia.

Three Fork Creek, to the north and adjacent to the rail lines, runs east to west. The Tygart Valley River runs from south to north along the western side of the Leer Mine. Tygart Lake is partially within the Leer Mine permit area, along the western boundary of the permit. The surrounding waterways are not navigable for commercial traffic.

The nearest airport is the North Central West Virginia Airport (CKB), which is located in Bridgeport, West Virginia. The North Central West Virginia Airport is 15.6 miles from Grafton, West Virginia. The Morgantown Municipal Airport (MGW) is located in Morgantown, West Virginia, 29.6 miles from the Leer Mine Property.

4.3 CLIMATE AND OPERATING SEASON

The climate associated with the Leer Mine Property is classified as a humid continental, characterized by hot, humid summers and moderately cold winters. Climate conditions vary greatly in the state of West Virginia due to influence of the rugged topography. Average high temperatures range from 82 to 87 degrees Fahrenheit in the summer, with average temperatures ranging from 15 to 25 degrees Fahrenheit in winter. Average yearly rainfall measured in Grafton, West Virginia is 48 inches per year. The Leer Mine currently operates year-round, regardless of weather conditions.

4.4 INFRASTRUCTURE

Power

Electrical power for the Leer Mine is provided by FirstEnergy Corp. subsidiary Mon Power through a 138 kV transmission line. A contract with Mon Power provides electrical power under Rate Schedule K.

Water

The Tygart Valley River lies to the west of the Leer Mine Property. The Tygart Valley River is not navigable for commercial traffic. Over half of the water required for mine operations such as mine dust suppression and preparation plant make up water is provided by recycling. The remainder is provided by a pump station installed beside Three Fork Creek, a tributary of Tygart Valley River, and is pumped to a million-gallon head tank. There is no contract or

monthly charge for the water from Three Fork Creek. Potable water for the facilities is obtained from the Taylor County Public Service District at an average monthly charge of $12,000.

Personnel

The northern West Virginia area surrounding the Leer Mine has a long history of underground coal mining and attracting mining personnel with qualified skills has not been an issue. The Leer Mine is projected to employ a maximum of 508 personnel over the LOM Plan and the Leer Mine employed approximately 501 personnel at the end of January 2021. The hourly labor force remains non-union and no change in this labor arrangement is anticipated in the short term.

Supplies

Supplies for the mining operations are available from multiple vendors that service the coal industry in the NAPP Region. The main vendors utilized by Arch to supply the Leer Mine include United Central Industrial Supply, Komatsu America Corp. (Joy Global), Jennmar Corporation, Strata Worldwide, Polydeck, Chemstream Inc., Richwood Industries, Inc., Conn-weld Industries, LLC, Coalfield Services Inc., Minova Global, Airtite Mine Products, LLC, Schauenburg Flexadux Corp., Contitech USA Inc., Greer Industries, Inc., and American Block Co., Inc.

5.0 HISTORY

5.1 PREVIOUS OPERATIONS

Prior to the development of the Leer Mine, there was very little mining that occurred on the property. A small underground coal mine operated by the Thornton Fire Brick Company was located in the Upper Freeport Seam to the southeast of Thornton, West Virginia. This mine was located off of Three Fork Creek and operated in the early 1900s. The Thornton Fire Brick Company also operated a surface mine or "clay pit" near Thornton, West Virginia, mining fireclay for brickmaking in the early 1900s. Available maps show an underground mine, of limited extent, in the Lower Kittanning Seam to the south of the Leer Mine on the east side of Frog Run. Available data shows this as Sterling Coal Company's Cecil coal mine, with mining shown to have occurred in the early 1900s.

5.2 PREVIOUS EXPLORATION AND DEVELOPMENT

Prior to Arch's control of the property in 2011, previous exploration included 153 continuous core holes drilled in proximity to the Leer Mine Property. Prior exploration activity dates back to 1922, with a list of prior companies conducting exploration, number of core holes drilled, seam thickness range, laboratories utilized for quality analysis, and dates are listed in Table 5.2-1.

Table 5.2-1 Previous Exploration

Company	Drill Holes	Seam Thickness (feet)	Quality Laboratory	Year Drilled
Mohawk Smokeless Coal Company	1	5.3	None	Unknown
Koppers Company	8	0.0 to 7.9	Unknown	1922
Eastern Gas & Fuel Associates	2	5.4	Eastern Associated Coal Corp.	1960
Eastern Gas & Fuel Associates	39	0.0 to 8.9	Eastern Associated Coal Corp.	1964
Tygart West Inc./Atlantic Richfield Co.	4	4.1 to 5.4	Unknown	1974
Hillman Coal Company	17	0.0 to 7.3	Unknown	1980
Eastern Associated Coal Corp.	3	3.9 to 4.7	Eastern Associated Coal Corp.	1982
Tygart West Inc./Anaconda Minerals Co	29	3.9 to 9.7	Colorado School of Mines	1982
Anker Energy [(1)]	1	4.2	Unknown	1986
Unkown (M93-14) [(1)]	1	4.2	None	1993
International Coal Group	39	0.0 to 8.4	SGS	2005
International Coal Group	8	2.8 to 5.8	SGS	2006
Patriot Coal (GUFDEP4) [(1)]	1	4.8	None	Unknown

[(1)] No documentation available

6.0 GEOLOGICAL SETTING, MINERALIZATION, AND DEPOSIT

6.1 REGIONAL, LOCAL, AND PROPERTY GEOLOGY

6.1.1 Regional Geology

The strata of the Tygart Valley River in Taylor, Barbour and Preston Counties, West Virginia consists of Pennsylvanian Age sedimentary strata of the Monongahela Group, the Conemaugh Group and the Allegheny Formation (see Figure 6.3-1). The gently dipping, stratiform or layered strata consists of shale, sandstone, claystone, fireclay, and coal seams. At present, economic sedimentary deposits are limited to coal seams of the Tygart Valley River. Limited scale mining of fireclay occurred in several areas near Grafton, West Virginia during the early 1900s.

The Monongahela Group includes the Sewickley, Redstone and Pittsburgh coal seams. The Pittsburgh Seam has been extensively surface and underground mined at higher elevations in the Tygart Valley River region. The Conemaugh Group coal seams include the Elk Lick, Harlem, Bakerstown, and Brush Creek. No known large-scale mining has taken place within the Conemaugh Group coal seams in the Tygart Valley River region. The Allegheny Formation includes the Upper and Lower Freeport, Johnstown Limestone, Upper and Lower Kittanning and the Clarion coal seams. The Upper Freeport, Upper Kittanning, Lower Kittanning, and Clarion seams have been previously mined in the Tygart Valley River region. All other coal seams of the Allegheny Formation in the area occur in limited areal extent, and are generally of insufficient thickness for mining.

6.1.2 Local Geology

The Monongahela Group strata is not present on the Leer Mine Property due to the lower elevations of the property. The strata present on the property consists of the Conemaugh Group and the Allegheny Formation. The Conemaugh Group coal seams consist of the Harlem, Bakerstown, and Brush Creek. All coal seams of the Conemaugh Group are thin and discontinuous. The Allegheny Formation coal seams consist of the Upper and Lower Freeport, Upper and Lower Kittanning, and Clarion. The Upper and Lower Freeport, Upper Kittanning and Clarion coal seams are discontinuous and of limited extent on the Leer Mine Property.

6.1.3 Property Geology

The principal minable coal seam on the Leer Mine Property is the Lower Kittanning Seam. The Lower Kittanning Seam occurs in a larger area, with a higher seam thickness than all other listed seams. The Leer Mine is actively mining the Lower Kittanning Seam. The Lower Kittanning Seam reserve extends northeast from Grafton, West Virginia toward Thornton, West Virginia. The reserve area is approximately 6.5 miles in length and approximately 4.0 miles wide. The Lower Kittanning Seam consists primarily of a single horizon of coal with a bone coal parting. Drillholes show seam thickness ranging from 0.0 to 10.5 feet. The seam thins (< 3.0 feet) to the south and east of the Leer Mine LOM Plan and to the north and east of the northern extension of the Leer Mine LOM Plan. The mineable coal seam is typically low-ash, high thermal content, high volatile A bituminous metallurgical coal product. Parting does occur within the property and generally is between one and three feet thick. The parting does not affect the end product since the coal is washed. The seam is generally continuous but is absent in areas outside the Leer Mine LOM Plan. The Lower Kittaning Seam is thin or missing in areas adjacent to the Leer Mine reserve. The missing coal areas are due to non-deposition of the Lower Kittaning coal seam.

6.2 MINERAL DEPOSIT TYPE AND GEOLOGICAL MODEL

The Leer Mine reserve is a relatively flat lying, sedimentary deposit of Pennsylvanian Age. The Leer Mine is actively mining a single coal seam, the Lower Kittanning.

Exploration consists of core drilling for the Lower Kittanning Seam carried out each year in advance of mining, to refine the reserve boundary and to define limits of the mine plan. For internal purposes, Arch models the reserve using the Geovia Minex® mine planning software package, completing model updates subsequent to each phase of exploration drilling. WEIR modeled the reserves and resources using Datamine MineScape® Stratmodel geological modeling software. The WEIR model is discussed in more detail in Section 9.1.

6.3 STRATIGRAPHIC COLUMN AND CROSS SECTION

Figure 6.3-1 and Figure 6.3-2 show the stratigraphic column and the Lower Kittanning Seam cross section related to the Leer Mine.

Figure 6.3-1 Stratigraphic Column

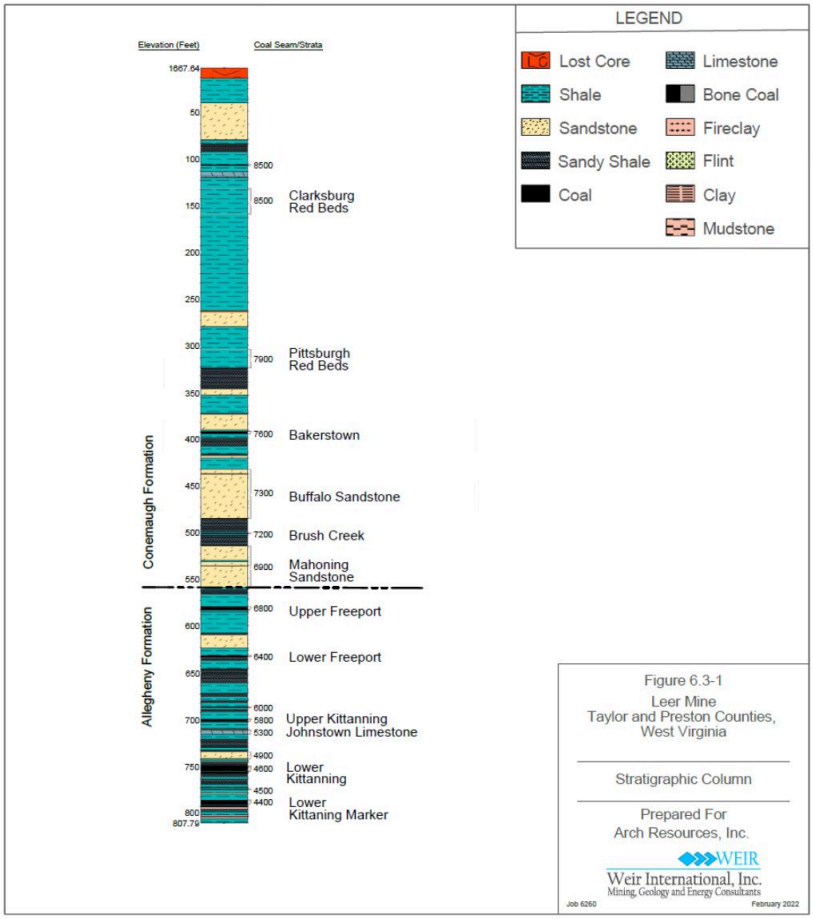
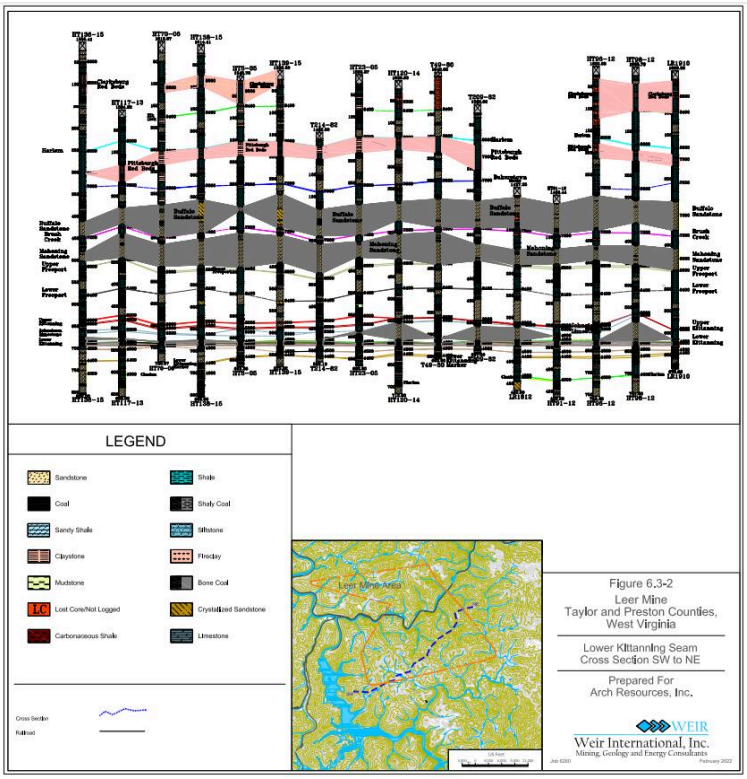


Figure 6.3-2 Lower Kittanning Seam Cross Section SW to NE



7.0 EXPLORATION

7.1 NON-DRILLING EXPLORATION

Drilling has served as the primary form of exploration carried out on the Leer Mine Property. In addition to the exploration, mine measurements are taken by Arch, at intervals between 100 and 300 feet throughout the Leer Mine underground mine workings. A total of 1,505 of these mine measurements were recorded. Arch also provided details of 47 channel samples that align with 26 holes that were previously drilled. The channel samples are used in conjunction with the drillholes to model clean coal quality.

7.2 DRILLING

Historical exploration at the Leer Mine has relied exclusively upon continuous core drilling performed by competent contract drilling companies. Coreholes at the Leer Mine Property are typically 3.76-inch diameter (yielding 2.5-inch diameter core samples). Exploration drilling provides core samples of roof strata, the coal seam and floor strata. The geologist's seam thickness measurements are checked against the geophysical logs for thickness accuracy and to confirm core recovery. A hole with significant lost core or crushed core can result in misleading data. Drillholes with core recovery of less than 90 percent are noted and subsequently reviewed and potentially excluded from geological and coal quality modeling. WEIR did not exclude any holes for poor core recovery, as all of the holes within the project area obtained core recovery of at least 90 percent. Arch's standard procedures state that holes with less than 95 percent core recovery are re-drilled in the same boring, using a wedge above the seam, so that offset drilling of a new hole is not required. During core drilling, all core samples are boxed, photographed, and stored. Roof and floor strata core samples are sent to laboratories for geotechnical strength tests. Coal seam core samples are sent to laboratories for quality analyses. Caliper, density, gamma, resistivity, and sonic downhole geophysical logs are completed as drill site and hole conditions allow. Each drillhole collar location is surveyed for accurate map coordinate and elevation data.

All original drillhole, survey, geological, geophysical, and quality data is scanned and stored on an Arch server, which is backed up nightly, so it can be accessed by select Arch personnel and quickly checked against the database, the geological model, or mine mappings. The original copies are stored in an offsite warehouse.

Table 7.2-1 summarizes the database of Arch's drilling programs.

Table 7.2-1 Drilling Programs

			Hole Type		Number of Holes with Base Data							
Drilling Series	Program Dates	Total Number of Drill Holes	Rotary	Core	Drill Hole Header	Survey Certificates	Geophysical Logs	Downhole Deviation Log	Geologist's Log	Driller's Log	Lab Analyis Certificates	Core Photographs
G Series	1922-1985	58	-	58	58	-	3	-	2	58	46	-
GN Series	2018	4	-	4	4	-	4	-	4	4	4	4
HT Series	2005-2015	90	-	90	90	32	3	-	90	85	86	89
HTR Series	2011-2012	6	1	5	6	-	5	-	-	5	-	-
LR Series	2015-2020	66	-	63	50	49	50	-	50	48	39	43
Ln Series	2020	7	-	7	7	-	-	-	7	-	-	-
M Series	1986-1993	2	2	-	2	-	-	-	-	2	-	-
T Series	1974-1982	50	-	50	50	-	29	-	50	50	50	-
WVGS	Unknown	1	-	1	1	-	-	-	1	-	-	-
Gaswells	Unknown-2014	13	NA	NA	13	6	7	-	-	-	-	-
		297	3	278	281	87	101		204	252	225	136

WEIR did not have direct involvement with the planning, implementation or supervision of Arch's drilling programs. However, having reviewed the details of each drilling program, WEIR finds the results to be consistent with industry standards and sufficient for use in the estimation of reserves and resources.

WEIR did not observe core samples in person, however, Arch provided photos of core logs for 136 drillholes. In review of these photos, WEIR found the cores to be representative of the data reported for each drillhole.

7.3 HYDROGEOLOGY

The Leer Mine is situated in the northern extent of the Tygart Valley River watershed within the Monongahela sub-basin, both being part of the greater Ohio Regional drainage basin. Drainages in the Leer Mine permit area include several named and unnamed, ephemeral and perennial tributaries. Three Fork Creek flows westward along the current Leer Mine permit boundary to its confluence with the Tygart Valley River at Grafton. To the south, Sandy Creek flows west along the Taylor-Barbour County border, draining into Tygart Lake to the southwest.

Principal aquifers within the Leer Mine permit area include the Buffalo and Mahoning sandstones at middle and lower elevations. These Pennsylvanian Age sandstones are typically confined by the less permeable Pittsburgh redbed strata capping the surrounding hilltops (see

Figure 6.3-2). The Tygart Valley River and regional groundwater flow direction is generally south to north, as water in the basin drains from the higher elevations in the Allegheny Mountain Province to the lower elevations of the Appalachian Plateau. Within the Leer Mine permit area, the gradient dips gently to northwest, with head elevation of 1,200 feet.

The average water infiltration rate into the Leer Mine void, based upon the expanded reserve area in Revision No. 21, ranges from 1,125 gallons per minute (gpm) to 1,515 gpm based upon two accepted procedures (McCoy and Leavitt equations) for estimating average infiltration. The average of the two infiltration rates, from both methods, would equate to 1,320 gpm. See Section 13.1.2 for further details on the hydrogeological model.

Arch has engaged in extensive surveying to characterize site hydrogeology and to determine groundwater inventories, water quality, and potential impacts to local usage as part of its Surface Mining Control and Reclamation Act (SMCRA) permitting process with the WVDEP. Baseline flow and quality parameters for surface and groundwater inventory have been established and monitored as required by WVDEP since 2005.

Water sampling methods for the Leer Mine are outlined and maintained by Arch in a site-specific work practice document. Reviewed annually, this operating procedure document details sampling locations, frequency, and collection protocols, including storage, transport, delivery and required chain of custody documentation. Approved methods for field data collection and instrument calibration are described, along with methods for creating sample splits, duplicates, and blind standards.

Samples are analyzed by independent laboratories that follow the most recent approved Environmental Protection Agency (EPA) sampling methodology and procedures. The laboratories employ internal quality control and quality assurance protocols before reporting results to Arch. Arch personnel then review the results again, as a second check for quality control and assurance before the results are published.

Groundwater inventories, water quality data, water balance, recharge and seepage rates have been reviewed in the approved permit and current permit revisions, including hydrologic impact assessments outlining risks, monitoring program detail, and mitigation obligations. Arch's approach to obtaining and managing its surface and groundwater data for the Leer Mine has been demonstrated to be adequate and aligned with regulatory requirements and standard industry practices. WEIR finds no material barriers to the continued success of the Leer Mine regarding hydrologic impact or compliance.

7.4 GEOTECHNICAL DATA

During core drilling, roof and floor strata of target coal seams are boxed, photographed and stored. Typically, three samples of roof and one sample of floor strata from each target seam are taken for strength testing where solid unbroken lengths of core exist. The samples are sent to the Appalachian Mining & Engineering laboratory in Lexington, Kentucky. Specific tests ran on core samples include Uniaxial Compressive Strength, Brazilian Indirect Tensile strength, Bulk Density, Specific Gravity, and Point Load index strength. Samples are prepared at the laboratory where the samples are machined into cylinders according to the appropriate ASTM specifications. Axial strain measurements are obtained using a hydraulic testing frame under a prescribed, constant load. Bulk density and specific gravity are determined by the weight, height, and diameter of the specimen used in the uniaxial strength test. Point load index strengths are obtained using a test frame with cones either perpendicular to, or parallel with, the specimen's bedding plane.

In addition to core strength testing, downhole sonic logging is performed on drillhole sidewalls to estimate compressive strength for rock strata. Sonic logs are generated using a high frequency sonic transducer that produces high-resolution imagery and reports strata characteristics such as fractures, compaction degree, and bedding plane orientation. The sonic logs are correlated with uniaxial strength measurements made on specimens from the same drillhole to estimate compression strength of roof strata. Sonic logging is a commonly used geophysical technique that provides valuable, low-cost data for ground control design.

A sample of the geotechnical data as used in a geotechnical study, *Longwall Chain Pillar Design for ICG's Tygart No. 1 Mine in the Lower Kittanning Seam* (WVU Pillar Study), commissioned with West Virginia University by Arch's predecessor company that controlled the Leer Property is shown in Table 7.4-1 as follows:

Table 7.4-1 Geotechnical Sample Data

Strata	Thickness (feet)	Youngs Modulus E (psi)	Poisson's Ratio v	Unconfined Compressive Strength (psi)	Tensile Strength (psi)	Friction Angle (degrees)
Borehole T212-82						
SH	14.20	1,240,337	0.09	1222	122	25.0
Drk Gry SH	7.14	1,240,337	0.09	1647	165	25.0
SH	9.32	1,240,337	0.09	1222	122	25.0
Drk Gry SH	13.39	1,240,337	0.09	1647	165	25.0
Gry SS	8.90	4,488,135	0.20	2364	236	30.0
Drk Gry SH	5.07	1,240,337	0.09	1647	165	25.0
LS	3.40	3,000,000	0.10	3107	311	42.0
SH	18.17	1,240,337	0.09	1222	122	25.0
SH w/ss Stks	9.74	3,142,738	0.21	2424	242	28.0
SH	2.50	1,240,337	0.09	1222	122	25.0
COAL (LK)	**6.00**	**300,000**	**0.34**	**900**	**90**	**30.0**
SH	4.62	1,240,337	0.09	1222	122	25.0
SH w/ss Stks	3.98	3,142,738	0.21	2424	242	28.0
Drk Gry SH	10.71	1,240,337	0.09	1647	165	25.0
Fireclay	9.36	250,000	0.30	547	55	20.0
SH w/ss Stks	4.00	3,142,738	0.21	2424	242	28.0
SH	13.88	1,240,337	0.09	1222	122	25.0

In addition to the WVU Pillar Study, Arch commissioned M. Heib (Heib Study) in February 2018 to conduct geotechnical testing and analysis of core holes in the Leer and Sentinel (now Leer South) mines. The report provides information related to horizontal stresses by roof strata, horizontal strain, Brinell Hardness, fracture trend analysis, Poisson's Ratio, uniaxial compressive strength, and Young's Modulus. A summary of the geotechnical data is shown in Table 7.4-2, as follows:

Table 7.4-2 Geotechnical Test Results

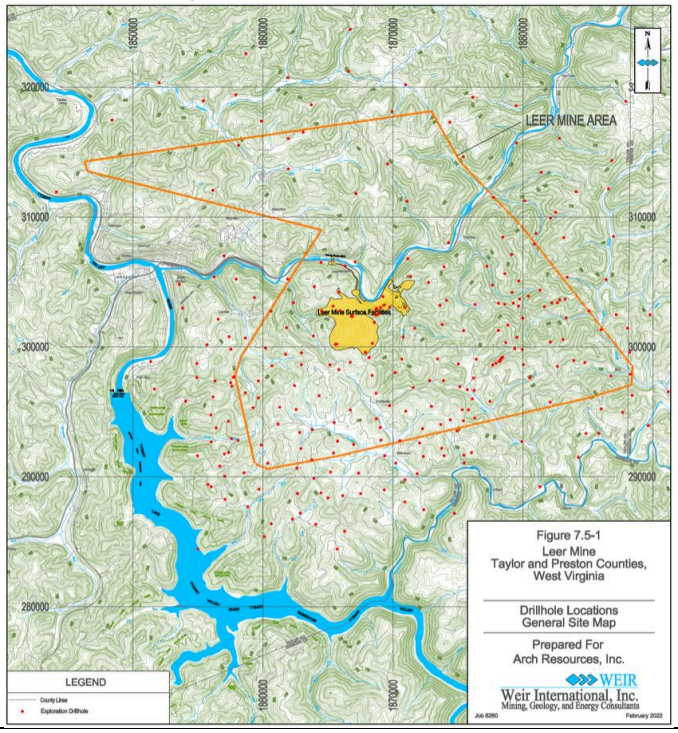
Hole	Sample	Included	Depth (feet)	Azimuth (degrees)	Principle Stress Major (psi)	Principle Stress Minor (psi)	Ratio	Lithology	Youngs Modulus E (psi)	Poisson's Ratio v	Unconfined Compressive Strength (psi)
HT101-13	UC-22	Yes	834.2	53	1,362	730	1.87	Shale	2.05E+06	0.17	3,714
HT101-13	UC-21	No	N/A	120	-	-	-	Sandy Shale	3.43E+06	0.01	6,755
HT101-13	UC-25	Yes	1008.3	83	2,873	1,712	1.68	Shale; fossils	5.56E+06	0.23	2,867
HT101-13	UC-32	No	N/A	53	-	-	-	Shale	6.32E+06	0.57	10,426
HT106-13	UC-30	Yes	422.7	118	815	413	1.97	Shale	2.49E+06	0.14	12,746
HT106-13	UC-37	Yes	436.6	73	1,555	806	1.93	Sandy Shale	2.96E+06	0.17	10,266
HT106-13	UC-34	Yes	498.6	107	1,330	693	1.92	Sandstone w/ shale streaks	2.64E+06	0.14	11,220
HT117-13	UC-24	Yes	359.8	35	385	155	2.48	Shale	5.55E+06	0.07	5,301
HT117-13	UC-23	No	N/A	32	-	-	-	Shale	6.48E+06	0.46	8,515
HT117-13	UC-36	Yes	422.7	70	2,719	1,618	1.68	Sandy Shale	8.18E+06	0.27	6,717
PD62-15	UC-29	No	N/A	155	-	-	-	Shale	3.35E+06	0.26	4,131
RM1602	UC-27	No	N/A	61	-	-	-	Shale	4.51E+06	0.24	7,924
RM1602	UC-26	No	N/A	65	-	-	-	Gray Sandstone	4.46E+07	0.03	10,388
			Average	79	1,577	875	1.93				

Since 2011, Arch has drilled 102 core holes in the Lower Kittanning Seam in the Leer Mine reserve area. All drillholes were cored, with core samples sent to Standard Labs for quality analyses. The thickness of the Lower Kittanning Seam identified in these drillholes ranged from 0.00 to 9.95 feet. A list of core holes drilled by Arch can be found in Table 7.6-1.

7.5 SITE MAP AND DRILLHOLE LOCATIONS

A map showing the location of all drillholes on the Leer Mine Property is shown on Figure 7.5-1.

Figure 7.5-1 Drillhole Collar Locations



7.6 DRILLING DATA

Arch generally uses Hammon Core Drilling, Inc. located in Craigsville, West Virginia to drill core holes. Downhole geophysical logging is performed by Geological Loggins Systems, located in Bluefield, Virginia. Coal quality analyses are currently performed by Standard Laboratories, Inc. (Standard Labs) located in Belington, West Virginia.

8.0 SAMPLE PREPARATION, ANALYSES, AND SECURITY

8.1 SAMPLE PREPARATION METHODS AND QUALITY CONTROL

Relative to the drilling conducted by Arch, once the target coal seam has been drilled, the coal core is pushed from the core barrel into a plastic lined wooden core box. The coal seam is measured and described by the geologist. The coal sample is then covered in plastic and the wooden box sealed. Cardboard dividers and foam tubing are used to tightly pack and cushion the coal sample within the wooden box. The coal core boxes are transported to the Arch core shed at Tucker Run where the core boxes are locked in a secure building. The geologist's seam thickness measurements are checked against the geophysical logs for thickness accuracy and to confirm core recovery. Within one week of completion of the core hole, the coal samples are removed from the wooden core boxes and placed in sealed plastic bags. The samples are coded and labeled with sample identification numbers based on drillhole id (for example, DT2001), sample sequence (A, B, C, etc..), and sample number, (1, 2, 3 etc..). (for example, DT2001A1 = first sample of first seam in drillhole DT2001.)

Once satisfied the data reports are accurate, the quality analyses are entered into the Arch coal database. Upon data entry completion, the modeling geologists export the data and inspects the data for variance from expected norms. If any data shows outside the norm for the property, the data is checked against laboratory results to ensure proper data entry. Quality data is gridded and mapped. Any anomalies in the data mapping are investigated. If anomalies are accurate, those items are brought to the attention of the mine engineers and sales staff.

8.2 LABORATORY SAMPLE PREPARATION, ASSAYING, AND ANALYTICAL PROCEDURES

8.2.1 Standard Laboratories, Inc.

Once quality samples are bagged and labeled, the samples are delivered to Standard Labs located in Belington, West Virginia for quality analyses. The samples are first prepared by crushing, splitting, and sizing. The analyses performed include Proximate, Washability, Ash Fusion, Ultimate, Ash Mineral, Dilatometer, Plastometer, Trace Elements, and Petrographics.

Standard Labs is certified via ANSI National Accreditation Board and located at 1196 Whitman Run Road, Belington, West Virginia 26250.

8.2.2 SGS North America, Inc

Standard Labs ships splits of the samples to the SGS North America, Inc. Mineral Services Division (SGS) laboratory located in Sophia, West Virginia for petrographic analyses. Petrographic analysis provides a clear understanding of the characteristics of the coal blend and is necessary to evaluate how coking operations will impact the final product.

SGS is certified via ISO/IEC 17025:2017 by A2LA and located at 151 Eastern Drive, Sophia, West Virginia 25921.

8.2.3 Eastern Associated Coal Corp. Laboratory

Approximately 19 core holes drilled in 1964, prior to Arch acquiring the property in 2011, were sent to Eastern Associated Coal Corp. Laboratory (EACC Lab) for analysis. WEIR was not provided any information of the protocols that the EACC Lab followed when performing the quality testing, but WEIR personnel familiar with the EACC Lab, when it was in operation, can confirm industry standard preparation sample and testing protocols were followed by the EACC Lab. Each laboratory quality sheet from EACC Lab was individually checked against a copy of the driller's and/or geologist's log to confirm that the samples match the depth and thickness of the coal seam. After completing a review of these quality samples, WEIR included these holes within the model.

8.3 QUALITY CONTROL PROCEDURES AND QUALITY ASSURANCE

Quality control procedures followed by Arch geologists are clearly defined. Arch's field geologists take specified steps to protect sample integrity and to ensure core samples are always under Arch geologist's control. These steps include the following:

- Field geologist to be on site whenever drilling is occurring
- Geologist's log to be created for each drillhole
- Rock-quality designation (RQD) logs to be prepared for roof and floor strata for all underground mineable seams
- Each drillhole to be logged using geophysical methods
- Underground mineable seams are sonic logged if drillhole conditions allow
- Geologist to compare field geologist's logs to the e-log data
- Geologist to compare the core samples against both field geologist's logs and e-logs to confirm coal thickness
- All immediate roof, coal and immediate floor core are to be boxed and photographed

- Quality sample sheets to be filled out, provided to a supervisor for approval and shipped to the laboratory
- Once core samples have been analyzed, field geologists to scrutinize the resulting quality data for accuracy
- Based on the homogeneity of the deposit and the consistent quality of the reserve area as evidenced from the product produced from this active mine, analytical laboratories are instructed to divide the samples and retain the second split for additional analysis should the original test report any anomalies.

8.4 SAMPLE PREPARATION, SECURITY, AND ANALYTICAL PROCEDURES ADEQUACY

Arch's procedures for quality analyses provide a full range of coal quality analyses so engineers and sales staff working with the data have a complete listing of the coal seam quality for each drillhole completed by Arch.

Drillhole core samples are assigned a sample ID number and a sample label is created. The label includes drillhole ID, sample ID number, and the to and from depths of the sample. The sample is then placed in a bag with the label. The bags are sealed using zip ties or tape. This is the beginning of the chain of custody. The samples do not leave the geologist's possession once removed from the core barrel. The samples remain with the geologist or are stored in a locked facility that only Arch geologists have access to, until delivery of the samples to the contracted laboratory. The delivery of the samples is carried out within one week of drillhole completion. Once in possession of the certified laboratory, the laboratory's security procedures are followed. After the sample has been tested, reviewed, and accepted, the disposal of the sample is done in accordance with local state and EPA approved methods.

WEIR has determined the sample preparation, security and analysis procedures used for the Leer Mine drillhole samples meet current coal industry standards and practices for quality testing and the laboratory results are suitable to use for geological modeling, mineral resource estimation and economic evaluation.

9.0 DATA VERIFICATION

9.1 DATA VERIFICATION PROCEDURES

Arch provided WEIR copies of all drilling records in the Leer Mine reserve area, which included Excel spreadsheets, driller's log, field geologist's logs, quality results sheets from the coal quality laboratories, mine measurement tables, as well as drawing files or PDFs of the e-logs. Each hole in the database was individually checked by WEIR against a copy of the driller's and/or geologist's log to confirm data accuracy.

Geological reviews performed by WEIR included:

- Drillhole lithology database comparison to geophysical logs
- Drillhole coal quality database comparison to quality certificates
- Channel sample coal quality database comparison to quality certificates

After completing the precursory verifications and validations described above, the drillhole data was loaded into Datamine's MineScape® Stratmodel, a geological modeling package. MineScape provides robust error checking features during the initial data load, which include confirmations of seam continuity, total depth versus hole header file data, interval overlap, and quality sample continuity with coal seams. Once the drillhole data was loaded, a stratigraphic model was created.

Several further verifications were then possible, which include:

- Creating cross sections through the model to visually inspect if anomalies occur due to miscorrelation of seams
- Creating structural and quality contour plots to visually check for other anomalies due to faulty seam elevations or quality data entry mistakes in the drillhole database

Typical errors which may impact reserve and resource estimation relate to discrepancies in original data entry. These errors may include:

- Incorrect drillhole coordinates (including elevation)
- Mislabeled drillhole lithology
- Unnoticed erroneous quality analyses where duplicate analyses were not requested
- Unrecorded drillhole core loss

WEIR conducted a detailed independent geological evaluation of data provided by Arch designed to identify and correct errors of the nature listed above. Where errors are identified and cannot be successfully resolved, it is WEIR's policy to exclude that data from the geological model. Based on its geological evaluation of data provided, WEIR did not exclude any holes within the Leer Mine resource areas.

9.2 DATA VERIFICATION LIMITATIONS

WEIR did not conduct an independent verification of property control surveys, nor has it independently surveyed the mining locations. Rather, WEIR has relied on information compiled from maps and summaries of the owned and leased property control prepared by Arch. WEIR did not conduct a legal title investigation relative to Arch's mineral and surface rights.

9.3 ADEQUACY OF DATA

It is WEIR's opinion that the adequacy of sample preparation, security, and analytical procedures for drillholes that were drilled by Arch after acquiring the property is acceptable and that these methods meet typical industry standards. Arch employs detailed process and procedures, described in Section 8.4, that are followed each time a core hole is to be sampled. The Arch geologist's logs for these holes contain sampling descriptions and lithologic descriptions that are sufficiently detailed to ascertain that an experienced geologist supervised the drilling and sampling. Arch coal quality analyses were performed to ASTM standards by qualified laboratories, as detailed in Section 8.0.

The adequacy of sample preparation, security, and analytical procedures are generally unknown for drillholes that were drilled prior to Arch acquiring the property in 2011. However, the geologist's logs for these holes contain sampling descriptions and lithologic descriptions that are sufficiently detailed to ascertain that an experienced geologist supervised the drilling and sampling. It is unknown if coal quality analyses were performed to ASTM standards by qualified laboratories, as detailed in Section 8.0, however, this legacy drillhole information was included as the samples matched the coal seam intervals and reported similar quality data. Model verifications further support WEIR's high level of confidence that a representative, valid, and accurate drillhole database and geological model has been generated for the Leer Mine that can be relied upon to accurately estimate coal resources and reserves.

The WVU Pillar Study described chain pillar designs for three and four entry gate road systems and provided minimum pillar sizes, which Arch exceeds, and should be an adequate basis for development of the Leer Mine LOM Plan. WEIR reviewed the WVU Pillar Study, which was authored by Dr. Syd S. Peng and A. Yassien, and found the quality of the work reasonable and WEIR is comfortable with the report results.

10.0 MINERAL PROCESSING AND METALLURGICAL TESTING

10.1 MINERAL PROCESSING TESTING AND ANALYTICAL PROCEDURES

Daily sampling is performed for plant feed and all stacking points prior to shipping clean coal products. The analyses performed include moisture, ash, sulfur, and Btu/lb on both an as-received and dry basis. These results help ensure both proper plant operation and coal product classification. Coal tonnages for raw and post-processed products, are estimated using standard belt scales which are calibrated monthly against the end of month survey data summary reports.

Efficiency testing is performed on all critical preparation plant circuitry on a bi-monthly basis to help ensure proper coal and non-coal separations are occurring throughout the plant operation. This performance testing is extensive and involves measuring flow rates, pressures, moistures, reagent application rates, size fractions, specific gravities, and coal qualities at specific processing points from raw feed all the way through products and tailings.

10.2 MINERALIZATION SAMPLE REPRESENTATION

Coal deposits originate in flat, low-lying ground within deltas, alluvial plains, and coastal systems, and as such are a relatively homogeneous, sedimentary mineral occurrence. The deposit within the Leer Mine area exhibits homogeneous characteristics and does not show any substantial variations in mineralization types or styles that would affect processing of the coal. Sample data are well representative of the deposit as a whole.

10.3 ANALYTICAL LABORATORIES

Coal sample analyses performed by Standard Labs are described in Section 8.2.1. Plant circuitry performance testing is performed by Precision Testing Laboratory, Inc. located in Beckley, West Virginia.

10.4 RELEVANT RESULTS AND PROCESSING FACTORS

Sample results by sample location for total moisture, as received ash, sulfur, Btu/lb, MAF Btu/lb, and dry ash, sulfur, Btu/lb, and volatile matter from January 2020 through March 2021 are summarized for count, minimum value, maximum value, average value and standard deviation in Table 10.4-1.

Table 10.4-1 Preparation Plant Sample Results

	Total Moisture (%)				
Sample Location	Count	Min	Max	Average	StdDev
Plant Feed	416	2.62	9.65	5.44	0.95
Coarse Met	518	3.21	20.73	7.14	2.94
#1 Midds	1,110	0.34	7.58	3.93	0.68
#2 Stacker-Met	316	5.54	9.75	7.28	0.66
#3 Stacker - Met	832	5.07	9.82	7.13	0.62

	As Received Ash (%)					Dry Ash (%)				
Sample Location	Count	Min	Max	Average	StdDev	Count	Min	Max	Average	StdDev
Plant Feed	416	26.59	66.27	49.36	7.12	416	27.86	69.80	52.18	7.37
Coarse Met	518	4.84	9.71	6.55	0.64	518	5.46	10.14	7.05	0.59
Spiral Clean Product	268	4.69	13.86	7.87	1.47	268	4.70	13.93	7.92	1.48
#1 Midds	1,110	16.78	26.50	20.93	1.39	1,110	17.59	27.89	21.79	1.42
#2 Stacker-Met	316	5.39	7.04	6.32	0.31	316	5.89	7.62	6.82	0.33
#3 Stacker - Met	832	5.24	7.62	6.39	0.35	832	5.70	8.18	6.88	0.36

	As Received Sulfur (%)					Dry Sulfur (%)				
Sample Location	Count	Min	Max	Average	StdDev	Count	Min	Max	Average	StdDev
Plant Feed	416	1.19	6.17	2.04	0.40	416	1.25	6.53	2.16	0.42
Coarse Met	518	0.70	1.40	0.99	0.11	518	0.75	1.47	1.06	0.11
Spiral Clean Product	268	0.86	1.53	1.16	0.11	268	0.87	1.54	1.16	0.11
#1 Midds	1,110	1.11	2.29	1.68	0.20	1,110	1.15	2.38	1.75	0.21
#2 Stacker-Met	316	0.73	1.14	0.96	0.07	316	0.79	1.23	1.04	0.08
#3 Stacker - Met	832	0.77	1.21	1.02	0.07	832	0.83	1.31	1.10	0.08

	As Received BTU/lb (%)					Dry BTU/lb.				
Sample Location	Count	Min	Max	Average	StdDev	Count	Min	Max	Average	StdDev
Plant Feed	416	2,929	10,318	6,289	1,261	416	3,092	10,809	6,661	1,357
#1 Midds	1,110	1,134	12,121	11,510	382	1,110	11,015	12,674	11,990	232
#2 Stacker-Met	316	13,144	13,765	13,506	102	316	14,406	14,853	14,568	63
#3 Stacker - Met	832	13,010	13,803	13,518	99	832	14,213	14,787	14,555	71

	MAF BTU/lb.					Dry Volatile Matter (%)				
Sample Location	Count	Min	Max	Average	StdDev	Count	Min	Max	Average	StdDev
Plant Feed	416	10,236	15,152	13,807	815	416	11.98	26.30	19.37	2.27
#1 Midds	1,110	15,167	15,459	15,329	37	1,110	25.94	29.93	27.83	0.73
#2 Stacker-Met	316	15,559	15,696	15,633	26	316	31.95	33.86	32.89	0.44
#3 Stacker - Met	832	15,305	15,698	15,629	32	832	31.24	34.19	33.00	0.54

Coal recovery and resulting product quality are primary concerns for any coal preparation plant. A coal preparation plant's recovery and resulting product quality are dependent on ROM coal quality and the efficiency at which raw ash may be removed by the preparation plant process. Tracking and adjusting throughput rates for different plant circuitry based on ROM coal feed quality is critical to plant efficiency and product quality.

Historical (2018 through 2021) preparation plant recovery averaged 46.6 percent and projected LOM Plan preparation plant recovery is estimated to range from 30.2 to 55.5 percent, averaging 40 percent over the LOM Plan.

While variable, preparation plant recovery is projected based on modeled out of seam dilution (OSD) based on well-defined seam structural grids. Projected preparation plant recovery reflects modeled changes in the ratio between mining height and coal seam height. Product qualities are expected to track closely with the modeled recovery from raw coal analysis, once adjusted for OSD material to be mined by the continuous miners and longwall.

Historical preparation plant performance from 2019 through 2021, based on 27.6 million preparation plant feed tons, processed 10.9 million metallurgical tons and 1.9 million middlings tons, with a resulting yield of 46.6 percent.

The actual results provide validation for modeled data and help to ensure coal sales specifications are met for resulting products.

10.5 DATA ADEQUACY

Arch employs testing and analytical procedures in accordance with industry standards, which result in efficient preparation plant operations and provides the necessary quality control to meet product quality and quantity projections. The testing performed is sufficient to support the projected preparation plant yield and saleable product quality for the LOM Plan.

11.0 MINERAL RESOURCE ESTIMATES

The coal resources, as of December 31, 2021, summarized below are reported as in-place resources and are exclusive of reported coal reserve tons (see Section 12.0 for reserve tonnage estimates). Resources are reported in categories of Measured, Indicated, and Inferred tonnage and in accordance with Regulation S-K Item 1302(d).

11.1 KEY ASSUMPTIONS, PARAMETERS, AND METHODS

Data Sources

Planimetric data was provided by Arch in AutoCAD format and primarily included base map information such as rivers, drainages, roads, mine features, and property boundaries.

The drillhole data provided to WEIR by Arch included lithology, coal quality and survey data, and was provided in different formats including Excel, ASCII files and PDFs. Geophysical logs, coal quality certificates, driller's logs, geologist's logs, downhole deviation data, and drillhole survey records were provided as scanned PDF files and AutoCAD drawing files. Data was provided for 297 holes, all of which are included in the structural model.

In-mine seam thickness and floor measurement were provided in tabular file format. These mine measurements included 1,505 data points. In-mine coal thickness data points were generally measured every 100 to 300 feet in the mined-out areas. Mine measurement data points were used to model thickness and structure but were not used as points of observations in estimating resource confidence.

Coal quality data for 239 drillholes was provided for the Leer Mine. Of the 239 drillholes, 91 holes were used in the quality model. Data was provided in Excel format along with quality certificates in PDF. Reasons for excluding drillhole quality samples in the modeling process included:

- Poor core recovery noted in the driller's logs.
- Quality logs that could not be matched to a drillhole.
- The qualities listed for the hole were not relevant to the model (for example raw Btu/lb. or sulfur were supplied, but not final product Btu/lb. or sulfur). The only relevant raw values used are specific gravity and raw ash. Both are derivable from one another and have bearing on estimated in-place tons.

Geological Model

The Leer Mine geological model was constructed by using seam surface grids that were created in Datamine's MineScape® Stratmodel (MineScape) geological modeling package.

Topography data was gridded using MineScape software and a grid cell size of 50 feet by 50 feet. Topographic contours from the USGS were provided by Arch in CAD format in 20-foot intervals. The contours were provided in the NAD27, West Virginia North State Plane coordinate system (FIPS 4701). The gridded USGS topography contours were compared to drillhole collars and showed that there are differences between the two sets of elevation data. On average, the drillhole collars are less than five feet above or below the USGS topography grid, with the maximum difference of 98 feet. These differences are not uncommon when comparing a national data set to localized collar elevations. For this reason, WEIR has not excluded any of the holes that have a large difference.

The Lower Kittanning Seam does not outcrop within the Leer Mine permit boundary.

The seam surfaces and thicknesses were created by loading the drilling and mine measurement data into MineScape and gridding the seam intercepts using a grid cell size of 50 feet by 50 feet. The parameters used to create the model are defined in the MineScape modeling schema which is a specification of modeling rules that is created for the site. The MineScape interpolators that were used in this study are common in most mine planning software packages. The Planar interpolator is a triangulation method with extrapolation enabled. Finite Element Analysis (FEM) is a widely used method for numerically solving differential equations arising in engineering and mathematical modeling. A trend surface is used in MineScape to promote conformability for the modeled seams to regional structures such as synclines, anticlines, or simply seam dip. MineScape caters to using different interpolators for thickness, roofs and floors (surfaces), and the selected trend surface as they are all modeled separately. The interpolator used for each of these items is selected on the basis of appropriateness to the data sets involved, as well as modeling experience. Stratigraphic Model Interpolators are shown in Table 11.1-1 as follows:

Table 11.1-1 Stratigraphic Model Interpolators

Interpolator	Parameter	Power/Order
Planar	Thickness	0
FEM	Surface	1
Planar	Trend	0

The coal seam that was modeled for this TRS is the Lower Kittanning Seam. Arch controls several other seams above and below the Lower Kittanning Seam that were loaded into the geological model, however, resources were not estimated for these additional seams. A summary of drilling statistics for the Lower Kittanning Seam is shown in Table 11.1-2.

Table 11.1-2 Drillhole Statistics

			Average	Minimum		Maximum		Standard
Seam	In Mine Plan	Number of Intercepts	Thickness (Feet)	Hole Name	Thickness (Feet)	Hole Name	Thickness (Feet)	Deviation (Feet)
Lower Kittanning	Yes	1,779	5.61	LR1907	0.00	MML1814	10.50	1.16

The gridded structure surfaces and coal seam thicknesses were validated against drillhole information to ensure that the data was properly modeled. Inconsistencies between modeled seam surfaces and surrounding drillholes were investigated and any confirmed errors in the drillhole data or model parameters were corrected. This process was repeated until a final version of the model was developed.

Coal Quality Model

The drillhole and channel sample quality data described previously in this report were used to create a washed coal quality model that included raw ash and raw relative density. The washed quality model values were based on a specific gravity of 1.50.

The drillholes were verified to ensure that the seam depths used in the lithology file matched the sample depths in the quality file. Twenty-five holes were found to have a fully sampled interval that included the Lower Kittanning Rider Seam, parting, and the Lower Kittanning Seam. In each of these 25 holes, the samples were composited and added to the quality model since the combined thickness of the three plies was less than the maximum mining height.

Coal quality samples were loaded into MineScape and composited against the drillhole thicknesses. The composited values were then gridded using a grid cell size of 200 feet by 200 feet and the inverse distance weighted (squared) interpolator. The following quality data was modeled for the Lower Kittanning Seam:

- Raw
  - Ash, Dry, weight percent
  - Relative Density
- Float @ 1.50 Specific Gravity
  - Ash, Dry, weight percent

- Calorific Value, Dry, Btu/lb
- Total Sulfur, Dry, weight percent
- Volatile Matter, Dry, weight percent
- Audibert-Arnu Maximum Dilation (ARNU), Dry, percent
- Vitrinite, Dry, weight percent
- Total Inerts, Dry, weight percent
- Rank Index
- Composition Balance Index
- Gieseler Maximum Fluidity, Dry, DDPM
- Hargrove Grindability Index, Dry
- Reflectance (ROMAX), Dry, percent
- Calculated Stability Index
- Free Swell Index
- Yield, weight percent

Quality contours were generated from the grids to check outlier values.

Additional Resource Criteria and Parameters

Based on WEIR's review and evaluation of the data and plans relative to the Leer Mine, resource estimation criteria were applied to ensure reported mineral resource tonnage has a reasonable prospect for economic extraction. Resource criteria and parameters for the Leer Mine are as follows:

- Resources were estimated as of December 31, 2021.
- Coal density is based on specific gravity data from drillholes and channel samples.
- Areas where coal thickness did not meet a minimum thickness of 3.0 feet were excluded from the resource estimate.
- Areas within 200 feet of old mine workings were excluded from resource estimates.
- Areas with less than 200 feet of cover were excluded from resource estimates.
- Tonnages associated with uncontrolled areas within the exclusive resource areas are excluded in resource estimates.
- Areas not considered feasibly accessible because of geometry and location in relation to previous mine workings were excluded from resource estimates.
- Areas that are currently covered by refuse, or planned refuse, were excluded from the resource estimate.

- Tonnage outside of current LOM Plan, but within existing property control, and meeting the criteria listed here, was classified as Resource tonnage and is reported exclusive of Reserve tonnage.

11.2 ESTIMATES OF MINERAL RESOURCES

The coal resources, as of December 31, 2021, are reported as in-place resources and are exclusive of reported coal reserve tons (see Section 12.0). Resources are reported based on the coal resource estimate methodology described and are summarized in Table 11.2-1 as follows:

Table 11.2-1 In-Place Coal Resource Tonnage and Quality Estimate as of December 31, 2021

								Coal Quality (Dry Basis)	
		Average Coal						Raw	
Mine		Area	Thickness	In-Place Resources (000 Tons)				Ash	Relative Density
Area	Seam	(Acres)	(Feet)	Measured	Indicated	Total	Inferred	(%)	(Lbs/CF)
Leer LOM	Lower Kittanning	2,195	4.39	2,400	11,600	14,000	4,900	20.8	90.48

Notes:

- Mineral Resources reported above are not Mineral Reserves and do not meet the threshold for reserve modifying factors, such as estimated economic viability, that would allow for conversion to mineral reserves. There is no certainty that any part of the Mineral Resources estimated will be converted into Mineral Reserves. Mineral Resources reported here are exclusive of Mineral Reserves.
- Resources stated as contained within a potentially economically mineable underground mine assuming a 3.0 feet minimum seam thickness, a high vol A coal realizing a sales price of $110.18 per ton FOB Mine and operating cost of $72.49 per ton.
- Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding

11.3 TECHNICAL AND ECONOMIC FACTORS FOR DETERMINING PROSPECTS OF ECONOMIC EXTRACTION

A Preliminary Feasibility Study was conducted to assess the prospects for economic extraction of coal within the Leer Mine.

The Free on Board (FOB) Mine coal sales price used in assessing the economic mineability of the Leer Mine is primarily based on sales of high volatile A metallurgical coal product, which averaged $118.91 per ton in 2018 through October 2021 and is projected to average $119.00 per ton over the Leer Mine LOM Plan. In addition to the metallurgical coal product, the Leer Mine sells a high ash middlings coal product, which averaged $26.36 per ton in 2018 through October 2021 and is projected to average $27.16 per ton over the Leer Mine LOM Plan. The

overall coal sales price is based on a high volatile A benchmark for HCC of $167.50 per metric tonne. Once converted to short tons, adjusted for transportation and the inclusion of middling coal sales, the estimated LOM Plan FOB Mine coal sales price is $110.18 per ton. The sales price is further supported in Section 16.0 of this report.

Capital expenditures are discussed in further detail in Section 18.1 and are projected to average $6.99 per ton over the Leer Mine LOM Plan compared to actual capital expenditures of $4.55 per ton in 2018 through 2020.

Operating costs are discussed in further detail in Section 18.2 and are projected to average $72.49 per ton over the Leer Mine LOM Plan compared to actual Leer Mine operating cost that averaged $61.98 per ton from 2018 through 2020.

Total projected capital expenditures and operating cost of $79.48 per ton and the coal sales price of $110.18 per ton, provide a reasonable basis for WEIR to determine that all coal of thickness greater than 3.0 feet has prospects of economic extraction within the Leer Mine.

WEIR estimated a breakeven NPV would result from a LOM Plan with an average coal thickness of 3.09 feet. Therefore, a coal thickness minimum cutoff of 3.0 feet would ensure that the Leer Mine LOM Plan average coal thickness would be greater than 3.0 feet, resulting in likely prospects for economic extraction. Relatively small areas within the LOM Plan have coal that may be thinner than the 3.0 feet cutoff and are evaluated on a case-by-case basis to determine if they are deemed to have prospects of economic extraction based on the economic benefit from mining these less than 3.0 feet areas to access and recover areas with higher coal thickness.

11.4 MINERAL RESOURCE CLASSIFICATION

Mineral Resource estimates prepared for the Leer Mine are based on the Regulation S-K Item 1302(d), which established definitions and guidance for mineral resources, mineral reserves, and mining studies used in the United States. The definition standards relative to resources are as follows:

Mineral Resource:
Mineral resource is a concentration or occurrence of material of economic interest in or on the Earth's crust in such form, grade or quality, and quantity that there are reasonable prospects for

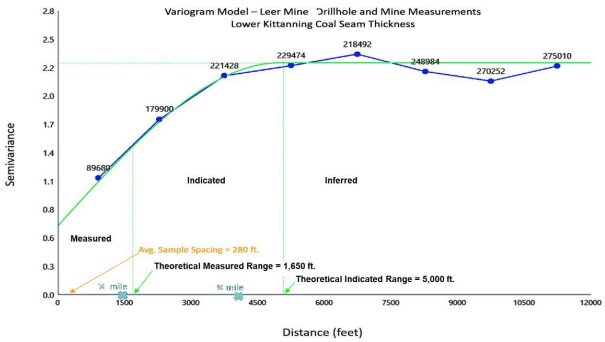
economic extraction. A mineral resource is a reasonable estimate of mineralization, taking into account relevant factors such as cut-off grade, likely mining dimensions, location or continuity, that, with the assumed and justifiable technical and economic conditions, is likely to, in whole or in part, become economically extractable. It is not merely an inventory of all mineralization drilled or sampled.

- *Inferred mineral resource* is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. The level of geological uncertainty associated with an inferred mineral resource is too high to apply relevant technical and economic factors likely to influence the prospects of economic extraction in a manner useful for evaluation of economic viability. Because an inferred mineral resource has the lowest level of geological confidence of all mineral resources, which prevents the application of the modifying factors in a manner useful for evaluation of economic viability, an inferred mineral resource may not be considered when assessing the economic viability of a mining project, and may not be converted to a mineral reserve.
- *Indicated mineral resource* is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of adequate geological evidence and sampling. The level of geological certainty associated with an indicated mineral resource is sufficient to allow a qualified person to apply modifying factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit. Because an indicated mineral resource has a lower level of confidence than the level of confidence of a measured mineral resource, an indicated mineral resource may only be converted to a probable mineral reserve.
- *Measured mineral resource* is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of conclusive geological evidence and sampling. The level of geological certainty associated with a measured mineral resource is sufficient to allow a Qualified Person to apply modifying factors, as defined in this section, in sufficient detail to support detailed mine planning and final evaluation of the economic viability of the deposit. Because a measured mineral resource has a higher level of confidence than the level of confidence of either an indicated mineral resource or an inferred mineral resource, a measured mineral resource may be converted to a proven mineral reserve or to a probable mineral reserve.

Geostatistical methods were applied to drillhole and mine measurement coal thickness data for the Lower Kittanning Seam at the Leer Mine to develop variogram ranges (radii) used for

resource classification. Figure 11.4-1 illustrates the variogram using 1,779 seam thickness measurements, both within and outside of the LOM Plan.

Figure 11.4-1 Variogram Model - Lower Kittanning Seam Thickness



As depicted above, variability in drillhole thickness measurements is highly correlated with the distance between individual drillholes, in particular within the theoretical ranges for Measured and Indicated tonnage. Additionally, WEIR's generation and review of the applicable quality contours further supports the continuity of coal quality throughout the deposit. Table 11.4-1 shows Lower Kittanning Seam quality parameters for the composited quality samples.

The theoretical ranges estimated for Measured (to 1,650 feet) and Indicated (to 5,000 feet) resources in WEIR's variographic and quality analysis demonstrates the spatial continuity of mineable coal seam thickness and quality in the Lower Kittanning Seam at the Leer Mine. WEIR has a high level of geological confidence in this data and considers it sufficient to allow for the application of modifying factors to support detailed mine planning and evaluation of the economic viability of the deposit within the Measured and Indicated ranges.

Table 11.4-1 Lower Kittanning Seam Quality Parameters for Composited Samples

Quality	Number	Total Length	Minimum	Maximum	Average
Audibert-Arnu Maximum Dilation %	72	469.41	203	322	300
Composition Balance Index	72	469.41	0.5	1.2	0.8
Calculated Stability	72	469.41	44	57	53.4
Free Swell Index	71	466.21	7.7	9	8.3
Rank Index	72	469.41	3.61	4.15	3.94
Reflectance % (ROMAX)	72	469.41	0.99	1.08	1.03
Vitrinites	72	469.41	55.8	75.7	66.19
Ash %	92	588.13	5.19	12.9	8.53
Btu	74	482.53	13,646	15,137	14,263
Sul %	92	588.13	0.54	2.53	1.21
Volatiles %	73	477.11	29.09	35.43	31.85

Note: All qualities at 1.50 Float Specific Gravity

The table above includes coal that is to be processed into both the middlings product and the metallurgical product and as such is a predictive measure but does not represent actual shipped products, which can vary for many reasons, including variations in coal depositional characteristics, non-coal parting and OSD quality characteristics and preparation plant separation specific gravities. As part of the preparation plant processing, the poorer quality middlings product is removed from the remaining clean coal, resulting in a higher quality metallurgical product.

WEIR has chosen to apply classification radii more conservative than the theoretical radii demonstrated above to be consistent with previous reporting for the Leer Mine deposit. Selection of more conservative classification radii only further increases confidence within the various tonnage classification categories.

Classification radii utilized by WEIR in this study are as follows:

- Measured: 0 - 1,320 feet (based on 1,730 observations informing estimate of coal thickness within this range)
- Indicated: 1,320 - 3,960 feet (based on 1,769 observations informing estimate of coal thickness within this range)
- Inferred: greater than 3,960 feet (based on 1,769 observations informing estimate of coal thickness within this range)

11.5 UNCERTAINTY IN ESTIMATES OF MINERAL RESOURCES

Mining is a high risk, capital-intensive venture and each mineral deposit is unique in its geographic, social, economic, political, environmental, and geologic aspects. At the base of any mining project is the mineral resource itself. Potential risk factors and uncertainties in the geologic data serving as the basis for deposit volume and quality estimations are significant considerations when assessing the potential success of a mining project.

Geological confidence may be considered in the framework of both the natural variability of the mineral occurrence and the uncertainty in the estimation process and data behind it. The mode of mineralization, mineral assemblage, geologic structure, and homogeneity naturally vary for each deposit. Structured variability like cyclic depositional patterns in sedimentary rock can be delineated mathematically with solutions like trend surface analysis or variography. Unstructured variability, in the distribution of igneous rock composition, for example, is more random and less predictable.

The reliability of mineral resource estimation is related to uncertainties introduced at different phases of exploration. Resources meeting criteria for Measured, Indicated, and Inferred categories are determined by the quality of modeled input data, both raw and interpreted. An exploration program comprises several stages of progressive data collection, analysis, and estimation, including:

- Geological data collection
- Geotechnical data collection
- Sampling and assaying procedures
- Bulk density determination
- Geological interpretation and modeling
- Volume and quality estimation
- Validation
- Resource classification and estimation

Error may be introduced at any phase. Data acquisition and methodologies should be properly documented and subject to regular quality control and assurance protocols at all stages, from field acquisition through resource estimation. Managing uncertainty requires frequent review of process standards, conformance, correctional action, and continuous improvement planning. Risk can be minimized with consistent exploration practices that provide transparent,

backwards traceable results that ultimately deliver admissible resource estimates for tonnage and quality.

Less dense drillhole coverage in the northwestern portion of the northern extension of the Leer Mine is a source of uncertainty, however that uncertainty is reflected in the classification of Indicated and Inferred resources versus Measured resources.

As discussed in Sections 8.0, 9.0, and 10.0, it is WEIR's opinion that Arch's methodologies of data acquisition, record-keeping, and QA/QC protocols are adequate and reasonable for resource estimation at the Leer Mine.

In summary, WEIR has reviewed all geologic and geotechnical data inputs, collection protocols, sampling, assaying, and laboratory procedures serving as the basis for the deposit model, its interpretation, and the estimation and validation of the volume and quality of coal resources at the Leer Mine. The spatial continuity of the Lower Kittanning Seam coal deposit at the Leer Mine is well demonstrated by professionally developed, well maintained, quantitative and qualitative data. WEIR finds no material reason regarding geologic uncertainty that prohibit acceptably accurate estimation of mineral resources.

11.6 ADDITIONAL COMMODITIES OR MINERAL EQUIVALENT

There are no other commodities or minerals of interest within the Leer Mine resource area other than the coal deposit discussed in this TRS.

11.7 RISK AND MODIFYING FACTORS

Sporadic, significant thicknesses of fireclay floors have been present in some of the previously mined areas, but did not adversely affect mining operations. There are similar such sporadic areas in future planned panels, which based on prior experience, are also not expected to adversely affect mining operations. Mine management recognizes that it is important to keep water out of these areas so that normal operations are not negatively affected.

Within the Leer Mine LOM Plan area, there are approximately 270 acres of uncontrolled property. Of that total, approximately 10 acres are within the exclusive resource area. Failure to obtain mining rights on the uncontrolled exclusive resource areas will have no impact on

the projected LOM Plan. The approximately 270 remaining uncontrolled acres are within the LOM Plan and are discussed in Section 12.6.

The concentration of drilling within the exclusive resource area is less dense than the rest of the Leer Mine area. This wider spacing can decrease the confidence of structural features, including seam thickness, roof and floor elevations, and definition of the 200-feet cover line. The resource area in the northern extension of the Leer Mine is bounded by the 200-feet cover line in some areas, with the spacing of the drilling near this line between 3,000 and 6,000 feet. Arch generally uses a 100-feet cover line as a cut-off for tonnage estimates within Central and Northern Appalachia, and generally do not longwall mine with less than 200-feet of cover but there are limited exceptions in the LOM Plan. This is evaluated on a case-by-case basis. Because of this WEIR has decided to use the more conservative 200-feet cover line. This affects only areas that are adjacent to Lower Kittanning Seam outcrops. However, these outcrop areas are exclusively outside of areas that WEIR considered for coal resource classification, and as such do not involve material uncertainty. Additional drilling in the northern extension of the Leer Mine will increase confidence in the structural features and better define the resource boundary.

Risk is also associated with volatility of coal market prices. However, even significant variations in operating costs, capital expenditures, and productivity would not likely preclude the economic mineability of the Leer Mine, at projected metallurgical coal market prices.

Unforeseen changes in legislation and new industry developments could alter the performance of Arch by impacting coal consumer demand, regulation and taxes, including those aimed at reducing emissions of elements such as mercury, sulfur dioxides, nitrogen oxides, particulate matter or greenhouse gases. The emphasis on reducing emissions, however, is more of a concern for mines producing a thermal coal product, as opposed to the core metallurgical coal produced from the Leer Mine.

12.0 MINERAL RESERVE ESTIMATES

12.1 KEY ASSUMPTIONS, PARAMETERS, AND METHODS

The conversion of resources to reserves at the Leer Mine considers the effects of projected dilution and loss of product coal quality, projected mineral prices and operating costs, regulatory compliance requirements, and mineral control to determine if the saleable coal product will be economically mineable. The design of an executable mine layout that accommodates the planned mining equipment and provides a safe underground work environment is also considered.

It is important to note that the LOM Plan is based on information provided by the company and does not contemplate development of surrounding reserves the company currently controls or contiguous reserves the company could acquire in the future, nor does it assume any productivity improvements, technological innovations and/or operating efficiencies that the company has achieved historically.

The Leer Mine LOM Plan layout has several key variables that will largely impact coal recovery. Pillar and panel dimensions are based on minimum, maximum, and optimal equipment operating parameters, as well as geotechnical considerations for mine operations safety and subsidence predictions.

Based on the mine's historical performance and projected mineral continuity, the mine design is the primary consideration, apart from mineral resource classification, whereupon resources are converted to reserves at the Leer Mine.

Based on WEIR's review and evaluation of the Leer Mine LOM Plan, the justification for conversion of resources to reserves were based on specific criteria. The following criteria were used to estimate reserves for the Leer Mine Property:

- Reserves were estimated as of December 31, 2021.
- Coal density was based on specific gravity data from drillholes and channel samples.
- Minimum mining height of 8.00 feet (96 inches) for continuous miners and 6.50 feet (78 inches) for the longwall.

- Maximum mining height of 8.0 feet (96 inches) for the longwall. Continuous miner areas can mine total thickness of the Lower Kittanning Seam anywhere in the Leer Mine Property.
- A minimum of six inches of out of seam dilution (three inches floor and three inches roof) is included in the ROM tonnage estimates, except in areas where the total seam thickness is greater than the maximum mining height. Mine measurements support the estimated dilution thickness.
- The different mining methods at the Leer Mine result in different aerial recoveries. Since seam heights are almost exclusively less than maximum longwall mining equipment mining heights, a recovery of 100 percent is applied for the longwall operations, as is typical in the industry. The continuous miner works' recoveries involve a smaller percentage of the total mined coal, and has variable recovery that is calculated based on development type (i.e. gateroads, main entries, supersections). The resulting recoveries for the continuous miners are based on design pillar sizes and ranges from approximately 30 to 66 percent. Mining recovery based on measured coal recovery by type of mining, are applied as follows:
  - Longwall 100 percent
  - Continuous Miner 42 percent
- For mine design purposes, it is assumed that acquisition of mineral control for currently uncontrolled areas will be successful, as it has been historically. LOM Plan design includes these uncontrolled areas, and acquisition cost as well as revenue from the sale of uncontrolled tonnage associated with these areas is included in the Preliminary Feasibility Study.
- Arch's mineral rights over the Leer Mine coal deposits supersedes the mineral rights for oil and gas wells on the property. Arch maintains the right to have the wells plugged and mine through them. Arch is required to compensate the well owner when the revenue stream from a well ceases. Typical acquisition cost of a well is $75,000 to $100,000, while plugging a gas well to Mine Safety and Health Administration (MSHA) standards, in order to mine through a well, ranges from $200,000 to $300,000 (included in capital costs). Therefore, coal tonnage surrounding the oil and gas wells has been included in the reserve estimates.
- The point of reference of reserve estimates is post preparation plant processing and recoverable tons were adjusted for a theoretical preparation plant yield based on drillhole and channel sample analyses washed at a 1.50 specific gravity.

- A conservative preparation plant efficiency factor of 95.0 percent was applied to reflect actual performance of the preparation plant, compared to theoretical laboratory results at a 1.50 specific gravity.
- The estimate of Reserve tons includes areas that are exclusively within the current Leer Mine LOM Plan.

12.2 ESTIMATES OF MINERAL RESERVES

The coal reserves that represent the economically viable tonnage controlled and uncontrolled by Arch, based on the coal reserve estimate methodology described and independent evaluation of the geology, are shown in Table 12.1-3 as follows:

Table 12.1-3 Recoverable Coal Reserve Tonnage and Quality Estimate as of December 31, 2021

								Coal Quality (Dry Basis)	
								Raw	
Mine Area	Seam	Product Quality	Area (Acres)	Average Coal Thickness (Feet)	Clean Recoverable Tons (000) Reserves Proven	Probable	Total	Ash (%)	Relative Density (Lbs/CF)
Controlled									
Leer LOM	Lower Kittanning	High Vol A	8,910	5.23	18,050	26,300	44,350	19.30	89.91
Uncontrolled									
Leer LOM	Lower Kittanning	High Vol A	270	5.33	590	810	1,400	20.39	90.01
Total			9,180	5.23	18,640	27,110	45,750	19.31	89.91

Notes:

- Clean recoverable Reserve tonnage based on mining recovery of 42 percent for continuous miner mining, 100 percent for longwall mining, modeled preparation plant yield, and a 95 percent preparation plant efficiency
- Mineral Reserves estimated at a sales price of $110.18 per ton FOB Mine and operating cost of $72.49 per ton
- Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding
- Mineral Reserves are reported exclusive of Mineral Resources.
- Coal quality listed includes coal that is to be processed into both the middlings product and the metallurgical product and does not represent actual shipped products, which can vary for many reasons, including variations in coal depositional characteristics, non-coal parting and OSD quality characteristics and preparation plant separation specific gravities. As part of the preparation plant processing, the poorer quality middlings product is removed from the remaining clean coal, resulting in a higher quality metallurgical product.

WEIR depleted LOM Plan reserve tonnage using actual mine workings through September 30, 2021, and subtracted actual production, reported by Arch, for the remainder of the year to arrive at reserves as of December 31, 2021.

WEIR completed a validation check of its model by using the model to calculate the theoretical tonnage of the areas mined in 2021 and comparing the results to the actual production tonnage in 2021. The results were within a variance of 2.3 percent. The variance can be explained in part by the differing methods of calculating tons. The WEIR model used a constant 42 percent mining recovery for all continuous miner development, whereas Arch's mining recovery ranged from 30 to 66 percent, based on whether mining gateroads or mains. The results of the validation are shown in Table 12.1-4.

Table 12.1-4 Reserve Validation

Mine Area	Seam	Actual 2021 Production Tons	Estimated Model Tons	Variance (%)
Leer	Lower Kittanning	4,370,000	4,270,000	1.02

12.3 ESTIMATES OF RESERVE CUT-OFF GRADE

WEIR estimated an average coal thickness of 3.09 feet would result in a breakeven NPV. Therefore, a coal thickness cutoff of 3.0 feet would ensure that the Leer Mine LOM Plan average coal thickness would be greater than 3.0 feet and result in positive NPV.

Based on WEIR's review and evaluation of the Leer Mine LOM Plan, mining coal less than 3.0 feet in thickness is minimal and only conducted on a case-by-case basis. Approximately 40 acres of coal with less than 3.0 feet thickness has been included in the reserve estimate.

Based on historical product coal quality, current coal sales contracts, and projected coal quality modeled by WEIR, WEIR does not foresee future coal quality deviations from the present that would adversely affect the saleable coal product.

12.4 MINERAL RESERVE CLASSIFICATION

WEIR prepared the Leer Mine reserve estimates in accordance with Regulation S-K Item 1302(e), which establishes guidance and definitions for mineral reserves to be used in the United States. The SEC Regulation S-K Definition Standards relative to reserves are as follows:

Modifying factors are the factors that a qualified person must apply to indicated and measured mineral resources and then evaluate to establish the economic viability of mineral reserves. A qualified person must apply and evaluate modifying factors to convert measured and indicated mineral resources to proven and probable mineral reserves. These factors include but are not restricted to: Mining; processing; metallurgical; infrastructure; economic; marketing; legal; environmental compliance; plans, negotiations, or agreements with local individuals or groups; and governmental factors. The number, type and specific characteristics of the modifying factors applied will necessarily be a function of and depend upon the mineral, mine, property, or project.

A *mineral reserve* is an estimate of tonnage and grade or quality of indicated and measured mineral resources that, in the opinion of the qualified person, can be the basis of an economically viable project. More specifically, it is the economically mineable part of a measured or indicated mineral resource, which includes diluting materials and allowances for losses that may occur when the material is mined or extracted.

- *Probable mineral* reserve is the economically mineable part of an indicated and, in some cases, a measured mineral resource.
- *Proven mineral reserve* is the economically mineable part of a measured mineral resource and can only result from conversion of a measured mineral resource.

Within the extent of the LOM Plan for the Leer Mine, Measured Resources were converted to Proven Reserves and Indicated Resources were converted to Probable Reserves. Within the extent of the LOM Plan for the northern extension of the Leer Mine, Measured and Indicated Resources were converted to Probable reserves.

12.5 COAL RESERVE QUALITY AND SALES PRICE

Leer Mine coal quality was determined by modeling the drillhole coal quality analyses for the reserve areas. The average dry basis coal quality, for raw coal and washed coal at a 1.50 specific gravity, for the reserves is shown in Table 12.5-1 as follows:

Table 12.5-1 Average Reserve Quality

	Coal Quality (Dry Basis)																	
	Raw		Washed @ 1.50 Specific Gravity [2]															
Seam	Ash (%)	Relative Density (Lbs/Cu.Ft.)	Ash (%)	Sulfur (%)	Volatile Matter	Calorific Value (Btu/lb.)	Theoretical Plant Yield (%)	Audibert-Arnu Maximum Dilation (%)	Composition Balance Index	Calculated Stability Index	Fluidity DDPM	Free Swell Index	Hardgrove Grindability Index	Total Inerts (%)	Reflectance [1] Rank Index	ROMAX (%)	Vitrinites (%)	
Lower Kittanning	19.30	89.86	8.38	1.19	31.90	14,281	71.10	170 - 332	0.86	53.90	30,000	8.50	74.00	25.12	3.96	0.96 - 1.08	65.30	

[1] Minimum/Maximum

The table above includes coal that is to be processed into both the middlings product and the metallurgical product and as such is a predictive measure but does not represent actual shipped products, which can vary for many reasons, including variations in coal depositional characteristics, non-coal parting and OSD quality characteristics and preparation plant separation specific gravities. As part of the preparation plant processing, the poorer quality middlings product is removed from the remaining clean coal, resulting in a higher quality metallurgical product.

Even though the middlings product will be separated from the metallurgical product, the average quality (inclusive of the middlings product) for the reserve tons show that the Leer Mine is a high volatile metallurgical coal product, with good coking properties. The range of dry washed volatile matter is between approximately 30 and 33 percent, with an average of 31.9 percent. The average quality is low ash, low sulfur, very low moisture, and high fluidity, all of which indicate good coking coal qualities.

The projected coal sales price in the Preliminary Feasibility Study is based on a high volatile A benchmark for HCC of $167.50 per metric tonne. Once converted to short tons, adjusted for transportation and the inclusion of middling coal sales, the estimated LOM Plan FOB Mine coal sales price is $110.18 per ton. As detailed previously, average sales price of high volatile A metallurgical coal product from 2018 to October 2021 was $118.91 per ton. The coal sales price is further supported in Section 16.0 of this TRS.

12.6 RISK AND MODIFYING FACTORS

The estimate of reserve tons includes areas that are exclusively within the Leer Mine LOM Plan. The concentration of valid drilling data points within the Leer Mine are generally less than 500 feet from the next nearest data point, resulting in a high confidence. All reserves within the Leer Mine LOM Plan area are within the Proven and Probable classifications determined using the geostatistics variographic study discussed in Section 12.4-1. While the concentration of drillholes in the proposed northern extension of the Leer Mine are not as dense as the active Leer Mine, the majority of reserve tons are within the Probable classification. It is WEIR's recommendation to add additional drilling data points in the northern extension of the Leer Mine to increase the confidence of the reserve area and potentially reclassify the Inferred Resource tons to a Probable Reserve.

Due to the relatively simple geology in the area, and the relatively high continuity of the Lower Kittanning Seam within the Leer Mine LOM Plan (both structure and quality), geologic uncertainties do not appear to pose a significant risk to the project. However, as mentioned in Section 11.7, relatively thick intervals of fire clay in the floor of some areas will require planning to avoid soft floor conditions which could potentially, in turn, cause adverse mining conditions. Keeping a dry mine in these areas will be important and should prove to be effective to avoid adverse floor conditions that could potentially hinder mine operations otherwise.

The Leer Mine has an excellent safety record and maintains diligent regulatory compliance. Workforce census has been, and is expected to remain stable. The primary mining equipment is well-maintained and has sufficient capacities to attain projected levels of productivity and production. This further contributes to Leer Mine being a relatively low risk operation.

Property acquisition problems in the future could affect some of the longwall panels. Even though the remaining reserves within the uncontrolled property are relatively small (approximately 270 acres total), moving the longwall system around uncontrolled property would likely result in significant production down time. In some cases, portions of the lost longwall panel adjacent to the uncontrolled property can be recovered utilizing continuous miners. WEIR is not aware of any obstacles to obtaining necessary property rights, and reasonably believes that the chances of obtaining such rights in a timely manner are highly likely. Given prior successes in Arch's property acquisition efforts, and relatively small tonnage impacts for unsuccessful reserve property acquisitions, this risk appears relatively low, as well.

Approximately 1.4 million tons of uncontrolled reserves were included within the reserve estimate. These estimated tons are within the uncontrolled properties that exist within the Leer Mine LOM Plan. Acquisition of these relatively small blocks of mineral resource is on-going by Arch and not dissimilar to other mining companies' property control tasks involving relatively small areas. The cost of acquiring these uncontrolled tracts is included within the economic model.

Coal recovery is an important aspect in assessing the economic viability of a mine. Based on Arch's historical extraction rates and generally conservative pillar design, WEIR does not anticipate significant deviation of product recovery in the future. Continuous miner recovery of 50 percent, without second mining, is a general industry mining recovery. However, given that the Leer Mine continuous miners are mostly developing gate roads with more conservative pillar sizing for support of longwall panels, the LOM Plan continuous miner recovery is

expected to range from approximately 30 to 66 percent, and average 42 percent. The recovery is based on the pillar size that has been designed for the particular work the continuous miners are completing. As noted above, the pillars' design is most importantly intended to provide safe operation of the primary coal extraction efforts which involve the longwall machinery. WEIR utilized a weighted average mining recovery of 42 percent for the Leer Mine continuous miners in its estimation of recoverable reserves, based on the pillar size required for the type of continuous miner development. The 100 percent longwall panel recovery is also a typical industry longwall mining recovery (when excluding head and tailgates and bleeders). As previously stated, reported reserves are not inclusive of any coal beyond the mining height limitations of the current equipment, which excludes approximately 58,000 clean recoverable tons over the Leer Mine LOM Plan.

Risk is also associated with the volatility of coal market prices. Even significant variations in operating costs, capital expenditures, and productivity would not likely preclude the economic mineability of the Leer Mine, at projected metallurgical coal sales prices.

13.0 MINING METHODS

The mining method utilized by the Leer Mine is longwall mining, with room and pillar continuous mining to develop main entries, longwall headgates and tailgates, and retreat mining production panels. The longwall mining method has been successfully utilized in the NAPP Region, and in other coal producing regions of the United States, since the 1960s. Longwall mining has the highest mining recovery of modern-day underground mining methods.

The Leer Mine is mining the Lower Kittanning Seam and parting interval within the seam utilizing continuous miners to develop longwall panels to be mined using a longwall mining system. The Leer Mine develops longwall districts (sets of adjacent longwall panels) with alphabetic designations. As of September 2021, the Leer Mine had completed mining in 18 longwall panels and was mining the 19th longwall panel (1 Left) in the 6th longwall district (see Figure 13.5-1).

13.1 GEOTECHNICAL AND HYDROLOGICAL MODELS

13.1.1 Geotechnical Model

ICG, Arch's predecessor, commissioned Mr. Syd S. Peng and Mr. Asmaa Yassien, of West Virginia University, Department of Mining Engineering to conduct a geotechnical study, WVU Pillar Study, dated December 2010. The Tygart No. 1 Mine was later renamed the Leer Mine by Arch. The study described chain pillar designs for three and four entry gateroad systems, using the Analysis of Longwall Pillar Study (ALPS) and computer numerical methods, and concluded, based on the geotechnical information from Section 7.4, that four entry gateroads with square pillars on 80 feet centers would be stable during different stages of mining and square pillars with 90 feet centers recommended when developing three entry gateroads. The current Leer Mine gateroad pillars exceed the pillar dimensions in the study, with gateroad pillars on 90 x 140 feet centers for the four entry gateroads and pillars 102 feet x 140 feet centers between the No. 1 and No. 2 entries, and 80 feet x 140 feet centers between the No. 2 and No. 3 entries, or 90 x 140 feet centers, for the three entry gateroads.

Arch also commissioned M. Heib (Heib Study) in February 2018 to conduct geotechnical testing and analysis of core holes in the Leer and Sentinel (now Leer South) mines. The report provides information related to horizontal stresses by roof strata, horizontal strain, Brinell

Hardness, fracture trend analysis, Poisson's Ratio, uniaxial compressive strength, and Young's Modulus, which is summarized in Section 7.4. This report provides Arch with information to prepare well designed mine plans recognizing local horizontal stresses, and design roof support measures to provide adequate roof control for the LOM Plan.

Arch utilized the input from the WVU Pillar Study to determine minimum pillar sizes and the Heib Study to determine orientation of maximum horizontal stresses for the LOM Plan.

13.1.2 Hydrogeological Model

Under the original approved mining plan, the Leer Mine was expected, upon completion of mining, to become fully inundated with water, with no gravity discharge. Because of this, the mine pool was expected to increase to 1,320 feet, creating the potential for unconfined seepage. The permit was modified in Revision No. 18 to include a long-term artesian discharge via a wet seal at 1,180 feet. In Revision No. 21, the discharge concept was modified to change the location and elevation of the planned artesian discharge. The water to be discharged at the elevation of the dewatering borehole is expected to be of good quality, with circumneutral pH and total iron concentrations that can readily settle without the use of chemical treatment. Therefore, the additional mining area added in Revision No. 21 will not create a perpetual discharge of water requiring treatment to meet water quality standards. Moreover, the planned artesian discharge will alleviate potential seepage along Three Fork Creek and will allow for centralized management of the effluent from the Leer Mine.

The average water infiltration rate into the Leer Mine void, based upon the expanded reserve area in Revision No. 21, ranges from 1,125 gallons per minute (gpm) to 1,515 gpm based upon two accepted procedures (McCoy and Leavitt equations) for estimating average infiltration. The average of the two infiltration rates, from both methods, would equate to 1,320 gpm. However, for design of the dewatering system and timing requirements, the projected average infiltration rate was increased by 180 percent, resulting in an average infiltration rate of 2,390 gpm.

Projected infiltration rates in response to rainfall, artesian discharge, and pool elevations were determined by Arch utilizing the rainfall distribution by calendar day. The elevation of the starting pool was set at the collar elevation of the dewatering borehole (1,058.7 feet). Most of the increase in the underground pool elevation is a function of the driving head building up to push water out of the artesian system. The evaluation of projected water infiltration rate considered two different situations, one without any of the artesian flow being recirculated into

the mine void and one with the pool discharge limited to 3,465 gpm, with any artesian flow above that being recirculated back into the mine. The projected maximum pool elevation would reach 1,061.6 feet.

Arch had detailed aerial mapping prepared along the area of Three Fork Creek, and Marshall Miller and Associates (MMA) was retained to prepare a subsidence prediction model in that area. The results of the MMA report indicated that the lowest line of zero subsidence from the longwall panels intercepts the surface at a surface elevation of 1,070 feet. Similarly, utilizing the 15-degree angle of critical deformation from the longwall panels, the projected lowest elevation the angle of critical deformation intercepts the surface is 1,068 feet. Utilizing the 1,068 feet elevation as the limiting elevation, the projected maximum pool elevation is 6.41 feet below the projected line of zero subsidence.

To maintain the underground mine pool at or below a maximum elevation of 1,062 feet, it will be necessary to install two angular 18-inch diameter dewatering boreholes. The angular boreholes will provide three benefits: (1) establish a fixed discharge elevation to maximize the recoverable coal resource; (2) eliminate the potential to create an uncontrolled discharge; and (3) significantly reduce or eliminate potential diffuse seepage along the flanks of Three Fork Creek as authorized in the original permit for the Leer mine. The angular boreholes will be installed at the present location of the clean coal stockpile within the currently permitted area in the Rocky Fork tributary of Three Fork Creek, after completion of mining. A flow control valve will be installed at the collar of the dewatering boreholes to regulate the flow, if needed for maintenance activities. The dewatering boreholes will have an elevation at the surface of 1,058.7 feet, which with exception of periods of prolonged drought will be the minimum underground pool elevation. The boreholes will penetrate the mine reservoir at an approximate elevation of 890 feet.

The boreholes will have an artesian discharge, with no pumping necessary to maintain the underground mine pool at a desired elevation. The artesian flow will discharge into two separate retention ponds that are constructed in series. Each pond will be designed and constructed to provide 19 acre-feet of storage capacity.

An additional step to ensure long-term compliance with water quality-based effluent limits (WQBEL) is incorporated into the permit. A pump system designed to limit the discharge from retention ponds to 3,465 gpm will be installed to transfer excess pond decant water back to the slope and return the water to the underground mine void. The pump will be operated as necessary to maintain compliance with effluent limits. The results of the treatability tests and

long-term water quality trends, along with the retention time in the designed storage ponds, indicate that that the operating time and rates on the return pumping system will be limited.

Arch has a work practice that outlines the procedures for properly obtaining field measurements (e.g., pH, flow, etc.) and collecting representative water samples at the Leer Mine permitted property. The procedures described in the work practice pertain to water sampling at the outfalls/outlets and stream monitoring locations. The sampling frequency, outlets/outfalls, stream monitoring locations and associated parameters are summarized in the Leer Mine permits, as well as Arch's Water Discharge Permit Environmental Operating Procedure (EOP). This work practice is intended to improve overall water quality compliance by providing a comprehensive summary of applicable monitoring requirements in the permit, the WV/NPDES rules for coal mining facilities at Title 47, Series 30 (47CSR30), and the EPA regulations under 40 CFR Part 136.

For sample analysis, Arch uses laboratories that follow the most recent approved EPA sampling methodology and procedures. The laboratories have internal quality control and quality assurance protocols that are followed before delivering sample results to the Arch Engineering Department. The Engineering Department then reviews the sample results once again, as a second check for quality control and quality assurance before the results are published.

13.1.3 Other Mine Design and Planning Parameters

Based on geotechnical studies conducted by Arch for the Leer Mine, longwall gateroads developed by the continuous miner sections consist of three entries, with the first gateroad in each longwall district consisting of four entries. The gateroads are typically developed on 80 to 100 feet centers between No. 1 and No. 2 entries, and 90 to 100 feet centers between No. 2 and No. 3 entries. Crosscut centers are typically 140 feet and typical entry widths are 19 feet.

Mains will be developed on entry centers of 70 feet and crosscut centers of 100 feet to 140 feet.

The approved MSHA roof control plan allows maximum entry width of 24.5 feet for the longwall face set up entry, and widths up to 23 feet for dual track spurs where additional roof support will be installed.

The longwall panels will vary in width from 788 feet to a maximum width of 1,185 feet, with longwall panel lengths that vary based on panel geometries constrained by property control or coal thickness less than 3.0 feet. The projected longwall panel lengths range from 3,340 feet to 16,906 feet with planned LOM longwall panel length totaling 231,253 feet and clean recoverable tons for the longwall panels in the Leer Mine LOM Plan totaling 42.6 million tons.

13.2 PRODUCTION, MINE LIFE, DIMENSIONS, DILUTION, AND RECOVERY

13.2.1 Production Rates

Projected continuous miner productivity is 105 feet per shift for gateroad development and 144 feet per shift for the continuous miner supersections. Supersections are continuous miner sections with split ventilation that allows two continuous miners to operate simultaneously. Longwall projected productivity is typically 52 feet of retreat per day (26 feet per shift).

The longwall and continuous miner production crews work nine-hour shifts, two shifts per day, with hot seat change at the section face. A third shift per day for the longwall and continuous miner units is utilized for maintenance. Each continuous miner crew works a five- and one-half day schedule (every other Saturday). There are four longwall crews that work a five days on, three days off schedule, rotating shifts every six weeks to provide longwall production seven days per week.

Actual ROM and clean production, preparation plant yield and productivity achieved by the Leer Mine longwall mining unit and the continuous miner units average for 2019 and 2020 are shown in Table 13.3.1-1 as follows:

Table 13.2.1-1 Leer Mine Historical ROM and Clean Production, Preparation Plant Yield, and Productivity

	2019-2020 Average
ROM Tons (000s)	8,950
Clean Tons (000s)	4,230
Preparation Plant Yield (%)	47.3
Productivity (Feet of Advance/Shift):	
Longwall [(1)]	27
Continuous Miners	99

[(1)] Feet of Retreat/Shift

Production from the longwall mining unit is projected to range from 135,162 to 480,312 clean tons per month, except for months having a longwall move or holidays. Annual longwall production will vary depending on coal seam thickness, mining height and the number of longwall moves each year. A production delay of 12 days is projected for all longwall moves.

Production from the continuous miner units is projected to range from 6,167 to 94,668 clean tons per month, depending on the number of shifts required to develop main entries and gateroads to support longwall mining. Planned mining height for the continuous miners is 9.0 feet.

The Leer Mine produced approximately 4.1 million clean tons in 2020 and 4.4 million clean tons in 2021 and projects total mine production to range from 2.8 to 5.1 million clean tons when the longwall and continuous miner units are operating (2022 to 2034) and 2.9 million clean tons per year in 2035 after the continuous miner units cease production in 2034.

Arch's projected clean production for the longwall and the continuous miner units for the Leer Mine LOM Plan are shown in Table 13.2.1-2 as follows:

Table 13.2.1-2 Leer Mine LOM Plan Projected Clean Production

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Clean Tons (000)															
Longwall	3,504	3,526	3,808	4,186	2,881	2,833	2,805	2,674	2,484	2,307	2,619	2,472	2,805	2,850	41,753
Continuous Miners	762	802	1,040	921	741	607	497	416	494	470	527	404	84	-	7,764
	4,266	4,328	4,848	5,107	3,622	3,440	3,302	3,090	2,978	2,777	3,146	2,876	2,889	2,850	49,518

13.2.2 Expected Mine Life

Current Leer Mine LOM Plan projects mining through October 2035, an expected mine life of 13 years (see Figure 13.5-1). It is important to note that the LOM Plan is based on information provided by the company and does not contemplate development of surrounding reserves the company currently controls or contiguous reserves the company could acquire in the future, nor does it assume any productivity improvements, technological innovations and/or operating efficiencies that the company has achieved historically.

13.2.3 Mine Design Dimensions

LOM Plan projects continuous mining units operating at the Leer Mine through May 2034 and the longwall mining unit through October 2035.

The longwall panels will typically be 1,185 feet wide, with panel lengths ranging from 4,310 feet to 16,906 feet in the LOM Plan. Several of the longwall panels are narrower than 1,185 feet, having widths ranging from 788 feet to 1,104 feet to accommodate resource geometry and seam thickness variations.

The projected mining for the LOM Plan is shown on Figure 13.5-1.

Mine design criteria utilized in the LOM Plan is as follows:

- Gas Wells
  - State Permit required to mine within 500 feet of a well
  - MSHA Permit required to mine within 150 feet of a well
  - Active Wells - tangent of 8 degrees x depth of cover or 50 feet, whichever is greater
  - Inactive Wells - tangent of 4 degrees x depth of cover or 50 feet, whichever is greater
  - Plugged Wells - mine through permitted with State and MSHA Permits

- Pillar Size
  - Analysis of Retreat Mining Pillar Stability (ARPMS) stability factor of 2.5 or greater for mining under public buildings or impoundments.
  - ARMPS stability factor of 2.0 or greater for long life areas and under residences in areas where subsidence is not planned.
  - ARMPS stability factor of 1.5 or greater for all other room and pillar development.
  - ALPS(R) tailgate loading stability factor of 1.3 or greater for longwall mining.

- Depth of Cover
  - In general, longwall mining will not be conducted in areas with less than 200 feet of cover. This may be evaluated on a case-by-case basis.

- Areas without Subsidence Rights
  - ARMPS stability factors of 2.0 or greater will be maintained during first mining.
  - Retreat mining will come no closer than a tangent of 30 degrees times depth of cover to the property boundary.
- Coal Thickness
  - In general, mining will not be planned in areas of coal less than 3.0 feet in thickness. This may be evaluated on a case-by-case basis.

- Continuous miner units are assumed to mine entire seam thickness (averaging 5.0 feet, ranging from 0.0 to 9.0 feet). Mining height required for ventilation tubing and longwall equipment transportation is a minimum of 8 feet, but is modeled at 9.0 feet.
- Longwall is assumed to mine the entire seam up to 8.0 feet (maximum mining height is 8.5 feet). Anything over that is assumed to be left behind. Typical mining height for the longwall is 6.5 feet, but is modeled at 7.0 feet.

13.2.4 Mining Dilution

OSD on continuous miner units is typically 2.0 to 3.0 feet from roof or floor. Longwall OSD is based on a minimum mining height of 6.5 feet, which typically results in OSD of 0.5 to 1.5 feet from roof or floor. Minimum dilution is 0.5 feet when the seam height is greater than the minimum mining height and typically involves floor material.

13.2.5 Mining Recovery

The longwall is projected to recover 100 percent of the in-place coal within the area projected to be mined from the starting and stopping point between the two gateroads. Typically, the longwall mines the coal seam up to a maximum mining height of 8.5 feet.

The continuous miner recovery is based on the pillar design and varies based on whether the panel is a gateroad, main entry or production panels. Typical continuous miner aerial recovery varies from approximately 30 to 60 percent for the LOM Plan. The continuous miners' maximum mining height capabilities will have the capacity to recover the entire seam thickness over the entire LOM Plan.

13.3 DEVELOPMENT AND RECLAMATION REQUIREMENTS

13.3.1 Underground Development Requirements

The Leer Mine is an active mine. As the mine expands, future development will be required for extensions of belt conveyors, mine power, pipelines, track, and ventilation overcasts. In addition, development into the northern extension of the Leer Mine reserve area will require additional ventilation shafts and infrastructure facilities.

Future bleeder shafts are anticipated for each of the remaining six longwall districts. Existing fans will be decommissioned from one longwall district and moved to the next to save costs. Each bleeder shaft and fan installation will be completed just prior to starting the longwall in

each district. Two new return shafts without fans are anticipated, one for the eastern reserves south of Three Fork Creek (to be constructed in 2021-2022), and one for the northern extension of the Leer Mine reserve, north of Three Fork Creek (to be constructed in 2023). An additional intake shaft is anticipated for the northern extension of the Leer Mine reserve, north of Three Fork Creek (to be constructed in 2023-2024).

A new refuse disposal facility will be needed by 2028. It is estimated that the new refuse disposal site will cost approximately $20 million to develop. This includes land acquisition, geotechnical investigations, permitting, clearing, and starter dam construction. WEIR is not aware of any obstacles or concerns that may impair Arch's ability to secure approvals and construct this facility.

13.3.2 Reclamation (Backfilling) Requirements

The construction of the Leer Mine required the removal of an estimated 2.2 million cubic yards (swelled) of material to create an adequate working surface for the valley fill, road fill, underground mine face-up, slope, shaft, haul roads, access roads, load-out facility, preparation plant facility, storage, coal stockpiles, and truck scales. Upon mine closure, selected areas will be reclaimed to near their Approximate Original Contour (AOC). Other areas will be left in-place as per the approved alternate post-mining land use requests. Regrading and backfilling activities will commence within 180 days after the mining operations are complete.

There are six openings to the surface from the Leer Mine. These openings consist of the slope, dual intake and elevator shaft, return shaft, two bleeder shafts (District 5 and Sharp), and the Hardesty intake shaft. Once mining operations terminate, the shafts will be sealed by filling with earth, rock, and rubble from the coal seam to the surface, after which a 8-inch-thick concrete cap will be poured at the surface, prior to backfilling, regrading, and seeding. The slope will be sealed by building a wet seal at the portal, prior to backfilling, regrading, and seeding.

Upon completion of mining, mine soil material will be utilized to return selected areas of the site to AOC. The mine soil material will include topsoil, subsoil, and mixed overburden material that was removed during the construction of the access roads, underground mine site, and preparation plant site. Upon completion of mining operations and regrading, the mine soil will be redistributed over the selected areas. Mine soil that served as a base for coal stockpiles in the preparation plant area will be tested to determine if supplemental liming is necessary prior to blending this material with the other mine soil onsite. After the permit area has been graded, soil analysis will be performed to determine the quantity of agricultural limestone, or

an equivalent supplement, and fertilizer necessary to achieve the post-mining land use. A soil analysis will be performed prior to seeding for each phase of mine reclamation.

13.4 MINING EQUIPMENT AND PERSONNEL

13.4.1 Mining Equipment

Currently, there are three longwall development (gateroad) continuous miner sections and one continuous miner supersection developing mains and production panels. The Leer Mine is currently utilizing the following industry standard mining equipment on the continuous miner units, as shown in Table 13.4-1.

Table 13.4.1-1 Continuous Miner Section Equipment

Gateroad Continuous Miner Unit	Continuous Miner Supersection Unit
1 - Joy 14CM15 Continuous Miner	2 - Joy 14CM15 Continuous Miners
2 - Narco 10SC32 Shuttle Cars	3 - Narco 10SC32 Shuttle Cars
1 - Fletcher CHDDR15 Roof Bolters	2 - Fletcher CHDDR15 Roof Bolters
1 - Fairchild 35C Battery Scoop	2 - Fairchild 35C Battery Scoops
1 - Feeder Breaker	1 - Feeder Breaker
2 - Auxiliary Face Fans	4 - Auxiliary Face Fans

Arch purchased and installed a state-of-the-art Joy longwall mining system for the Leer Mine, which incorporates technological advances in equipment component capacity, strength and durability. The longwall mining system consists of the following equipment shown in Table 13.4.1-2.

Table 13.4.1-2 Longwall Mining Equipment

Longwall Section
212 - Joy Roof Support Face Shields, 1,040-Ton Capacity (1.5 meter wide)
1 - Joy 7LS1D Shearer
1 - Joy Armored Face Conveyor (1,200 feet)
1 - Stageloader
1 - Crusher
1 - Tailpiece with Pontoons
1 - Scoop
1 - Power Center, 7,000 KVA
1 - Power Center, 3,000 KVA
4 - Kamat Pressure Pumps, 100 gpm each

The Leer Mine longwall mining system is capable of operating at the widths and lengths projected by Arch.

No changes are planned in the type of mining equipment used during the Leer Mine LOM Plan. The longwall is projected to cease operation in 2036, after mining all the projected longwall panels.

Four to five continuous miner sections will continue mining through 2030, two continuous miner sections will operate through 2032, and the last continuous miner section is projected to cease operating in 2033.

13.4.2 Staffing

The Leer Mine staffing as of February 2021 was comprised of 455 salary and hourly employees associated with the mine and 46 salary and hourly employees associated with the preparation plant.

The Leer Mine is scheduled to produce coal two production shifts each day, A Shift and B Shift. Crews on the Owl or idle shift provide support services including production unit moves, off-shift maintenance and other support functions as required. In addition, general underground support crews work each shift performing routine supply, belt maintenance and outby support functions. Hourly personnel are not affiliated with any union, with no anticipated changes in the near term.

The preparation plant is staffed with three crews to process ROM coal 24 hours per day, six to 6.5 days per week. Each crew works three, 12-hour shifts and is off for two days. Shut down periods are typically July 4th week, Thanksgiving week, Christmas Eve and Christmas Day.

The projected staffing level for the LOM Plan is expected to remain similar to the current staffing level through 2032 and then will taper off through the end of the LOM Plan in 2035.

Most of the employees live nearby in Preston and Taylor Counties. Arch has had no major issues hiring qualified candidates for open positions and relies considerably on employee referrals.

Mine Safety

An industry standard for safety performance is the Non-Fatal Days Lost (NFDL) Incidence Rate, which is determined by the number of lost time injuries multiplied by 200,000 divided by the manhours worked.

The Leer Mine (excluding the preparation plant) manhours worked, NFDL injuries, and NFDL Incidence Rate reported to the MSHA for 2018 through Third Quarter 2021, compared to the national average NFDL Incidence Rate for United States underground coal mines are shown in Table 13.4.2-3 as follows:

Table 13.4.2-3 Leer Mine Manhours Worked, NFDL Injuries and NFDL Incidence Rate

				NFDL Incidence Rate	
	Manhours	NFDL Injuries			National
	Worked	Leer	Contractor	Leer	Average
2018	1,113,142	1	-	0.18	3.18
2019	1,122,624	-	1	-	3.05
2020	1,144,218	11	-	1.92	3.14
2021 [(1)]	867,860	2	-	0.46	NA

[(1)] As of Third Quarter YTD

The Leer Mine NFDL Incidence Rate was significantly lower than the national average from 2018 through 2020. The Leer Mine received the Sentinels of Safety Award, an industry accolade, in the large underground mine category, having worked all of 2019, and a total of more than 2 million manhours, without a lost time incident.

The Leer Preparation Plant manhours worked, NFDL injuries, and NFDL Incidence Rate reported to the MSHA for 2018 through Third Quarter 2021, compared to the national average NFDL Incidence Rate for United States preparation plants are shown in Table 13.4-6 as follows:

Table 13.4.2-4 Plant Manhours Worked, NFDL Injuries and NFDL Incidence Rate

				NFDL Incidence Rate	
	Manhours	NFDL Injuries		Leer	National
	Worked	Leer Plant	Contractor	Plant	Average
2018	102,670	-	1	-	1.77
2019	104,148	-	1	-	2.03
2020	105,891	1	-	1.89	1.78
2021 [(1)]	81,892	-	-	-	NA

[(1)] As of Third Quarter YTD

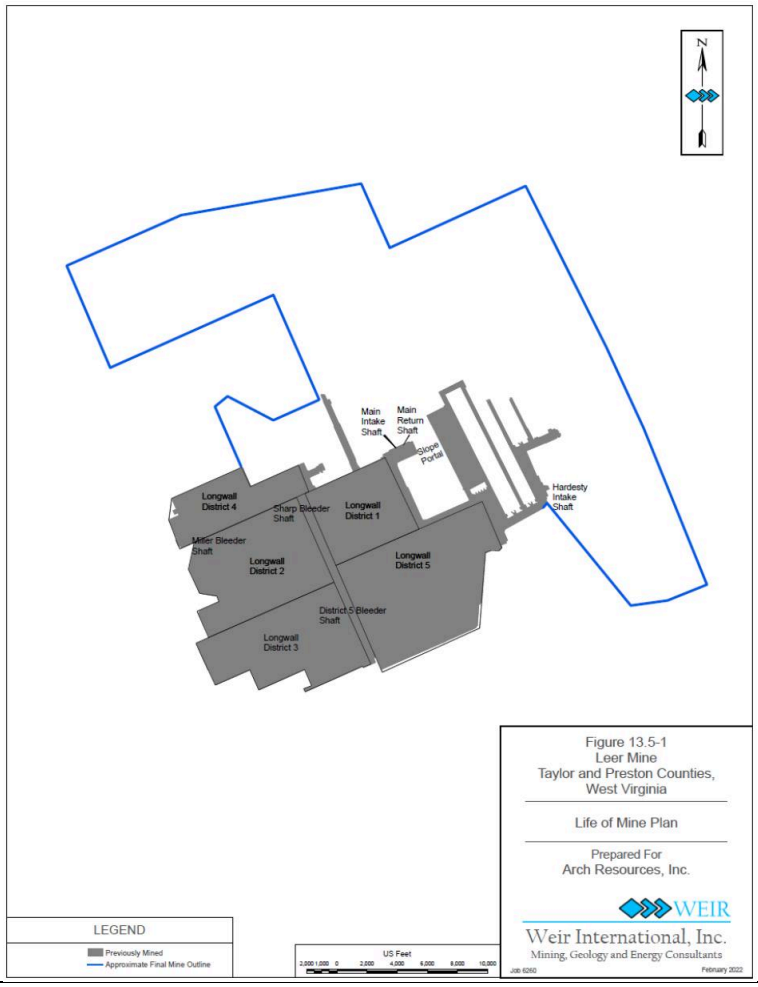
Only one injury was incurred at the preparation plant in 2018 through 2020, which resulted in the NFDL Incidence Rate of 1.89 compared to the national average of 1.78 for 2020.

Leer Mine management personnel are very proactive in providing a safe working environment for all personnel. As an example, the breathing apparatus for use at the Leer Mine in case of firefighting is a Draeger Self Contained Breathing Apparatus (SCBA). Other breathing apparatus to be used in case of mine evacuation, include the Ocenco M-20 units, providing 10 minutes of oxygen are worn on the miner's belts and the Ocenco EBA 6.5 SCSRs, providing 60 minutes oxygen, which are available on the underground transport vehicles, at 5,700 feet intervals along the escapeway and at the underground belt drives.

13.5 LIFE OF MINE PLAN MAP

The projected mining for the Leer Mine LOM Plan is shown on Figure 13.5-1.

Figure 13.5-1 Life of Mine Plan



14.0 PROCESSING AND RECOVERY METHODS

14.1 PLANT PROCESS

The preparation plant consists of two identical processing circuits, with primary and secondary heavy media cyclones, classifying cyclones, spirals, reflux classifiers, and column flotation. The ROM material size fractions and circuits utilized are summarized in Table 14.1-1 and are more fully described in Section 14.2.

Table 14.1-1 Plant Process Size Fractions and Circuits

Size Fraction	Size	Feed %	Circuit
Coarse	2 in. x 1mm	73	Heavy Media Cyclone
Fine	1mm x 100 Mesh	20	Reflux Classifiers
Ultrafine	100 Mesh x 325 Mesh	5	Column Flotation
Ultrafine	325 Mesh x 0	2	Discard
Secondary	2 in. x 1mm		Heavy Media Cyclone

14.2 PLANT PROCESSING DESIGN, EQUIPMENT CHARACTERISTICS AND SPECIFICATIONS

The Leer Preparation Plant, built by Powell Construction, is a well designed and constructed, state-of-art technology preparation plant. The preparation plant was designed with two identical processing circuits, which can be operated simultaneously or one at a time. Each circuit can process 700 ROM tph of raw coal for a total design feed rate of 1,400 ROM tph, although the preparation plant typically operates at 1,500 ROM tph (750 to 775 ROM tph per circuit). The preparation plant feed rate is adjusted based on the desired product quality, which often results in the preparation plant's processing rate to be higher than the design rate.

ROM material is conveyed from the slope belt conveyor to the Raw Coal #1 or Raw Coal #2 stacking tube. The ROM material is reclaimed from the stacking tubes and is sized at a nominal 2 inch top size. All of the -2 inch material reports to the plant feed conveyor where it is conveyed to the plant feed surge bin prior to processing.

The material from the surge bin reports to the raw coal screens where it is screened at +2 inch, 2 inch x 1mm and 1mm x 0. The +2 inch is discarded onto the rejects conveyor. The 2 inch x

1mm is washed in a heavy media cyclone at 2 inch x 1mm. The fine 1mm x 100M material is washed via reflux classifiers. The ultrafine 100 mesh x 325 mesh material is cleaned by column flotation. The +1mm material is washed at a high gravity first to reject the rock. This +1mm product is then re-washed at a low specific gravity in a heavy media cyclone resulting in a metallurgical coal product and a secondary middlings product.

Coarse reject material is conveyed to and stored in a bin, then trucked to the refuse disposal site. Fine reject material is pumped from the thickener to the impoundment for disposal.

To ensure the desired saleable product quality is being produced from the preparation plant, daily proximate analyses, weekly petrographic analyses, bi-weekly ash/mineral analyses, and bi-monthly plant efficiency testing are conducted.

The middlings product contains coal that is typically 9,000 to 11,500 Btu/lb, with an ash level of 17 to 30 percent and sulfur content of 1.8 to 2.2 lbs. SO_2/MBtu. This product is primarily utilized by power plants as a blend with other feed coals.

The preparation plant washes all the ROM coal and can process ROM coal to a 100 percent metallurgical coal product, or to an 87.5 percent metallurgical coal and 12.5 percent middlings product.

The preparation plant operates two, 12-hour shifts per day, six to six and one-half days per week, and typically processes 35,000 to 36,000 ROM tons per day. Shut down periods are typically July 4th week, Thanksgiving Week, Christmas Eve, and Christmas Day.

The current stage of the refuse disposal site is 7 of 10 designed stages. Stage 8 was approved by the MSHA on July 20, 2020. Placement of coarse refuse is being done in a workmanlike manner, in accordance with approved refuse disposal plans.

The preparation plant and coal handling facilities consist of the following equipment shown in Table 14.2-1:

Table 14.2-1 Major Preparation Plant and Material Handling Equipment

ROM Coal Handling System:
- 2 - ROM Stockpiles
- 1 - ROM Reclaim Tunnel, 630-Feet
- 4 - Belt Scales
- 2 - Tram Iron Magnets
- 1 - Raw Coal Sizer
- 1 - Single Stage Sweep Sampler
- 1 - Surge Bin, 150-Ton Capacity

Preparation Plant:
- 2 - Raw Coal Deslime Screens, 14-Feet x 24-Feet Double Deck
- 2 - Primary Heavy Media Cyclones, 1.15-Meter Diameter
- 2 - Refuse Drain and Rinse Screens, 14-Feet x 20-Feet Double Deck
- 2 - Steam Coal Drain and Rinse Screens, 14-Feet x 20-Feet Single Deck
- 2 - Secondary Heavy Media Cyclones, 0.9-Meter Diameter
- 2 - Met Coal Drain and Rinse Screens, 14-Feet x 20-Feet Single Deck
- 2 - Midds Coal Drain and Rinse Screens, 10-Feet x 20-Feet Single Deck
- 2 - Met Coal Centrifuges, Ludowici 1500
- 2 - Midds Coal Centrifuges, Ludowici 1400
- 2 - Banks of 6 Raw Coal Classifying Cyclones, 15-Inch Diameter
- 4 - Primary Reflux Classifiers
- 2 - Secondary Reflux Classifiers
- 2 - Banks of 6 Triple Start Compound Spirals
- 2 - Banks of 8 Effluent Cyclones, 6-Inch Diameter
- 2 - High Frequency Refuse Screens, 8-Feet x 12-Feet
- 2 - Primary Column Flotation Cells, 15-Feet x 24-Feet
- 2 - Secondary Column Flotation Cells, 15-Feet x 24-Feet
- 2 - Banks of 32 Deslime Cyclones, 6-Inch Diameter
- 3 - Met Coal Screen Bowl Centrifuges, 44-Inch Diameter x 132-Inches
- 1 - Midds Coal Screen Bowl Centrifuge, 44-Inch Diameter x 132-Inches
- 1 - High Rate Thickener, 140-Feet Diameter
- 6 - Magnetic Separators, 48-Inch Diameter x 10-Feet
- 1 - Magnetic Separators, 36-Inch Diameter x 6-Feet
- 2 - Magnetite Bins, 100-Ton Capacity

Clean Coal Handling System:
- 2 - Belt Scales
- 2 - Two Stage Clean Coal Samplers
- 1 - Midds Coal Stockpile
- 2 - Clean Coal Stockpiles
- 1 - Reclaim Tunnel, 620-Feet
- 1 - Tertiary Clean Coal Sampler
- 1 - Batch Weigh Rail Loadout

Refuse Handling System:
- 1 - Refuse Conveyor, 42-Inch
- 1 - Refuse Bin

Total stockpile capacity at the Leer Mine is 400,000 tons of ROM coal and 300,000 tons of clean coal.

14.3 ENERGY, WATER, PROCESS MATERIALS, AND PERSONNEL REQUIREMENTS

The preparation plant consumes approximately 4.9 million kilowatt-hours of electricity/month. Water requirements are approximately 1,800 gpm of make-up water with a closed-loop water system. The preparation plant pumps fine slurry to the refuse slurry impoundment and then clarified water is pumped from the refuse slurry impoundment back to the plant.

Magnetite consumption is approximately 0.60 pounds per ROM ton processed. The preparation plant chemicals utilized cost approximately $0.08 per ROM ton processed.

Personnel requirements to operate the processing shifts at the preparation plant are one salary and nine hourly employees per shift. In addition, there are four salary and two hourly personnel that perform administrative and maintenance duties associated with the preparation plant.

15.0 INFRASTRUCTURE

15.1 ROADS

Access to the Leer property is off of U.S. Route 50, east of the town of Grafton in Taylor County, West Virginia. The nearest cities are Morgantown, West Virginia to the north and the cities of Clarksburg and Bridgeport, West Virginia to the west. The property can be accessed from Morgantown via U.S. Route 119 to Grafton. Morgantown is located 25 miles north of Grafton. The property can be accessed from Bridgeport via U.S. Route 50. Bridgeport is located 16 miles west of the Leer Mine.

15.2 RAIL

The Leer Mine transports coal via the CSX railroad, which operates the Mountain Subdivision railway from Cumberland, Maryland through Grafton, West Virginia. CSX operates a rail yard at Grafton, West Virginia.

15.3 POWER

Electrical power for the Leer Mine is provided by FirstEnergy Corp. subsidiary Mon Power through a 138 kV transmission line. A contract with Mon Power provides electrical power under Rate Schedule K.

15.4 WATER

The Tygart Valley River lies to the west of the Leer Mine Property. The Tygart Valley River is not navigable for commercial traffic.

Over half of the water required for mine operations such as mine dust suppression and preparation plant make up water is provided by recycling. The remainder is provided by a pump station installed beside Three Fork Creek, a tributary of Tygart Valley River, and is pumped to a million-gallon head tank. There is no contract or monthly charge for the water from Three Fork Creek. Potable water for the facilities is obtained from the Taylor County Public Service District at an average monthly charge of $12,000.

15.5 PIPELINES

A water pipeline from the Taylor County Public Service District provides potable water to the Leer Mine offices and bathhouse facilities.

There is no natural gas service to any of the facilities.

A 12-inch diameter slurry pipeline with four, 200 hp motors pumps slurry from the thickener at the preparation plant to the refuse slurry impoundment.

15.6 PORT FACILITIES, DAMS, AND REFUSE DISPOSAL

Port Facilities
Arch ships the Leer Mine metallurgical coal to either the CSX Chesapeake Coal Terminal or the Dominion Terminal Associates LLP (DTA) for export to customers.

CSX owns and operates the CSX Chesapeake Coal Terminal transshipping facility located at Curtis Bay, Maryland and is the primary facility used by the Leer Mine. Arch Coal Sales, Inc. (ACS), a subsidiary of Arch, has a rail contract and throughput arrangement with CSX through 2024, with dedicated storage capacity of approximately 200,000 tons of saleable coal. In 2020, Arch shipped 1.73 million tons from the Leer Mine through the facility, which serves as a transload facility for the export of utility and metallurgical coals and is served by the CSX rail line. Annual throughput capacity of the CSX facility is 11 to 13 million tons and Arch projects shipping 2.2 million tons from the Leer Mine through the facility in 2021.

The DTA coal shipping and ground storage facility is located in the port of Hampton Roads on the East Bank of the James River in Newport News, Virginia. DTA has state-of-the-art sampling and blending systems. Arch, through its subsidiary, Ashland Terminals, owns 35 percent of DTA, with the remainder owned by Contura Energy. CSX delivers unit trains from eastern United States coal mines and DTA has ground storage capacity of 1.7 million tons, with coal segregated in storage areas by coal type and shipper. Arch controls approximately 600,000 square feet of ground storage space and depending on the number of stockpiles can store between 350,000 and 560,000 tons of coal.

In 2020, Arch shipped 753,000 tons from the Leer Mine through DTA. Arch projects shipping 700,000 tons from the Leer Mine through DTA in 2021 and has the capacity to ship much more

if needed. DTA accommodates seagoing vessels and coastal barges and colliers of up to 177,000 DWT. Pier length is 1,162 feet with berths for loading on either side. Both berths are dredged to a mean low water depth of 50 feet to match the harbor channel.

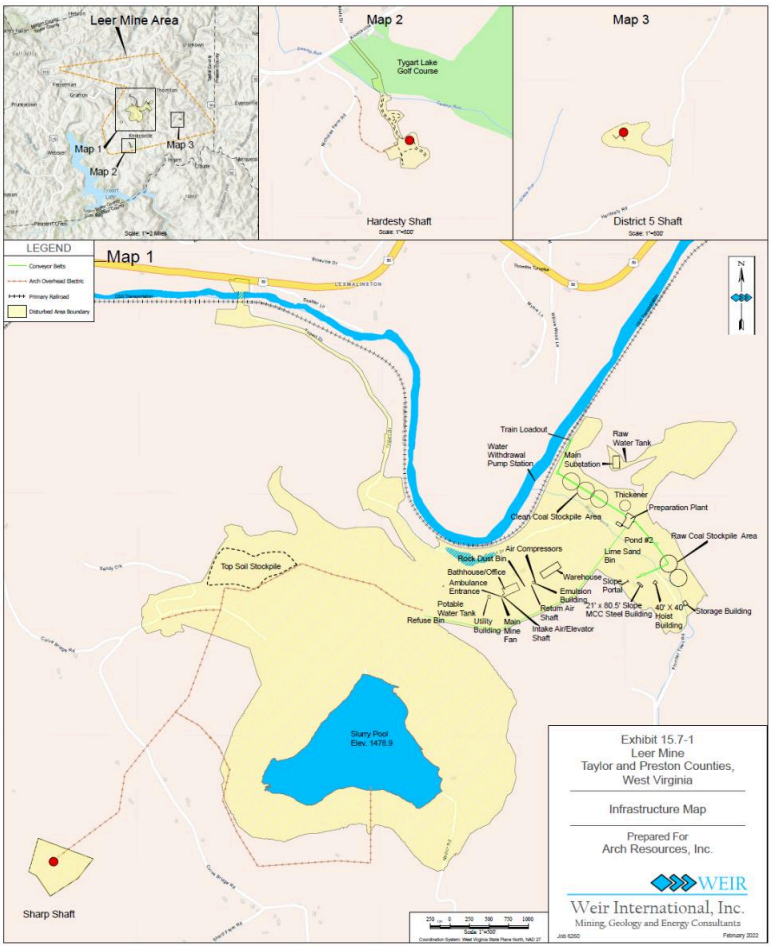
Dams and Refuse Disposal

Coarse refuse is conveyed to the refuse disposal site and fine refuse is pumped from the preparation plant thickener to a designed slurry cell at the refuse disposal area. The current stage of the refuse disposal area is 7 of 10 designed stages. Stage 8 was approved by the MSHA on July 20, 2020. Coarse refuse capacity is projected to last through May 2031 at which time Leer will have permitted and constructed a new refuse site in Rocky Branch. There is adequate coarse and fine refuse disposal capacity at Rocky Branch to serve the LOM Plan.

15.7 MAP OF INFRASTRUCTURE

The Leer Mine infrastructure is summarized below on Figure 15.7-1, with a detailed map provided on Exhibit 15.7.-1.

Figure 15.7-1 Mine Infrastructure



16.0 MARKET STUDIES

16.1 MARKETS

Overview

The Leer Mine produces a high quality, high volatile metallurgical coal. Historically, the market for metallurgical coal from the Leer Mine has been domestic metallurgical coal consumers and the global seaborne metallurgical coal market. Production from the Leer Mine is a high volatile A coal, as well as a middlings product.

A summary of the various classifications of coal from the Leer Mine is as follows:

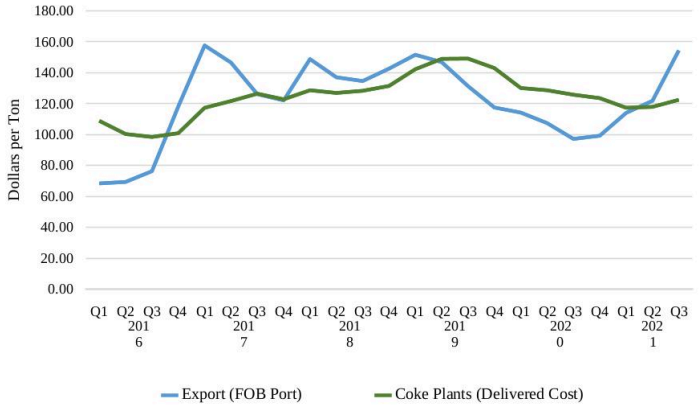
High volatile metallurgical coal contains more than 31 percent volatile matter and is typically represented as high volatile A and high volatile B coal. A third class of high volatile metallurgical coal is referred to as high volatile C, which has calorific, sulfur and petrographic quality considerably less than high volatile A and B metallurgical coals. High volatile metallurgical coal, primarily high volatile A and B coals, serve both the domestic and global seaborne metallurgical coal markets. The Leer Mine sells a high volatile A metallurgical coal.

Metallurgical Historical Coal Sales Prices

Coal sales prices are influenced by many factors, including domestic supply and demand, global supply and demand dynamics, productivity, cost of competing fuels, transportation, and inflation, both mining cost inflation and general inflation.

The market for US metallurgical coal consists of both domestic metallurgical coal consumers and exports into the global seaborne metallurgical coal market. The US Energy Information Administration (EIA) compiles average historical price data for metallurgical coal delivered to domestic coke plants and metallurgical coal delivered to tidewater terminals for export. Note that the EIA data includes all classifications of metallurgical coal (high, mid and low volatile) as well as both spot and contract sales prices. The historical prices for metallurgical coal are shown on Figure 16.1-1 as follows:

Figure 16.1-1 Metallurgical Coal Sales Prices



Source: EIA Quarterly Coal Report

Between 2016 and Third Quarter 2021, export prices (FOB Port) and domestic coke plant prices (delivered cost) have averaged $120.33 and 124.41 per ton, respectively.

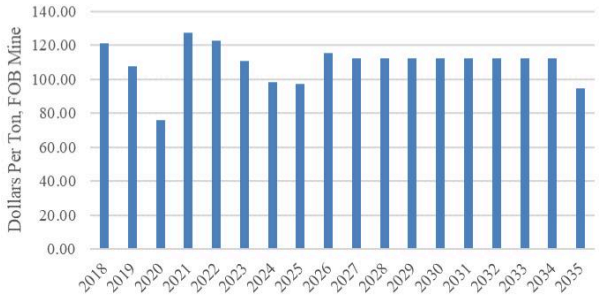
Arch expects strong ongoing demand for the Leer Mine metallurgical coal over the next two decades and across the remaining life of the Leer Mine reserve base. The primary driver for this positive view is Arch's bullish outlook on global steel production over this timeframe, coupled with ongoing degradation and depletion of high-quality metallurgical coal reserves around the world.

On the demand side, Arch sees robust, ongoing increases in steel production in developing economies such as India, coupled with relatively stable demand requirements in already developed economies such as Europe and the U.S. Importantly, Arch believes the developing world will continue to be highly reliant on "new steel" (i.e. steel produced in blast furnaces using coke made from metallurgical coal) as opposed to recycled steel produced in electric arc furnaces that rely primarily on electricity and scrap metal. This assumption is based on the understanding that developing economies are still at the outset of the industrial development curve and have little scrap available for recycling purposes. Moreover, Arch expects high-quality steel produced in blast furnaces to continue to dominate key steel market segments, including automotive.

In 2020, integrated steel production using coke made from metallurgical coal is responsible for 75 percent of global steel supply, and Arch sees that remaining relatively stable in the near to intermediate term. In addition, Arch believes that a significant amount of new steel will be required in a de-carbonizing world, given steel's importance in urbanization, infrastructure replacement and the construction of essential de-carbonization tools such as mass transit systems, wind turbines and electric vehicles. Moreover, Arch believes that the highest-quality metallurgical coals will continue to enjoy a significant advantage in the marketplace, for several reasons. First, the use of high-quality coking coals in coke blends facilitates the most efficient, and thus lowest carbon, steel-making process. Second, the Leer Mine metallurgical coal product is particularly valuable to steelmakers seeking to produce a strong coke despite the use of a wide range of metallurgical coals in their coke blends. Finally, the highly competitive cost structure of the Leer Mine means that it can remain competitive, and continue to earn an attractive margin, even during challenging market environments, or in the event that metallurgical demand should begin to contract at some point in the future.

The 2018 through October 2021 actual and 2022 through 2036 forecasted coal sales price for the Leer Mine utilized in the LOM Plan financial model is shown on Figure 16.1-2.

Figure 16.1-2 Historical and Forecast Coal Sales Price



Note: 2018 through October 2021 are actual

The projected coal sales price in the Preliminary Feasibility Study is based on a high volatile A benchmark for HCC of $167.50 per metric tonne. Once converted to short tons, adjusted for transportation and the inclusion of middling coal sales, the estimated LOM Plan FOB Mine price is $110.18 per ton.

16.2 MATERIAL CONTRACTS

The Leer Mine saleable product is marketed by ACS, a subsidiary of Arch. ACS has offices in St. Louis, Missouri, London, and Singapore. Most of the sales contracts are 12 months in length. North American contracts are typically on a calendar year basis while most of the international coal sales contracts are on a fiscal year beginning in April.

The Leer Mine 2020 and 2021 metallurgical coal sales were sold to customers in regions as shown in Table 16.2-1.

Table 16.2-1 Historical Metallurgical Coal Sales by Region

	Sales (million tons)	
Customer Region	2020	2021
North America	1.1	1.1
Asia	0.8	1.5
Europe/South America	1.6	1.6
	3.5	4.2

ACS has a long-term contract with CSX Corporation for export shipments and throughput at the Curtis Bay Terminal in Baltimore, Maryland through the end of 2024. As a general rule, most North American customers hold their own rail contracts.

16.3 PRICE FORECAST

Leveraging its historical marketing and selling of Leer Mine coal production, Arch prepared forecasts for its planned LOM production. Arch forecasts the Leer Mine High Volatile A metallurgical coal product to sell for an average price of $119.00 per ton between 2022 and 2035. Its middlings product, over the same time period, is expected to sell for $27.16 per ton. Overall average price realization per ton for the Leer Mine metallurgical coal is forecasted at $110.18 per ton.

17.0 ENVIRONMENTAL STUDIES, PERMITTING, AND LOCAL INDIVIDUALS OR GROUPS AGREEMENTS

17.1 ENVIRONMENTAL STUDIES

As part of the permitting process required by the WVDEP, numerous baseline studies or impact assessments were undertaken by Arch. These baseline studies or impact assessments included in the permit are summarized as follows, with pertinent text from the permit replicated below:

- Groundwater Inventory
- Surface Water Quality and Quantity
- Probable Hydrologic Consequences

Groundwater Inventory

Arch conducted an extensive survey to inventory water use and determine the extent and purpose of ground water usage in the subject area. The analysis delineated surface drainage watersheds and used them as organizational units in the database. Field teams made door-to-door visits to every residence to gather information set forth on questionnaire forms regarding water supply source(s), extent of reliance, purpose of reliance (domestic, agricultural, etc.), depth of well(s), character of springs, and other data. The teams took photographs at each supply source point. The teams measured water level depths in wells where possible and surveyed locations with hand-held GPS.

The following Table 17.1-1 summarizes results of the survey, as to usage. The “industrial” usage category in this instance refers largely to agricultural use for livestock watering supplies. Other “industrial” uses in the subject area include a kennel, a butcher shop, and a golfing facility.

Table 17.1-1 Groundwater Inventory

Use	Spring	Well
Industrial [Predominantly Agriculture]	263	12
Domestic	43	90
Potable	5	5
Recreation	27	-
Unknown	9	10
Unused	111	-
Industrial/Domestic	7	3
Industrial/Domestic/Potable	11	-
Industrial/Potable	1	123
Industrial/Recreational	1	-
Domestic/Potable	27	102
Domestic/Potable/Recreation	5	-
Wildlife	1	-
Being Developed	1	3
Other	16	-
Total	528	348

Baseline ground water monitoring has been conducted at 32 locations throughout the subject area, 13 of which are springs, while the remaining 19 are water wells. Most of those stations were initially monitored beginning in October 2005. Thirty-four additional ground water stations were monitored on a one-time basis, 24 of which are wells, while the remaining 10 are classified as springs. Results of the groundwater inventory are included in the permit.

Surface Water Quality and Quantity

Baseline surface water monitoring for flow and quality parameters has been conducted at 82 locations throughout the permit area. Four of those stations are Baseline Water Quality (BWQ) monitoring only, 11 are a combination of BWQ and Probable Hydrologic Consequence (PHC) baseline monitoring, while the remaining 67 are PHC monitoring only. The BWQ stations were monitored twice monthly until 12 flowing or no-flow monitoring events were observed, whichever occurred first. PHC monitoring was conducted monthly for six consecutive months. Surface water baseline data is found in the permit.

Daily rainfall readings were recorded utilizing an automated rainfall measuring and recording system. The rain gauge was installed at a location situated within a three-mile radius of all BWQ sampling stations. Rainfall summary data is found in the permit.

Probable Hydrologic Consequences

Planned subsidence will occur quickly as the longwall face advances. It is expected that direct fracturing of overburden will extend up through the shale-dominated sequence lying between the Lower Kittanning Seam and the base of the Mahoning Sandstone. Given its distance above the mine (more than about 30 times the mining height) and its competency, neither the Mahoning Sandstone, or the Buffalo Sandstone unit above it, is expected to undergo significant, if any, direct fracturing. It will, instead, exhibit broad sagging and dilation of bedding planes, with consequent increased porosity (increased storage capacity) and lateral permeability in response to mining.

The general or overall effect of the planned mining will be to induce direct fracturing of the shale-dominated strata, up to roughly the base of the Mahoning Sandstone or its horizon. The little water that is present in that strata will be drained to the mine, but the shale interval contains no significant aquifers other than, perhaps, the Lower Kittanning Seam itself, which appears to be penetrated by a few wells located at the extreme southern and northern fringes of the property, well outside the area of planned mining.

The Buffalo-Mahoning sandstone interval is situated in what will be the dilated zone of subsidence, where storage will be increased, and water levels will initially fall. In that zone, downward leakage to the underlying fractured zone will be at a very low rate, and likely will be exceeded by combined vertical and lateral recharge, such that water levels in that dilated zone will gradually recover to, or nearly to, the pre-mining levels.

Above the Pittsburgh Redbeds, strata will be constrained and remain, in general, hydrologically unaffected by subsidence. Only in the very near-surface interval where no lateral constraint occurs is there likely to be any significant disturbance hydrologically. In that zone, water moving at local base level (such as that moving through stress-relief fractured and/or weathered rock beneath small upland stream valleys) will likely remain unaffected in the long term, but water moving through perched aquifers to discharge as hillside springs or seeps may be relocated to alternate discharge points.

Recovery of any impacts to the Pittsburgh Redbeds or overlying strata (strata situated more than 400 feet above the mine) is expected to take place quickly after the longwall face passes beneath, except, perhaps, at shallow perched horizons that discharge to hillside springs or seeps. Some of those perched horizons in the laterally unconstrained zone may undergo a shift in flow paths, causing the discharge point to move.

In the dilated subsidence zone, occupied by the Saltsburg-Buffalo-Mahoning Sandstone sequence and constituting an aquifer that is commonly utilized for well supplies in the area, the increase in storage induced by subsidence will cause initial drops in water level, but gradual recovery or partial recovery during mining is expected to occur, as vertical and lateral recharge is expected to exceed the rate of downward leakage from that interval. Post-mining, recovery will occur after the portal entries are sealed and pumping is terminated.

In the fractured zone extending from the mine up to near the base of the Mahoning Sandstone, recovery will not significantly occur until after mining has been completed and pumping is terminated. After the slope and shaft entries are fully sealed to prevent outflow through those conduits (as is planned), slow leakage of infiltrating water from overlying zones will eventually re-saturate this fractured, permeability-enhanced strata. The potentiometric surface will likely be generally similar to that which existed before mining.

Under the original approved mining plan, the Leer Mine was expected to become fully inundated, with no gravity discharge. Because of this, the mine pool was expected to increase to 1,320 feet, creating the potential for unconfined seepage. The permit was modified in

Revision No. 18 to include a long-term artesian discharge via a wet seal at 1,180 feet. In Revision No. 21, the discharge concept was modified to change the location and elevation of the planned artesian discharge. The water to be discharged at the elevation of the dewatering borehole is expected to be of good quality, with circumneutral pH and total iron concentrations that can readily settle without the use of chemical treatment. Therefore, Revision No. 21 will not create a perpetual discharge of water requiring treatment to meet water quality standards. Moreover, the planned artesian discharge will alleviate potential seepage along Three Fork Creek and will allow for centralized management of the effluent from the Leer Mine.

17.2 REFUSE DISPOSAL AND WATER MANAGEMENT

Refuse Disposal

The Leer Slurry Impoundment (MSHA ID No. WV03-09191-01) is classified as a high hazard potential structure that provides for the disposal of about 38 million cubic yards of coarse coal refuse (CCR) and 17 million cubic yards of fine coal refuse (FCR) over the anticipated life of the Leer Mine. The Leer Mine has been producing coal from the Lower Kittanning Seam since 2013 and is projected to produce from the northern extension beginning in May, 2022. Refuse from both areas will be placed in the Leer Slurry Impoundment. The initial impoundment plan, prepared by Geo/Environmental Associates (G/A), provided for nine stages of refuse disposal construction.

MSHA's Mine Waste and Geotechnical Engineering Division (MWGED) recommended approval of the plan only through Stage 4A (crest elevation remaining at 1,420 feet). The first two stages were centerline and downstream construction. Stages 3 and 4 were modified upstream construction that included a large downstream buttress fill which would raise the dam to a crest elevation of 1,460 feet. In February 2014, G/A submitted a revised plan proposing to enlarge the facility with a total of eight stages beyond Stage 4. The same year, MWGED initiated more rigorous recommendations for short-term slope stability design for upstream-constructed stages, based on current and prudent engineering practice. MWGED recommended that this plan not be approved until satisfactory stability analyses were provided that considered short-term conditions and appropriate FCR strengths under staged loading for each upstream stage. Stage 4 was approved for completion to its final 1,460-foot crest elevation (Stage 4B) on December 8, 2015.

To comply with the new upstream stability analysis recommendation, Arch began submitting each stage separately to MSHA for approval, from Stage 5 onward. Each stage has specific

FCR strength requirements determined by upstream stability analyses and confirmed by performing geotechnical testing and piezometer installations in the completed pushout. Schnabel Engineering (Schnabel) used this information to verify the upstream stability as the stage is raised. The design crest elevations for Stages 5 and 6 are 1,500 and 1,540 feet, respectively. The stages also include construction of a 3,500 feet extension of the dam on the north and east sides of the pool area, creating a 3-sided impounding structure as the crest is raised above the existing topography on the north and east sides. These stages use a principal spillway consisting of a short 36-inch diameter riser and a 36-inch diameter conveyance pipe installed in the left (south) main dam abutment. Arch abandons the previous stage's spillway pipe by grouting once the subsequent stage reaches its design crest elevation.

Stage 7, which is currently under construction, will be a 40-feet high upstream-constructed raise to elevation 1,580 feet, with a 36-inch diameter principal spillway in the left abutment, similar to Stage 6. The only significant change will be extensions of the initial pushouts to at least 50 feet beyond the anticipated toe of the Stage 7 upstream slope. The resulting bench at the embankment toe will be submerged under the FCR slurry as the pool rises. This measure addresses an ongoing surplus of CCR volume to be disposed relative to in-pool FCR volume, and also enhances upstream slope stability. MWGED recommended approval of Stage 7 on February 28, 2019.

As of July 2021 (the end of the last annual reporting period to MSHA), Stage 6B (minimum crest elevation 1,540 feet) was complete and the Stage 7B crest raise to elevation 1,580 feet was complete for most of the north and east embankment extensions. The main dam embankment (western crest) elevation remained at approximately 1,542 feet and the maximum pool elevation was 1503 feet.

Per a December 2018 modification approved by the MSHA, Arch placed CCR fill up to 80 feet thick in the pool area between the north and east embankments and an island of higher natural ground in the pool area. This fill slopes gently from elevation 1,520 feet at the north and east embankment toe to an elevation of 1,500 feet where it abuts the island 200 to 500 feet southwest of the toe. Most, or all, of the shallow FCR accumulated in this area was displaced as the CCR fill was advanced. This fill is the foundation of the upstream-constructed Stage 7 and a portion of the Stage 8 raise of the north and east embankments.

Stage 8 will be similar to previously approved Stage 7 and will raise the dam crest 40 feet to an elevation of 1,620 feet. The Stage 8A raise will use upstream construction on settled FCR- which will be at an estimated elevation of 1,510 to 1,520 feet when construction begins. At the

time of WEIR's visit, slurry elevation was at an elevation of 1,542 feet. Approximately 1,700 linear feet of Stage 8 A at the north and east embankments will be founded on the previously described CCR fill and natural ground island in the pool area rather than FCR. Previous pushouts at the impoundment have typically displaced about 40 to 50 feet of FCR without any reports of pushout instability. As in Stage 7, Arch will extend the initial pushout a minimum of 50 feet beyond the intended toe of the Stage 8A upstream slope. This excess portion of the pushout will be submerged as the ponded FCR pool rises. The completed Stage 8A will result in an upstream-widened crest at elevation 1,580 feet. Stage 8B will then raise the crest to 1,620 feet, with 2.5 horizontal to 1 vertical (2.5H:1V) slopes upstream and 2H:1V slopes downstream. Stage 8 was approved by the MSHA on July 20, 2020.

Beyond Stage 8, Arch plans to extend the Leer Slurry Impoundment through Stage 10 with a crest elevation of 1,680 feet and spillway at an elevation of 1,671 feet, which is projected to be attained in 2031. Coarse refuse storage beyond 2031 is planned for Rocky Branch, with an initial stage constructed an elevation of 1,360 feet projected for completion in 2029. The ultimate Rocky Branch crest elevation is projected at 1,620 feet. If needed, the coarse refuse at the Leer Slurry Impoundment could cover the fine refuse material and raise the top of the coarse refuse to an elevation of 1,780 feet. Total cumulative FCR and CCR storage through the LOM Plan is estimated at 94.2 million tons. If required, the Rocky Branch site could store an additional 62.0 million tons of FCR and CCR.

Water Management

The Leer Mine created two separate temporary fills with culverts utilized for stream diversions. An unnamed tributary of Rocky Branch was diverted below Valley Fill No. 1 utilizing a temporary 7-feet diameter culvert below Valley Fill No. 1 under the Preparation Plant Site Pad. Rocky Branch was diverted utilizing a temporary 10-feet diameter culvert under the downstream portion of the Preparation Plant Site Pad and temporary 9-foot diameter culvert under the upstream portion of the Preparation Plant Site Pad. All temporary culverts were designed to safely convey a 100-year, 24-hour precipitation event.

Water monitoring and management at the Leer Mine consists of several pumping, camera, and treatment systems. Cameras and lights have been installed at strategic locations to allow for visual monitoring of chemical tanks, ponds, and outlets 24 hours a day.

Automatic treatment system for chemical applications at the impoundment ponds consists of turbidity probes, controller, and three pumps for each chemical used. The automatic treatment system for chemical applications of preparation plant ponds consists of turbidity probe, pH

probes, controller, and two pumps for chemicals used in treatment. Treatment tanks are linked to controllers to provide levels and alerts. Email alerts are sent to environmental personnel if any system reading is out of the desired range.

The pumping system at the impoundment ponds allows recirculation between ponds, or diversion to the preparation plant for water used in processing. The preparation plant ponds pumping system allows recirculation between ponds, or diversion to the load out or the preparation plant. Pumping is monitored to track usage as well as recycled water at the operation. The monitoring is tracked by flow meters and pump hours.

Water outlets are sampled in accordance with the approved NPDES permit.

Arch has a work practice that outlines the procedures for properly obtaining field measurements (e.g., pH, flow, etc.) and collecting representative water samples at the Leer Mine permitted property. The procedures described in the work practice pertain to water sampling at the outfalls/outlets and stream monitoring locations. The sampling frequency, outlets/outfalls, stream monitoring locations and associated parameters are summarized in the Leer Mine permits, as well as Arch's Water Discharge Permit Compliance Environmental Operating Procedure (EOP). This work practice is intended to improve overall compliance by providing a comprehensive summary of applicable water quality monitoring requirements in the permit, the WV/NPDES rules for coal mining facilities at Title 47, Series 30 (47CSR30), and the EPA regulations under 40 CFR Part 136.

The laboratories have internal quality control and quality assurance protocols that are followed before delivering sample results to the Arch Engineering Department. The Engineering Department then reviews the sample results once again as a second check for quality control and quality assurance before the results are published.

17.3 PERMITS AND BONDING

Coal mines in West Virginia are required to file applications for and receive approval of mining permits issued by the WVDEP to conduct surface disturbance and mining activities. The Leer Mine has been issued mining permits and associated NPDES permits by the WVDEP as shown in Table 17.3-1 as follows:

Table 17.3-1 Leer Mining and NPDES Permits

Permit Number	Permitted Surface Area (Acres)	Issue Date	NPDES Permit No.
U-2004-06, Revision No. 24	152.82	9/11/2020	WV1017764
O-2017-06, IBR No. 4	274.89	6/3/2020	WV1017764
	427.71		

Permit U-2004-06 includes the areas for the preparation plant, underground mine and associated support facilities and infrastructure. Permit O-2017-06 includes the area for the slurry cell and associated drainage structures. The associated NPDES permit is required to allow discharges of water from the permit areas and require submittal of bi-monthly water samples to ensure the discharges are within allowable water quality standards.

The majority of the Leer Mine LOM Plan area is permitted. The permit application for the first two longwall districts of the northern extension of the Leer Mine was submitted on May 3, 2021 and is currently being reviewed by the regulatory agencies. The groundwater inventories and baseline water quality surveys for those areas have been completed. The groundwater inventories and baseline water quality surveys cost approximately $60,000. Future permit revisions will be needed to add underground mining area and associated surface area for bleeder shaft sites.

The Leer Mine has a good compliance record without a history of significant fines or violations. The last violation for U-2004-06 was on June 4, 2015, with a fine of $700 and the last violation for O-2017-06 was on October 9, 2013, with no fine assessed. As an indicator of the Leer Mine's attention to environmental compliance, Leer was presented the Good Neighbor Award from the Office of Surface Mining Reclamation & Enforcement on October 21, 2019.

The current permit numbers, bond amounts and reclamation liability for each permit is shown in Table 17.3-2 as follows:

Table 17.3-2 Leer Mine Permitted Area, Reclamation Liability and Bonds

Permit Number	Permitted Surface Area (Acres)	Reclamation Liability [1] ($000)	Bond No.	Bond Amount ($000)
U-2004-06	152.82	10,762	SUR0044268	7,424
O-2017-06	274.89	5,867	1066186	1,155
	427.71	16,629		8,579

[1] Represents the undiscounted cash flows to satisfy reclamation as of July 2020

17.4 LOCAL STAKEHOLDERS

As indicated in Section 13.5, Arch currently employs approximately 500 personnel at the Leer Mine and is projected to have a maximum employment of 508 personnel during the Leer Mine LOM Plan. The mine also creates substantial economic value with its third-party service and supply providers, utilities and through payment of taxes and fees to governmental agencies.

The Leer Mine is located in a rural and fairly isolated area of West Virginia. Reportedly there have been no social or community impact issues relative to the Leer Mine for several years. Arch received the Greenlands Award from the West Virginia Coal Association for developing, in 2011, the Tygart Valley Community Advisory Panel, which is a non-profit, volunteer entity serving as a forum for open discussion between representatives of the Leer Mine and the residents of the Tygart Valley Area.

17.5 MINE CLOSURE PLANS

The construction of the Leer Mine required the removal of an estimated 2.2 million cubic yards (swelled) of material to create an adequate working surface for the valley fill, road fill, underground mine face-up, slope, shaft, haul roads, access roads, load-out facility, preparation plant facility, storage, coal stockpiles, and truck scales. Upon mine closure, selected areas will be reclaimed to near AOC configuration. Other areas will be left in-place as per the approved alternate post-mining land use requests. Regrading and backfilling activities will commence within 180 days after the mining operations are complete.

There are six openings to the surface from the Leer Mine. These openings consist of the slope, dual intake, and elevator shaft, return shaft, two bleeder shafts (District 5 and Sharp), and the Hardesty intake shaft. Once mining operations terminate, the shafts will be sealed by filling with earth, rock, and rubble from the coal seam to the surface, after which an 8-inch-thick concrete cap will be poured at the surface, prior to backfilling, regrading, and seeding. The slope will be sealed by building a 25 feet long wet seal at the portal, prior to backfilling, regrading, and seeding.

Upon completion of mining, mine soil material will be utilized to return selected areas of the site to AOC. The mine soil material will include topsoil, subsoil, and mixed overburden material that was removed during the construction of the access roads, underground mine site, and preparation plant site. Upon completion of mining operations and regrading, the mine soil

will be redistributed over the selected areas. Mine soil that served as a base for coal stockpiles in the preparation plant area will be tested to determine if supplemental liming is necessary prior to blending this material with the other mine soil onsite. After the permit area has been graded, soil analysis will be performed to determine the quantity of agricultural limestone, or an equivalent supplement, and fertilizer necessary to achieve the post-mining land use. A soil analysis will be performed prior to seeding for each phase of mine reclamation.

The primary pre-mining land use for Permits No. O-2017-06 and U-2004-06 consisted of forestland with a secondary land use of hayland or pasture. The approved post-mining land use for both permits is forestland. The minimum standard for woody plants is 70 percent ground cover of legumes and perennial grasses, and 450 trees (including volunteer tree species) and/or planted shrubs per acre for the growing season of the last year of the responsibility period.

The current permit number, permitted surface area, end of mine reclamation liability estimated by Arch, bond number, and bond amount, is shown in Table 17.3-2. The total bond amount of $8.6 million is based on the mine closure reclamation liability cost estimate as of July 1, 2020, which projected the majority of the reclamation work to take place from 2034 through 2039.

The WVDEP utilizes a bond matrix that determines the rate per acre based upon the activity that the land is to be used for. The U-2004-06 permit takes into account the preparation plant and underground mining areas. The O-2017-06 permit takes into account the refuse impoundment.

17.6 ENVIRONMENTAL COMPLIANCE, PERMITTING, AND LOCAL INDIVIDUALS OR GROUPS ISSUES

Permit No. U-2004-06 has only had two permit violations, listed on the WVDEP website, as of October 12, 2020. The first citation was issued for exceeding total aluminum content on August 29, 2013, and was terminated that day. The second violation was issued on June 4, 2015, for completion of developmental mining under protected structures within the 30-degree angle of draw before a pre-subsidence survey had been completed and approved by the WVDEP or before the company had requested and been granted a postponement and/or exemption. The violation was terminated through Revision No. 12 where the company requested and was granted a postponement/exemption for performing pre-subsidence surveys for areas of developmental mining (less than or equal to 60 percent extraction).

There were four violations issued from October 21, 2011, through October 9, 2013, related to Permit No. O-2017-06. Three of the violations were terminated and the fourth violation, issued on October 9, 2013, was withdrawn for being improperly issued. The violation on October 21, 2011, was issued for water exceeding effluent limitations and was terminated that day. The violation on May 16, 2012, was issued for a pipeline that discharged muddy water that impacted the water in the receiving stream and was terminated that day. The violation on January 22, 2013, was issued for a line to pump water from the slurry cell to a pond was not included in the NPDES permit and was terminated on July 1, 2013.

The number of environmental violations issued is low for a coal mining operation the size of the Leer Mine.

There are some residents in the general area that are members of a local watershed group, *Save the Tygart Watershed Association*, that on occasion, in conjunction with the Sierra Club, have appealed permit decisions by the WVDEP. The objections historically are primarily related to unsubstantiated concerns relating to potential water discharges creating material damage to the hydrologic balance within the permit area and Three Fork Creek, upon which the operation is situated. Three Fork Creek is a Total Maximum Daily Load (TMDL) watershed previously impacted by historic mining operations prior to existence of the facility. A TMDL is the calculation of the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will meet and continue to meet water quality standards for that particular pollutant.

Based on WEIR's review of Arch's plans for environmental compliance, permit compliance and conditions, and dealings with local individuals and groups, Arch's efforts appear to be adequate and reasonable in order to obtain approvals necessary relative to the execution of the Leer Mine LOM Plan.

17.7 LOCAL PROCUREMENT AND HIRING COMMITMENTS

While not a commitment, the Leer Mine trains and hires five to six applicants from the graduating class of the local high school each year.

18.0 CAPITAL AND OPERATING COSTS

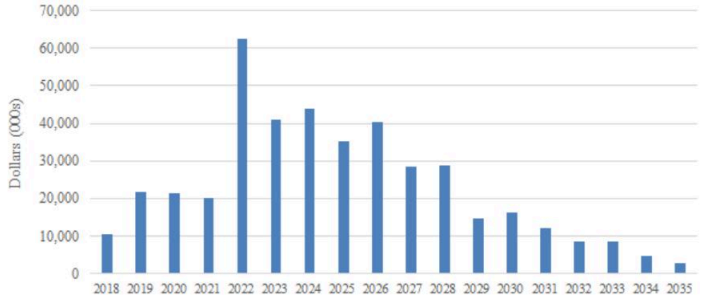
Arch provided historical operating costs and capital expenditures for the Leer Mine, which were an adequate check and basis for the LOM Plan cost projections. The operating costs and capital expenditures are included in the financial statements that are audited annually by Ernst & Young LLP for Arch's 10-K reporting to the SEC. The auditing performed by Ernst & Young, LLP is conducted in accordance with the standards of the Public Company Accounting Oversight Board.

18.1 CAPITAL EXPENDITURES

The Leer Mine will require capital to be expended each year for infrastructure additions/extensions, as well as for mining equipment rebuilds/replacements to continue to produce coal at currently projected annual levels of production. Arch has invested $275 million in the Leer Mine, since inception. These costs ($275 million) are considered "Sunk Costs" and as economic returns in this economic analysis are presented only on a forward-looking basis, Sunk Costs are not included in the economic return of the project, as estimated in this study.

The projected capital expenditures are categorized according to intake, return and bleeder shafts and fans, creek restoration, development capital (advancement items - belt, power, rail, and waterline, mining equipment, and gas well plugging), refuse expansion, fine coal recovery, and Three Forks crossing. Actual capital expenditures for 2018 through 2020 and projected capital expenditures, in 2021 dollars, for 2021 through 2036, are shown on Figure 18.1-2.

Figure 18.1-2 Historical and Projected LOM Plan Capital Expenditures



Note: 2018 through 2020 actual/ 2021 through 2035 projected LOM Plan includes 10 percent contingency)

The 2022 capital expenditures include $23 million for a belt press addition to the preparation plant, which is estimated to have a 20-month payback at projected coal sales prices.

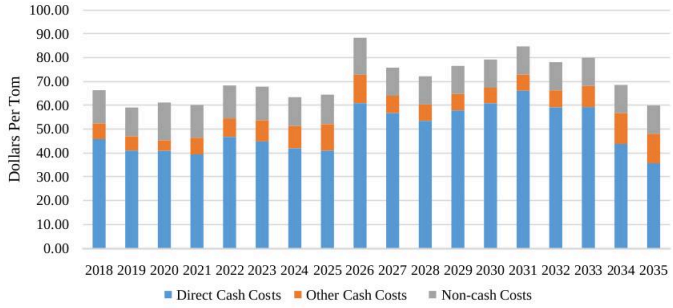
Arch began development of the Leer Mine in 2011 and commenced longwall mining in 2013. Mine management has had several years of experience estimating capital expenditures for longwall mining and the risk of inaccurate estimates is low. The LOM Plan projected average capital cost of $6.99 per ton is $2.44 per ton higher than the four-year historical average of $4.55 per ton, as a result of equipment and infrastructure requirements. Capital expenditures estimates per annual ton are estimated to have an accuracy within +/- 25.0 percent.

Contingency costs account for undeveloped scope and insufficient data. Contingency for required major projects and mining equipment is estimated at 10 percent and is intended to cover unallocated costs from lack of detailing in scope items. It is a compilation of aggregate risk from estimated cost areas.

18.2 OPERATING COSTS AND RISKS

Operating costs are projected based on historical operating costs and adjusted based on projected changes in staffing, hours worked, production, and productivity for mining areas in the LOM Plan. The Leer Mine actual and the Leer Mine LOM Plan projected operating costs in dollars and dollars per ton sold, are shown on Figure 18.2-1.

Figure 18.2-1 Leer Mine Historical and LOM Plan Operating Costs



Descriptions or explanations of the operating costs considered in the LOM Plan are as follows:

Direct Cash Cost:

- Labor cost, which includes wages and benefits for hourly and salary personnel at the mine and preparation plant.
- Contract mining, which includes payments for third party companies providing mining labor, although not projected in the LOM Plan.
- Maintenance and repair, which are expenses related to upkeep of mining equipment and associated infrastructure.
- Tires and Tubes, which are expenses primarily related to rubber tired mobile equipment.
- Operating supplies, which are various items used for mine operations and the preparation plant.
- Drilling and Roof Support, which are expenses related to installation of roof bolts, timbers and crib material.
- Explosives, which are expenses related to blasting rock material when mining equipment becomes stuck between the roof and floor or to create additional cavity height for ventilation overcasts or belt conveyor drives.
- Utilities, which are expenses related primarily to purchase of power to operate electrical equipment in the mine and preparation plant, telephone and data lines, water, and garbage services.
- Fuels and lubes, which are expenses related to diesel fuel, gasoline, motor oil and grease.
- Equipment leases and rent, which are expenses related to copier machines, roller for the refuse area and occasionally rental of a telehandler.
- Taxes and insurance are expenses related to sales taxes on purchased goods and services and to property and liability insurance for risk management purposes.
- Miscellaneous/contract services, which include items such as security services and fines and penalties.
- Capitalized costs, which primarily include longwall items that are replaced or rebuilt between longwall panels that are amortized over the life of the longwall panel.
- Coal Inventory change, which represents the difference in value of the coal and parts and supplies inventory between one accounting period and the next period.

Other Cash Costs:

- Black Lung excise tax, OSM and West Virginia Reclamation tax, and West Virginia Severance tax
- Royalties are expenses paid to landowners that lease property to the Leer Mine.

Non-Cash Costs:

- Reclamation change, Depreciation and Development, and Depletion

The LOM Plan projected cost of sales of $72.49 per ton is $10.51 per ton higher than the three-year historical average of $61.98 per ton. With the long history of cost of sales, no contingency is included, although the accuracy of the LOM Plan projected cost of sales should be considered to be within 13 percent of the historical average.

Capital and Operating Cost Estimation Risk

The Leer Mine has been in operation since 2011 and has had a relatively long period relative to experience with capital and operating costs. Since the mining operation will continue in the same coal seam and mined in the same manner as historically, there is little risk associated with the specific engineering estimation methods used to arrive at projected capital and operating costs. An assessment of accuracy of estimation methods is reflected in the sensitivity analysis in Section 19.3.

For purposes of the Preliminary Feasibility Study completed relative to the Leer Mine LOM Plan, capital costs are estimated to an accuracy of +/- 15 percent with a contingency of 10 percent and operating costs are estimated with an accuracy of +/- 13 percent with no contingency.

19.0 ECONOMIC ANALYSIS

19.1 ASSUMPTIONS, PARAMETERS, AND METHODS

WEIR prepared a Preliminary Feasibility Study financial model in order to assess the economic viability of the Leer Mine LOM Plan. Specifically, plans were evaluated using discounted cash flow analysis, which consists of annual revenue projections for the Leer Mine LOM Plan. Cash outflows such as capital, including preproduction costs, sustaining capital costs, operating costs, transportation costs, and taxes are subtracted from the inflows to produce the annual cash flow projections. Cash flows are recognized to occur at the end of each period. There is no adjustment for inflation in the financial model, all cash flows are in 2021 dollars. WEIR's study is conducted on an un-levered basis, excluding costs associated with any debt servicing requirements.

To reflect the time value of money, annual net cash flow projections are discounted back to the project valuation date, using a discount rate of 10 percent. The discount rate appropriate to a specific project depends on many factors, including the type of commodity and the level of project risks, such as market risk, technical risk, and political risk. The discounted present values of the cash flows are summed to arrive at the project's NPV.

Projected cash flows do not include allowance of any potential salvage value. Additionally, capital previously expended (sunk cost) is not included in the assessment of economic returns.

Arch has indicated that based on accrued Net Operating Losses (NOLs), Arch does not anticipate necessary income tax payments relative to income from Leer Mine. Royalties are forecasted based on mineral lease rates and anticipated mine plan progression through various lease boundaries within the Leer Mine resource area.

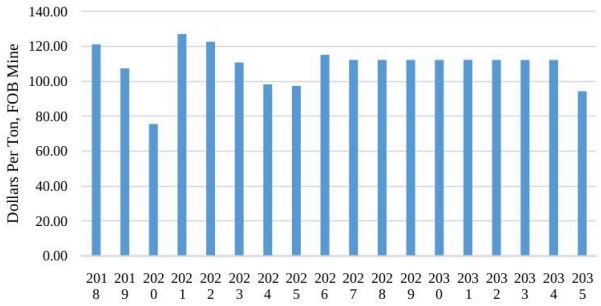
In addition to NPV, the Internal Rate of Return (IRR) is also calculated. The IRR is defined as the discount rate that results in an NPV equal to zero. Payback Period is calculated as the time required to achieve positive cumulative cash flow for the project at a 10 percent discount rate. As the Leer Mine is ongoing with no initial investment required (i.e. already sunk cost), payback period is less than one year.

The Preliminary Feasibility Study financial model developed for use in this TRS is meant to evaluate the prospects of economic extraction of coal within the Leer Mine resource area. This

economic evaluation is not meant to represent a project valuation. Furthermore, optimization of the LOM plan was outside of the scope of this engagement.

The actual and LOM Plan coal sales price forecasts used to estimate revenue are shown on Figure 19.1-1.

Figure 19.1-1 Coal Sales Price Forecast

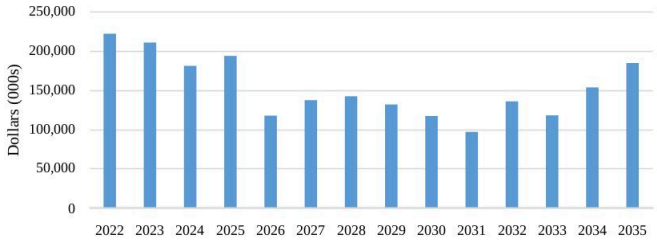


The projected coal sales price in the Preliminary Feasibility Study is based on a High Volatile A benchmark for HCC of $167.50 per metric tonne. Once converted to short tons, adjusted for transportation and the inclusion of middling coal sales, the estimated LOM Plan FOB Mine price is $110.18 per ton.

19.2 ECONOMIC ANALYSIS AND ANNUAL CASH FLOW FORECAST

The annual cash flow for the Leer Mine LOM Plan is shown on Figure 19.2-1 as follows:

Table 19.2-1 Annual Cash Flow Forecast



The Leer Mine LOM Plan has an after-tax NPV of $1.25 billion, at the base case discount rate of 10 percent (Table 19.2-2). As the Leer Mine is ongoing with no initial investment required (i.e. already sunk cost), the IRR indicates that the project NPV is infinite. Cumulative (undiscounted) cash flow over the LOM Plan is positive, at $2.13 billion. The Return on Investment (ROI), at the 10 percent discount rate, is 419 percent.

The after-tax NPV, IRR, cumulative cash flow and ROI are summarized in Table 19.2-2 as follows:

Table 19.2-2 After-Tax NPV, IRR Cumulative Cash Flow, and ROI

	LOM Plan
NPV ($000)	1,251,682
IRR (%)	Infinite
Cumulative Cash Flow ($000)	2,126,535
Return on Investment (%)	419

Table 19.2-3 presents key operational statistics for the LOM Plan on an after-tax basis. Over the LOM Plan, the average cost of sales is $72.49 per clean ton sold. Operating costs include direct cash costs, other cash costs, and non-cash costs.

Table 19.2-3 Key Operating Statistics

	LOM Plan
ROM Tons Produced (000s)	125,207
Clean Tons Produced (000s)	44,195
Preparation Plant Yield (%)	35.3
Marketable Tons Sold (000s)	44,408
	($ Per Ton)
Coal Sales Realization	110.18
Direct Cash Costs	50.94
Other Cash Costs	9.00
Non-cash Costs	12.55
Total Cost of Sales	72.49
Profit / (Loss)	37.69
EBITDA	50.24
CAPEX	6.99

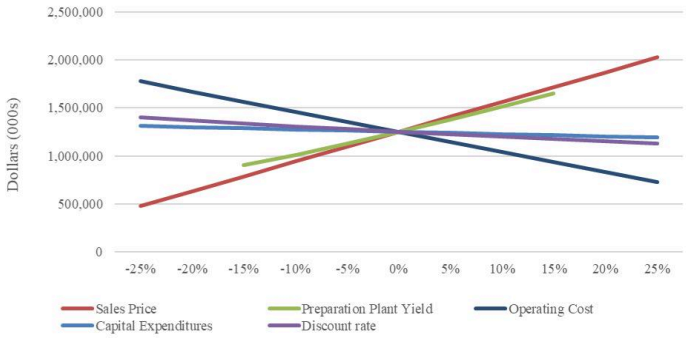
19.3 SENSITIVITY ANALYSIS

A sensitivity analysis was undertaken to examine the influence of changes to assumptions for coal sales prices, preparation plant yield, operating cost, capital expenditures, and the discount rate on the base case after-tax NPV. The sensitivity analysis range (+/- 25 percent) was designed to capture the bounds of reasonable variability for each element analyzed. The basis for reasonable variability for each element analyzed is summarized as follows:

- Sales Price - Historical coal sales price variability of 16 percent between 2017 and 2020
- Preparation Plant Yield - Variability in preparation plant yield data of up to 17 percent from the 2018 through 2020 average yield
- Operating Cost - Estimated accuracy of 13 percent
- Capital Costs - Assumed accuracy of +/- 25 percent
- Discount Rate - based on range of variability from 7.5 to 12.5 percent

Figure 19.3-1 depicts the results of the NPV sensitivity analysis.

Figure 19.3-1 Net Present Value Sensitivity Analysis



The chart above shows that the project NPV is most sensitive to changes in coal sales price, operating cost, and preparation plant yield. It is less sensitive to changes in discount rate and capital expenditures.

20.0 ADJACENT PROPERTIES

Geological data outside of the Leer Mine Property was provided to WEIR for inclusion in the report analysis. This data went through the same verification procedures WEIR used on all drillhole data within the Leer Mine Property. These data points have been used in the geological structure and quality modeling but are not included in Leer Mine Property summaries of minimum and maximum coal thicknesses and/or standard deviations. Additionally, these data points were not utilized as points of observation relative to applying resource confidence intervals. Utilizing the data outside of the Leer Mine Property assists in trending data through the extremities of the reserve and resource boundaries, which in turn provides a more realistic estimation of tonnage and quality along the borders of the property.

WEIR has discovered no relevant information for any property adjacent to the Leer Mine or its northern extension.

21.0 OTHER RELEVANT DATA AND INFORMATION

Conducting a due diligence investigation relative to the mineral and surface rights of Arch's mining operations was not part of WEIR's scope of work. This TRS is based on Arch controlling, by lease or ownership, or having the ability to acquire the coal reserves and surface lands necessary to support its mine plans.

The ability of Arch, or any coal company, to achieve production and financial projections is dependent on numerous factors. These factors primarily include site-specific geological conditions, the capabilities of management and mine personnel, level of success in acquiring mineral rights and surface properties, coal sales prices and market conditions, environmental issues, securing permits and bonds, and developing and operating mines in a safe and efficient manner. Unforeseen changes in legislation and new industry developments could substantially alter the performance of any mining company.

Coal mining is carried out in an environment where not all events are predictable. While an effective management team can identify known risks and take measures to manage and/or mitigate these risks, there is still the possibility of unexpected and unpredictable events occurring. It is not possible therefore to totally remove all risks or state with certainty that an event that may have a material impact on the operation of a coal mine will not occur.

22.0 INTERPRETATIONS AND CONCLUSIONS

22.1 SUMMARY OF INTERPRETATIONS AND CONCLUSIONS

Interpretation

Among other U.S. underground mines, the Leer Mine is consistently ranked within the top quartile as measured by mine productivity (tons produced per employee hour worked, as reported by MSHA). Additionally, Arch has a long operating history of resource exploration, mine development, and mining operations at the Leer Mine, with extensive exploration data including drillholes, in-mine seam thickness and elevation measurements, and in-mine channel samples supporting the determination of mineral resource and reserve estimates, and projected economic viability. The data has been reviewed and analyzed by WEIR and determined to be adequate in quantity and reliability to support the coal resource and coal reserve estimates in this TRS.

The LOM Plan includes projected mining in a limited number of small areas that will be encountered in later years of the LOM Plan where Arch does not have mineral control. Most of these areas are expected to be acquired by Arch, in adequate time, before the areas are scheduled to be mined. However, if those areas cannot be acquired, adjustments could be made to the scheduled LOM Plan to avoid those areas.

Conclusion

The coal resource and coal reserve estimates and supporting Preliminary Feasibility Study were prepared in accordance with Regulation S-K 1300 requirements. There are 14.0 million in-place tons of measured and indicated coal resources, exclusive of reserves, and 45.8 million clean recoverable tons of underground mineable reserves within the Leer Mine as of December 31, 2021. Reasonable prospects for economic extraction were established through the development of a Preliminary Feasibility Study relative to the Leer Mine LOM Plan, considering historical mining performance, historical and projected metallurgical coal sales prices, historical and projected mine operating costs, and recognizing reasonable and sufficient capital expenditures.

22.2 SIGNIFICANT RISKS AND UNCERTAINTIES

Risk, as defined for this study, is a hazard, condition, or event related to geology and reserves, mine operations and planning, environmental issues, health and safety, and general business issues that when taken individually, or in combination, have an adverse impact on Arch's

development of the Leer Mine. Risks can disrupt operations, adversely affect production and productivity, and result in increased operating cost and/or increased capital expenditures.

In the context of this TRS, the likelihood of a risk is a subjective measure of the probability of the risk occurring, recognizing the magnitude of the risk defined as follows:

Low Risk indicates that the combined probabilities (low/medium/high) together with the economic impact (minimal/significant/adverse), if conditions exist, should not have any material adverse effect on the economic viability of the project.

Moderate Risk indicates that the combined probabilities (low/medium/high) together with the economic impact (minimal/significant/adverse), if conditions exist, could have a detrimental effect on the economic viability of the project.

High Risk indicates that the combined probabilities (low/medium/high) together with the economic impact (minimal/significant/adverse), if conditions exist, could have a seriously adverse effect the economic viability of the project.

Based on a review of available information and discussions with Arch personnel, WEIR identified potential risks associated with the Leer Mine LOM Plan. The risks, WEIR's assessment of risk magnitude, and comments based on WEIR's experience with underground mining operations are summarized in Table 22.2-1 as follows:

Table 22.2-1 Leer Mine Risk Assessment Summary

Area of Risk	WEIR Risk Assessment	Comments
Geology and Coal Reserves	Low	The Lower Kittanning Seam has been extensively mined by the Leer Mine. This mining has not indicated any anomalies in the seam other than normal thinning and thickening, and encountering expected minimal water originating from overlying sandstone strata.
Horizontal Stress	Low	The next longwall districts, 6 and 7, will have longwall panels oriented approximately perpendicular to the current northeast/southwest orientation. Geotechnical studies undertaken do not anticipate problems.
Land Acquisition	Low	To fully develop the Lower Kittanning Seam, it will be necessary to acquire additional mineral control, specifically north of the currently controlled mineral leases. Planning will be necessary to assure that these additional mineral leases are acquired prior to longwall panel development.

Area of Risk	WEIR Risk Assessment	Comments
Methane	Low	Although methane gas is present in the Lower Kittanning Seam, gas liberation experienced to date has been low to undetectable and is expected to remain low, undetectable or at levels that can be safely mitigated during mining. Procedures and continuous gas monitoring are in place to prevent, to the extent possible, methane ignitions and mine fires.
Overburden Stress	Low	The potential for a coal pillar bump or release of stress when mining will be monitored as a part of the normal mining operation. Maximum overburden is approximately 850 feet, and the risk of bumps occurring is minimal, since coal outbursts, as a result of sudden release of energy, are typically associated with depth of cover of 1,500 to plus 2,000 feet.
Qualified Employees	Low to Moderate	In five to eight years, there may be as many as four longwall mines producing in the region. This will increase competition for skilled workers although the Leer Mine typically hires a small number of redhat miners to train each year.
Rail Lines	Low to Moderate	In five to eight years, there may be as many as four longwall mines producing in the region. This may increase competition for rail line capacity. The potential for up to 16 million tons annually with only one CSX rail line in the region may cause congestion and/or increase shipping costs.
Refuse Disposal	Low	Additional refuse disposal area will need to be permitted and developed for use in 2028.
Roof Lithology	Low to Moderate	All underground coal mines have the potential to experience unstable roof conditions. The current Longwall District 5 has minor issues related to a rider seam that merges with the main bench of the Lower Kittanning Seam and results in thicker coal but also some roof instability in the transition zone. This potential risk can be kept in the low range through proper ground control engineering and following approved roof control plans.
Seam Dip	Low	The structure of the Lower Kittanning Seam has a relatively gentle dip, with some localized small areas of relatively steeper dips.
Spontaneous Combustion	Low	The Lower Kittanning Seam has a low potential for spontaneous combustion, and the Leer Mine has not, to date, experienced any loss of production due to spontaneous combustion, since each longwall district is sealed as mining is completed to mitigate the potential of spontaneous combustion. The atmosphere in each sealed area is monitored and made inert with injection of nitrogen gas, if needed.
Water Inflow	Low to Moderate	There have been areas where the Leer Mine has encountered water inflow from the water-bearing sandstone overburden. Normal mine development has and will need to continually address any water encountered through the current and expanded pumping system to adequately handle water encountered in the mine workings.

It is WEIR's opinion that the majority of the risks can be kept low and/or mitigated with proper mine engineering, planning and monitoring of the mining operation.

23.0 RECOMMENDATIONS

The Leer Mine has sufficient geologic exploration data to determine mineral reserves. Future exploration work will be undertaken by Arch to continuously provide geological data primarily for use by mine operations personnel related to effective implementation of the LOM Plan. Future exploration work and mineral property acquisition should include what has been historically implemented related to the following:

Geology

- Have an experienced geologist log core holes, measure core recovery, complete sampling. Geophysically log core holes to verify seam and coal thickness and core recovery.
- Geophysically log rotary holes to verify strata and coal thickness.
- Continue to prepare laboratory sample analysis at a 1.40, 1.50 and 1.60 specific gravity to better match the preparation plant specific gravity when processing a metallurgical coal.
- Continue collecting channel samples (include parting).
- Obtain a survey coordinate where a channel sample has been collected.
- Add additional drilling data points in the northern extension of the Leer Mine to increase the confidence of the resource area.

Mineral Property

- Acquire or obtain leases of uncontrolled properties at least two years before the projected mining date.

Permitting and Regulatory Approvals

- Continue permitting and construction efforts relative to a new refuse disposal facility

24.0 REFERENCES

References used in preparation of this TRS are as follows:

- Syd S. Peng and Asmaa Yassien. 2010. *Longwall Chain Pillar Design for ICG's Tygart No. 1 Mine in the Lower Kittanning Seam*
- Monty Heib. 2018. *Report of Diametral Strain Measurement (DSM): Core Holes PD62-15, RM1602, RM1606 (Barbour County, WV)*
- Josuha Bonner. 2019. *Cumulative Hydrologic Impact Assessment Update*
- James Sumner. 2020. *Roof Control Plan Update*
- James Sumner. 2020. *Updated Ventilation Plan*
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- Arch. 2020. *Underground Mine Abandonment Plan*
- Arch. 2020. *Surface and Coal Control drawings*
- Arch. 2020. *Property control Summary Information spreadsheet*
- Arch. 2020. *Clean Coal Handling Facility Drawing 11401-46100*
- Arch. 2020. *Loadout Facility Drawing 11401-47100*
- Arch. 2020. *Raw Coal Handling Facility Drawing 11401-11100*
- Arch. 2020. *Raw Coal Handling Facility Drawing 11401-22100*
- Arch. 2020. *Stockpile Capacities drawing*
- Arch. 2020. *Leer Mine Map as of October 7, 2020*
- Arch. 2020. *Leer Mine LOM Timing Map*
- Arch. 2020. *Leer Mine Infrastructure Map*

Websites Referenced:

- Securities and Exchange Commission - Modernization of Property Disclosures for Mining Registrants - Final Rule Adoption
  https://www.sec.gov/rules/final/2018/33-10570.pdf
- MSHA Data Retrieval Site
  https://www.msha.gov/mine-data-retrieval-system
- WVDEP Permits No. O-2017-06 and U-2004-06
  https://apps.dep.wv.gov/webapp/_dep/securearea/public_query/ePermittingApplicationSearchPage.cfm

25.0 RELIANCE ON INFORMATION PROVIDED BY THE REGISTRANT

In preparing this report, WEIR relied upon data, written reports and statements provided by the registrant. It is WEIR's belief that the underlying assumptions and facts supporting information provided by the registrant are factual and accurate, and WEIR has no reason to believe that any material facts have been withheld or misstated. WEIR has taken all appropriate steps, in its professional opinion, to ensure information provided by the registrant is reasonable and reliable for use in this report.

The registrant's technical and financial personnel provided information as summarized in Table 25.1 as follows:

Table 25.1 Information Relied Upon From Registrant

Category	Information	Report Section
Legal	Mineral control and surface rights	3
Geotechnical	Pillar design, roof control plans, and rock quality analyses	13.1.1
Hydrogeological	Hydrogeological Analysis including inflow rates, permeability and tranmisivity calculations, and watershed analysis	13.1.2
Marketing	Coal sales price projections	16
Environmental	Permits, bond, and reclamation liability	17
Macroeconomic	Real price growth (coal sales, labor and other cash costs)	18

APPENDIX A - EXHIBITS

Exhibit 15.7-1 Infrastructure Map