Industrial Materials Supply and Demand in the County: Sourcing the Future

Prepared for:
Salt Lake County

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The conclusions in this report titled Industrial Materials Supply and Demand in the County: Sourcing the Future (Report) are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared.

Stantec has assumed all information received from third parties in the preparation of the Report to be correct.

This Report is intended solely for use by the Salt Lake County in accordance with Stantec's contract with the County.

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Executive Summary

Scope: Salt Lake County (the County) engaged Stantec-Mining to assess the supply and demand for "Industrial Minerals"[1] in and around Salt Lake County over the next 20 years. The County expects to realize a 40% population increase over the next four decades, which will create additional demand for Industrial Minerals to build new homes, roads, buildings, and other supporting infrastructure. The analysis focused on the following Industrial Minerals related to this population increase: sand, gravel, and crushed stone – referred to as "aggregate" in this Report.

Methodology and Results: With respect to the demand analysis, Stantec considered two demand models, population growth and an econometric analysis, and concluded that the population growth model is a more useful model for forecasting demand. Based on the population growth model, Stantec estimates that the County will consume about 365 million tons (Mt) of aggregates over the next 20 years, reaching about 20 Mt in annual demand by the end of 2044. See ***Figure 2*** in ***Section 2.1.2*** below for a breakdown of that estimate. With respect to the supply analysis, Stantec limited its assessment to supply from existing operations that currently supply Salt Lake County (including estimates of current production capacity and projections of available resources).[2] Based on that approach, Stantec estimates that there are roughly 321 Mt of aggregate resources remaining over the next 20 years from quarries that currently supply the County. See ***Table 1*** and ***Table 2*** in ***Section 3*** below for a breakdown of that estimate.

The difference (or "gap") between the total projected demand figure (365 Mt) and the total amount of estimated aggregate resources remaining over the next 20 years from quarries that currently supply the County (321 Mt) is 44 Mt. Stantec also conducted a gap analysis based on projected annual consumption and supply over the same 20-year period. That annual gap analysis projects an annual gap as of 2044 of about 15 Mt.[3]

Data Limitations: In Stantec's opinion, the supply and demand analysis in this Report (including a resulting gap analysis) provide a reasonable forecast of the trend in the aggregates market for the

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[1] For the purposes of this Report, and pursuant to the scope of the work in the RFP through which Stantec was engaged, the term 'Industrial Minerals' shall have the meaning defined by the Utah Geological Survey, i.e., non-metallic and non-fuel mineral resources, including (and for the purpose of this analysis primarily focused on) construction aggregate (sand and gravel and crushed stone), as well as potash, salt (sodium chloride), phosphate, high-calcium limestone, high-magnesium dolomite, uintaite (Gilsonite®), bentonite, and gypsum. References to 'mining' and 'minerals' throughout this document generically refer to the extraction of Industrial Minerals as defined above.

[2] The supply analysis also assumes that current market share will remain static.

[3] The gap estimates of 44 Mt and 15 Mt in this Report are based solely on existing operations that currently supply the County (and then only includes the County's "market share" of those operations). These estimates also do not include alternate sources of aggregate such as recycled materials. Recycling of aggregate has potential for expanding the projected supply.

County but should not be relied upon for precise demand in any given year or production or resources at any given quarry. County-level demand and quarry-level supply (i.e., production and resources) are almost never publicly reported (with some exception) and are therefore not readily available for review. This is due to a variety of reasons, including that the state mining regulatory body, the Division of Oil, Gas and Mining (DOGM), does not regulate all aggregate production operations throughout the State.[4] As a result, data reported through DOGM is limited in scope. In addition, some quarries (though regulated by DOGM) do not report their production annually.[5] To address these limitations on the accuracy of supply data, Stantec elected to utilize the following methodology to estimate supply: Stantec first collected available data from the DOGM public website and then revised that information per discussions with industry representatives. For operations that were not regulated by DOGM, Stantec utilized Google Earth searches to determine supply estimates. Although Stantec relied upon its experience in the industry to finalize these estimates, it should be noted that there is a sizable difference between (1) quarry-level production reported to DOGM and some of Stantec's quarry-level production estimates, and (2) total annual production reported to DOGM from Salt Lake and Toole counties and Stantec's annual demand estimates in this Report.

Next Steps: Assessing the future supply and demand for aggregates in the County is a complex subject that involves numerous issues. Due to the limited scope of the consulting agreement for this Report, Stantec recommends that Salt Lake County conduct a more detailed analysis to better understand the aggregate market and prepare for potential future supply gaps. The analysis could include the following topics of investigation:

- An analysis of (i) transportation corridors (including rail options) from potential sources, (ii) transportation issues related to cement mixing/concrete batching operations (both inside and outside of quarry operations), (iii) quantified emissions (including the effect of electrification of heavy-duty trucking), (iv) traffic, (v) impacts on aggregate pricing, and (vi) other scenarios.
- A review of the likelihood of potential resources in and around the County of being developed, and an assessment of the costs and benefits of such resources, such as impacts to quality of life for nearby residents.
- A review of how the permitting process impacts developing new quarries in and around the County and how changes may affect future supply for the County.
- An analysis to further quantify and assess the benefits and costs of resources outside of the County that have high potential for supplying the County, such as the large resources being developed in Tooele County, including in the Grantsville area.

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[4] Generally, DOGM regulates operations that produce "consolidated material" (e.g., hard rock that requires blasting), whereas operations that produce "unconsolidated materials" (e.g., alluvial materials that can be collected without blasting) are governed by local authorities and not DOGM.
[5] A review of DOGM filings reveals that a significant number of operators do not report annually.

- An expanded visibility assessment for potential future quarry locations in and around the County.
- An evaluation of the amount of aggregate recycling that currently occurs in and around the County and opportunities for new recycling initiatives, as well as roadblocks to increasing recycling and policy recommendations to remove those roadblocks.
- An assessment of the current regulatory reporting and compliance requirements in Utah for aggregate production.

1 Introduction

The County expects to realize a 40% population increase over the next four decades. In that time, it is expected that approximately 60% of that growth will be concentrated in the southwestern portion of the valley, primarily near Herriman, Daybreak, and Bluffdale. This growth will create additional demand for aggregates, particularly for transportation infrastructure, commercial development, public infrastructure, and residential development. However, because some of the largest quarries currently supplying the Salt Lake County market are nearing the end of their life, the County will need to balance its need and cost for sources of aggregates with the well-being and interests of the local communities[6] and the availability of resources.

Stantec was engaged by the County to prepare a supply and demand analysis of present and future aggregates. Stantec determined that the best course of action was as follows:

1. Develop demand models for aggregates for the County based on population growth, historical consumption, and econometric analysis.
2. Build an aggregates supply model for the County based on an estimate of current production and currently identified and permitted resources.
3. Perform a gap analysis that compares the current supply and demand models over the next 20 years.
4. Identify potential new sources of aggregates to meet demand by mapping potential future sources of aggregates and assessing criteria such as “visibility” and “permittability.” This includes mapping geologic units with aggregates within 40 miles of the County in mapping software.

2 Demand Analysis

Aggregates are the most mined materials in the world and are the primary material in concrete and asphalt. About 2.47 billion metric tons of aggregate valued at over $35 billion was mined in 2023 in the US from over 9,000 quarries. In 2023, about 46 Mt valued at over $500 million was mined in Utah.[7]

The 2021 Infrastructure Investment and Jobs Act allocated $118 billion to the Highway Trust Fund to repair roads and bridges and support major transportation projects, which may cause spikes in demand over the next 5-10 years. On average, 38,000 tons of aggregate rock are used to construct one mile of

[6] “Interests of the local communities” include considerations such as property values, air quality, visual impacts, noise, traffic, and recreational opportunities.
[7] https://www.usgs.gov/centers/national-minerals-information-center/crushed-stone-statistics-and-information

highway, 400 tons of aggregate are used to construct the average home, and about 15,000 tons are used to construct a school or hospital.[8]

Demand for aggregates is largely driven by changes in the local population. As the size of the population in a region expands, the need for housing and supporting infrastructure increases. Population density is also believed to influence the level of aggregates demand. As a region moves from low to high density, road, infrastructure, and new residential and commercial construction will rise, increasing aggregates demand, until reaching urban maturity.

Broad macroeconomic indicators, such as real GDP growth, also correlate with aggregate demand, since economic growth is correlated with new construction, which includes the building of warehouses, manufacturing facilities, offices, and the roads and bridges that serve the new infrastructure. When economic growth creates real income growth, consumers spend more of their income, spurring demand for commercial activity and larger houses. Tax income for the local cities and counties also increases, providing larger budgets for road maintenance and construction of parks and other facilities. Unemployment, an indicator of economic growth for which data is available, may negatively correlate with demand for aggregates.

Fiscal policy also influences aggregates demand, as is the case with all economic sectors. An increase in the federal funds rate increases construction costs and leads companies to conserve cash, which decreases construction and economic activity. For these reasons, an increase in the federal funds rate would have an inverse correlation with the demand for aggregate rock.

Infrastructure spending is a key driver for demand as it directly leads to construction activity – either new infrastructure or updating and maintaining existing infrastructure – that requires large volumes of aggregates. The miles of public roads and number of new bridges – as well as the condition of existing roads – are variables that can be used to estimate the demand of maintaining infrastructure.

As part of its analysis, Stantec considered two demand models. The first used the county population forecasts and historic data for aggregate demand per person to forecast future demand. The second used econometric methods to test the explanatory power of other variables related to demand for aggregate to attempt to develop an alternative forecast.

2.1 Population Growth Demand Model

2.1.1 Methodology

Stantec developed a demand forecast by multiplying population forecasts by historical aggregate demand per person figures.

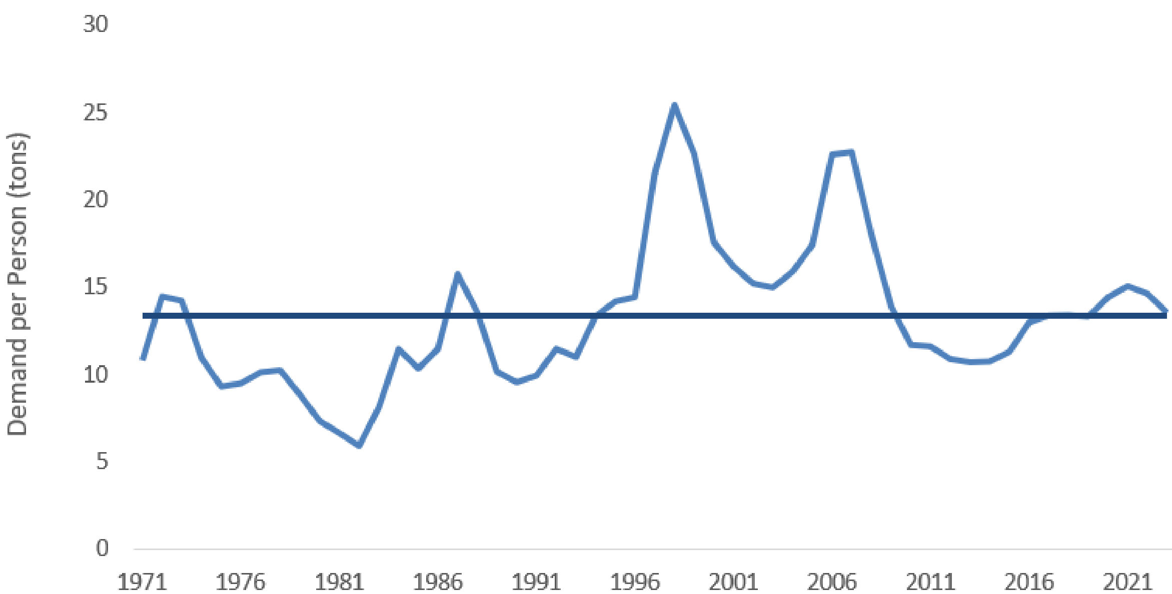
- *Population Forecast:* Stantec used a population forecast provided by the University of Utah's Kem

[8] https://www.aem.org/news/construction-aggregates-101-what-they-are-and-why-they-matter

C. Gardner Policy Institute.[9] The Gardner Institute produces long-term population and demographic projections to support Utah policy decision making. The projections are updated every four years.

- *Aggregate Demand Per Person:* Aggregate demand per person figures were calculated by dividing the total annual demand by the population. The USGS collects aggregates data from producers via a survey and publishes production data quarterly.[10][11] The data provided by the USGS is state-wide and includes total production and pricing. Reliable county-level data is not available, so Stantec relied on the state-wide data to estimate demand per person figures for the County. This is a common practice in industry for market estimates. Annual demand per person figures can be seen in ***Figure 1***.

Figure 1. Historical Utah Aggregate Demand per Capita



The historical average aggregate demand per person was multiplied by the population forecast to arrive at a baseline estimate for forecasted aggregate demand. The low and high population forecasts were multiplied by the first and third quartile demand-per-person figures, respectively, to provide low and high demand forecasts.

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[9] https://gardner.utah.edu/demographics/population-projections/
[10] https://www.usgs.gov/media/files/usgs-aggregates-time-series-data-state-type-and-end-use
[11] https://www.usgs.gov/centers/national-minerals-information-center/crushed-stone-statistics-and-information#mis

2.1.2 Results

The results of the population growth demand model can be seen in ***Figure 2.*** The demand in 2044 is estimated to range between 15 Mt and 24 Mt, with the base case being 20 Mt. ***Figure 3*** shows how the forecast compared to historical demand.

Figure 2. Population-Based Forecast

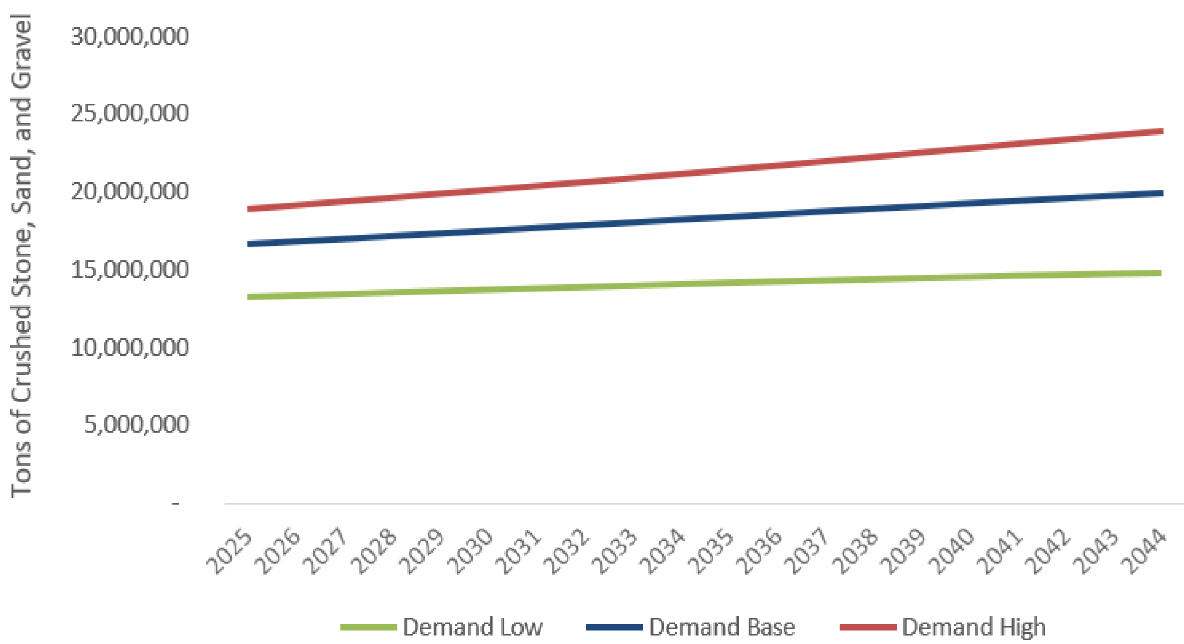
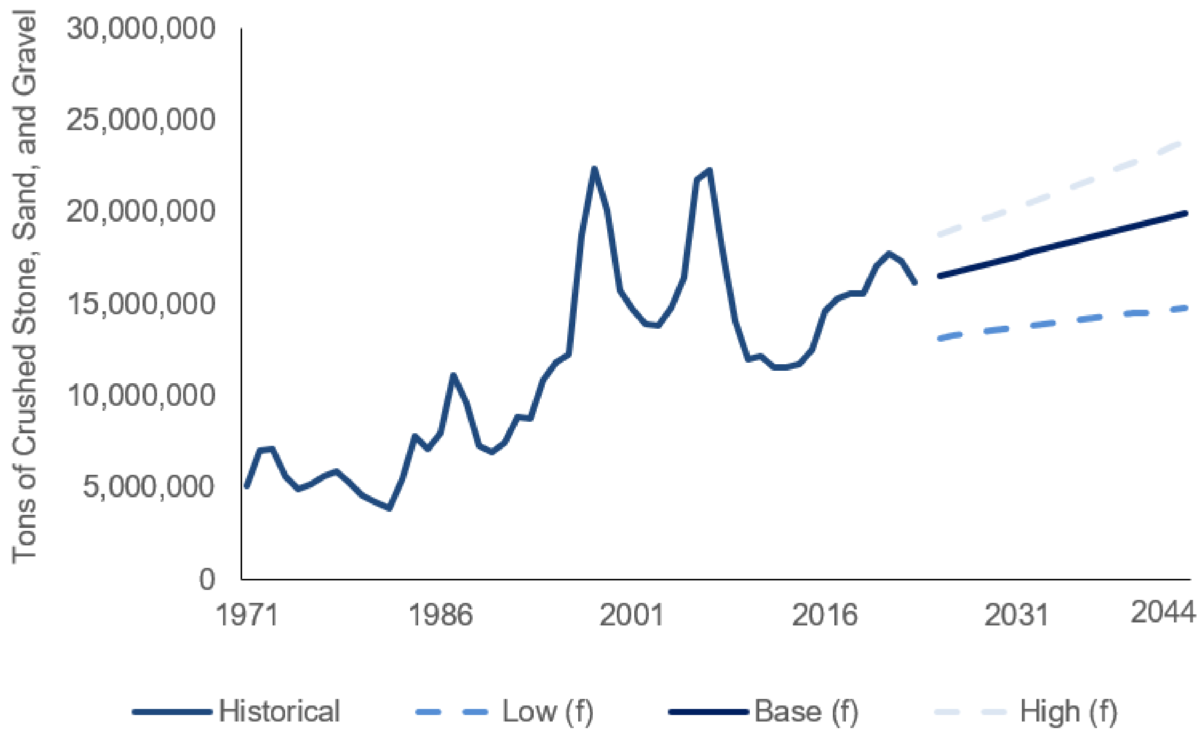


Figure 3. Historical and Forecasted Consumption in the County



Based on infrastructure spending and large project development, it is expected that certain years in the future may have spikes in demand, similar to those in the periods from 1996 to 2000 and 2004 to 2008. These are dependent on federal and state infrastructure spending, large private projects, and economic boons (such as large sports related projects and opportunities). While these spikes may occur in the future, they likely would not affect the overall demand trend nor the total consumption estimate. The average demand per person figure used in the forecast included the spikes in demand between 1996 and 2008.

2.2 Recommended Demand Model

Stantec's analysis shows that the best model for forecasting aggregate demand in the County is the population-based model. Population growth has a high correlation with aggregates demand in the Utah data. The variables found to have explanatory power for aggregates demand during the econometric analysis are difficult to reliably forecast, giving them less utility for the purposes of this study. The econometric analysis can be found in **Appendix A**.

3 Supply Analysis

Aggregate resources are typically mined within 30-50 miles of where they are consumed. The location of quarries is limited by the geologic resources available, permitting constraints, and the optimum locations for supplying major demand centers. In order to conduct its supply analysis, Stantec developed a database with estimated annual production and remaining resources for each identified quarry in the County, as well as for quarries outside of the County that currently supply the County. Those quarries and their estimated production and resources are shown in *Table 1* and *Table 2* below.[12] Quarries that are on the border or near the border of Salt Lake County were considered as quarries in the County for the analysis.

Production Estimates: As noted above, data for annual production for some of the quarries is available through the public filings with the DOGM. Stantec estimated production for quarries that have not reported production to DOGM by physically observing (through Google Earth) their property size and the size and amount of equipment on site.

Resource Estimates: None of the companies publicly publish data on the remaining resources at their quarries. Stantec estimated the remaining resource at each quarry by reviewing permit applications for sites permitted through DOGM and estimating the amount of remaining material in the original mine plans.[13] For quarries that did not file their mine plans with DOGM, Stantec estimated their remaining resource by physically observing (through Google Earth) the property size and estimating the maximum depth and extents of the pits.

As shown in ***Table 1*** and ***Table 2*** below, the combined estimated total of aggregate resources remaining that will likely source the County over the next 20 years is 321 Mt (broken down as roughly 223 Mt from the quarries located within the County and roughly 98 Mt from the quarries outside of the County that currently supply the County).[14]

3.1 Quarries within Salt Lake County

Sixteen quarries that are located within the County have roughly 223 Mt of aggregate resources remaining that will likely source the County over the next 20 years. About 80% of those aggregate resources are on the north side of the County around Beck Street and on the south side of the County near the Point of the

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[12] The term "quarry" (as used herein) includes quarries that DOGM regulates and other operations identified by Stantec. It is possible that some existing aggregate producing operations (e.g., relatively small gravel pits) are not included in the supply analysis, e.g., relatively small gravel pits and "on site" aggregate that is excavated at new largescale real estate developments (such as the residential Daybreak community) as developable land is continually prepped).

[13] These estimates were informed (in part) by consultation with applicable operators.

[14] This estimate is limited to existing operations known to Stantec and does not include alternate sources of aggregate such as recycled materials.

Mountain.[15] ***Table 1*** below shows those fifteen quarries that are located in the County, their estimated production capacity, an estimate of the percentage of product sold to the Salt Lake County market, and an estimate of the remaining resources for Salt Lake County.

3.2 Quarries Outside of the County Currently Supplying the County

Additional quarries located outside of Salt Lake County also currently supply the County and will likely continue to source the County over the next 20 years. ***Table 2*** below shows those quarries, their estimated production capacity, an estimate of the percentage of product sold to the Salt Lake County market, and an estimate of the remaining resources for Salt Lake County.[16]

3.3 Other Quarries within 40 Miles of the County

Table 3 shows other quarries that are within 40 miles of the County that are not known to be currently supplying the County. Stantec assesses that most of these quarries are unlikely to supply the County in the future due to the road distance from the market and the demand from projected growth areas closer to those quarries.

3.4 Quarry Maps

Figure 4 below shows a map of the quarries identified in each of the tables.

[15] Of this 80%, roughly 20% are on the north side of Salt Lake City near Beck Street and roughly 60% are on the south side of the County near Point of the Mountain.
[16] All of the quarries shown on ***Table 2*** are located in Tooele County.

Table 1. Quarries in Salt Lake County

Company	Location	Estimated Annual Production Capacity[17]	Market Split[18]		Estimated Current Annual Salt Lake County Supply	Estimated Remaining Resource for Salt Lake County[19]
			Salt Lake County	Other County		
Geneva Rock	Draper (Point of the Mountain)	6,000,000	50%	Utah	3,000,000	60,000,000
Geneva Rock	West Valley	100,000	100%	-	100,000	5,000,000
Granite Construction	Cottonwood Heights	1,000,000	85%	Summit	850,000	375,000
Kilgore	Unincorporated (Parleys)	300,000	100%	-	300,000	4,000,000
Kilgore	Draper (Point of the Mountain)	500,000	50%	Utah	250,000	4,000,000
Kilgore	West Valley	300,000	100%	-	300,000	3,000,000
Lakeview Rock Products	Salt Lake City (Beck Street)	1,800,000	45%	Davis	810,000	18,000,000
Staker Parson	Bluffdale	1,200,000	75%	Utah	900,000	60,000,000
South Valley Rock	Herriman	500,000	100%	-	500,000	5,000,000
Staker Parson	Salt Lake City (Beck Street)	3,000,000	60%	Davis	1,800,000	30,000,000
Staker Parson	Draper (Point of the Mountain)	1,600,000	50%	Utah	800,000	16,000,000
Staker Parson	West Valley	300,000	100%	-	300,000	3,000,000
Staker Parson	West Jordan	150,000	100%	-	150,000	3,000,000
Strang Excavating	West Valley	500,000	100%	-	500,000	7,000,000
TM Crushing	West Valley	150,000	100%	-	150,000	3,000,000
Utah Sand and Gravel	Salt Lake City (Beck Street)	500,000	60%	Davis	300,000	2,000,000
Total		**17,900,000**			**11,010,000**	**223,375,000**

[17] The "Estimated Annual Production Capacity" is an estimate that was arrived at by Stantec considering various factors such as industry self-reporting (through either reports that were delivered to DOGM by the operators and/or interviews of those operators by Stantec), as well as (in some instances) a single point-in-time physical observation using Google Earth to estimate property size and the size and amount of equipment on site.

[18] Roughly 40% of the total amount of aggregate that is produced in Salt Lake County is currently exported to other counties, and that exported product largely comes from the quarries located near the northern and southern borders of the County. For example, quarries on the Salt Lake/Davis County border sell about half of their product to Davis County and quarries on the Salt Lake/Utah County border sell about half of their product to Utah County.

[19] The figures reflected in the "Estimated Remaining Resource for Salt Lake County" are based on estimates of the remaining life of each quarry and the "Estimated Current Annual Salt Lake County Supply" estimate. As such, these figures assume that the market share breakdown will remain static over the next 20 years. If that market share were to shift, the "gap" projection would need to be shifted accordingly.

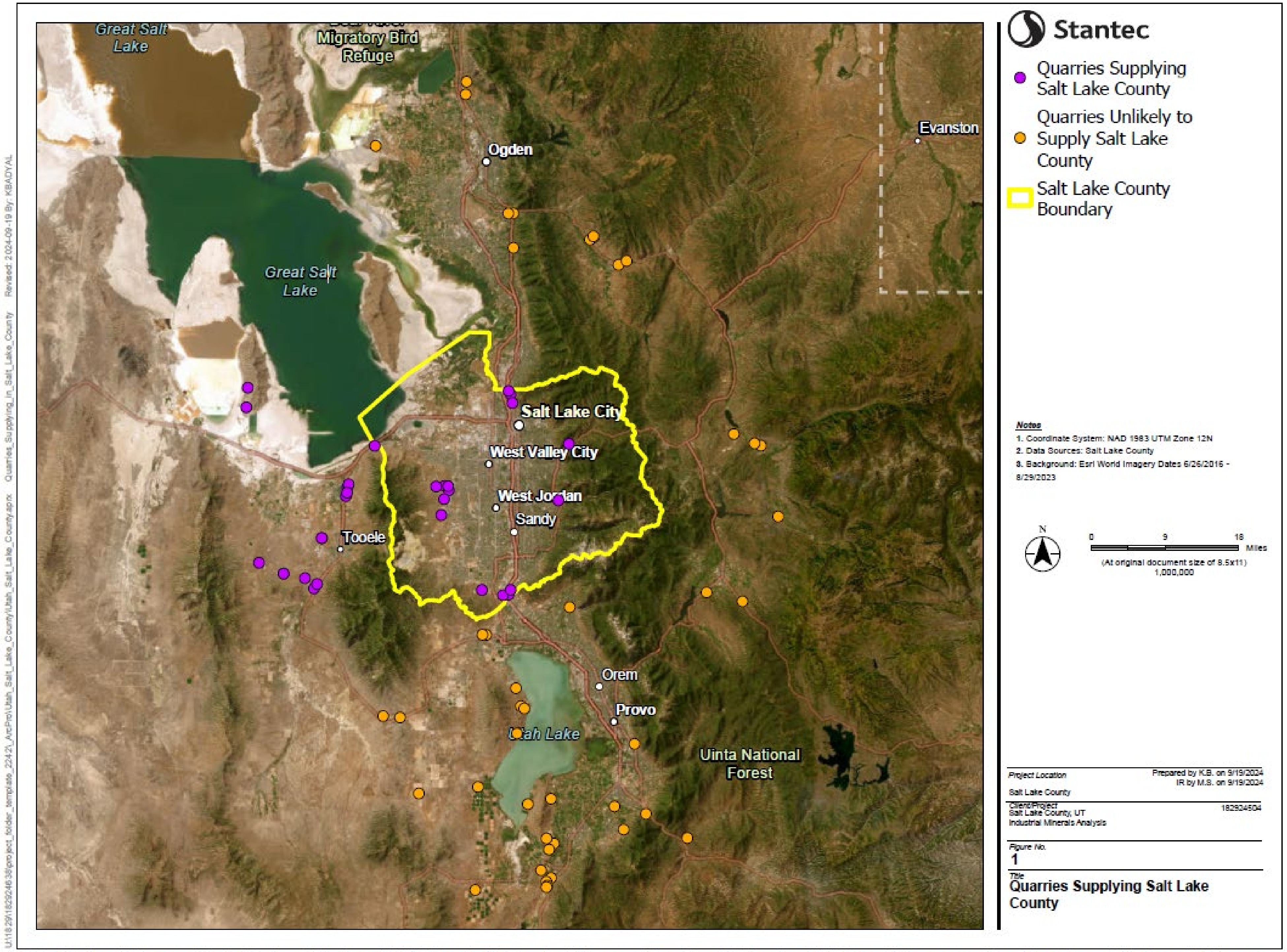
Table 2. Quarries Outside of the County Currently Supplying the County

Company	Quarry	Estimated Annual Production Capacity	Estimated Current % Sold to Salt Lake County	Estimated Current Annual Salt Lake County Supply	Estimated Remaining Resource for Salt Lake County
Adobe Rock Products	Erda	75,000	90%	67,500	750,000
Ames Construction	Erda	225,000	90%	202,500	1,125,000
Ames Construction	Bauer	75,000	90%	67,500	375,000
Bolinder Resources	Rocky Ridge	225,000	90%	202,500	3,375,000
Bolinder Resources	Stansbury Island	50,000	90%	45,000	2,500,000
Geneva Rock	Black Rock	100,000	90%	90,000	5,000,000
Geneva Rock	Bauer	150,000	90%	135,000	2,000,000
Granite Construction	Erda	500,000	90%	450,000	20,000,000
Harper Investments	Bauer	75,000	90%	67,500	2,000,000
Kilgore	Bauer	400,000	90%	360,000	50,000,000
Kilgore	Grantsville	150,000	90%	135,000	2,500,000
Kilgore	Erda	225,000	90%	202,500	2,250,000
Kilgore	Stockton	400,000	90%	360,000	2,000,000
Staker Parson	Bauer	400,000	90%	360,000	2,000,000
TM Crushing	Stansbury Island	150,000	90%	135,000	2,000,000
Total		**3,000,000**		**2,880,000**	**97,875,000**

Table 3. Quarries Outside of the County Which Stantec Assesses Are Unlikely to Supply the County

Other Quarries within 40 Miles of Salt Lake County		
Ames Construction - Lake Point (Utah)	Geneva - West Warren (Weber)	Staker Parson - Lehi (Utah)
CMC Rock - 10 Mile (Utah)	Greenhalgh Construction - Santaquin (Utah)	Staker Parson - McGuire (Box Elder)
CMC Rock - Bateman (Utah)	Kenny Seng Construction - West Mountain (Utah)	Staker Parson - South Weber (Davis)
CMC Rock - South Pelican Point (Utah)	Kilgore - Benjamin (Utah)	Sunroc - Salem (Utah)
CMC Rock - West Mountain (Utah)	Kilgore - Highland (Utah)	Sunroc - Santaquin Summit Ridge (Utah)
Condie Construction - Payson (Utah)	Maverick Rock - West Santaquin (Utah)	Sunroc - Spanish Fork (Utah)
Crandalls Crushing - Peoa (Summit)	Skyview Excavation & Grading - Enterprise (Morgan)	Sunroc - S.H.O.P (Utah)
Craythorne - Layton (Davis)	Smokey Mountain Ranch - Diamond Fork (Utah)	Sunroc - Santaguin (Utah)
Dunn Construction - Five Mile (Tooele)	Staker Parson - Browns Canyon (Summit)	TM Crushing - Elberta (Utah)
Evans Rock Products - Springville (Utah)	Staker Parson - Daniels Canyon (Wasatch)	TM Crushing - Five Mile (Utah)
Geneva - Devils Hollow (Morgan)	Staker Parson - Francis (Summit)	TM Crushing - Lake Mountain (Utah)
Geneva - Morgan (Morgan)	Staker Parson - Gomex (Utah)	TM Crushing - Talons Cove (Utah)
Geneva - Pelican Point (Utah)	Staker Parson - Heber Binggeli (Wasatch)	Wardell Brothers - Enterprise (Morgan)
Geneva - Peoa (Summit)	Staker Parson - Hot Springs (Weber)	Whitaker Construction - Rees (Morgan)
Geneva - South Weber (Davis)	Staker Parson - Keigley (Utah)	

Figure 4: Quarries in and around Salt Lake County



4 Gap Analysis

As noted in the Introduction section, a gap of approximately 44 Mt of aggregate exists between the total projected demand in the County over the next 20 years (365 Mt) and the estimated resources that remain available from quarries that currently supply the County (321 Mt) over that same period. In addition to that analysis of the total gap over the next 20 years, Stantec also assessed the gap analysis on an annual basis over that same 20-year time horizon. In doing so, Stantec based its analysis on an estimate of current production rates for existing quarries that had been identified by Stantec, potential remaining resources, and the demand forecast.

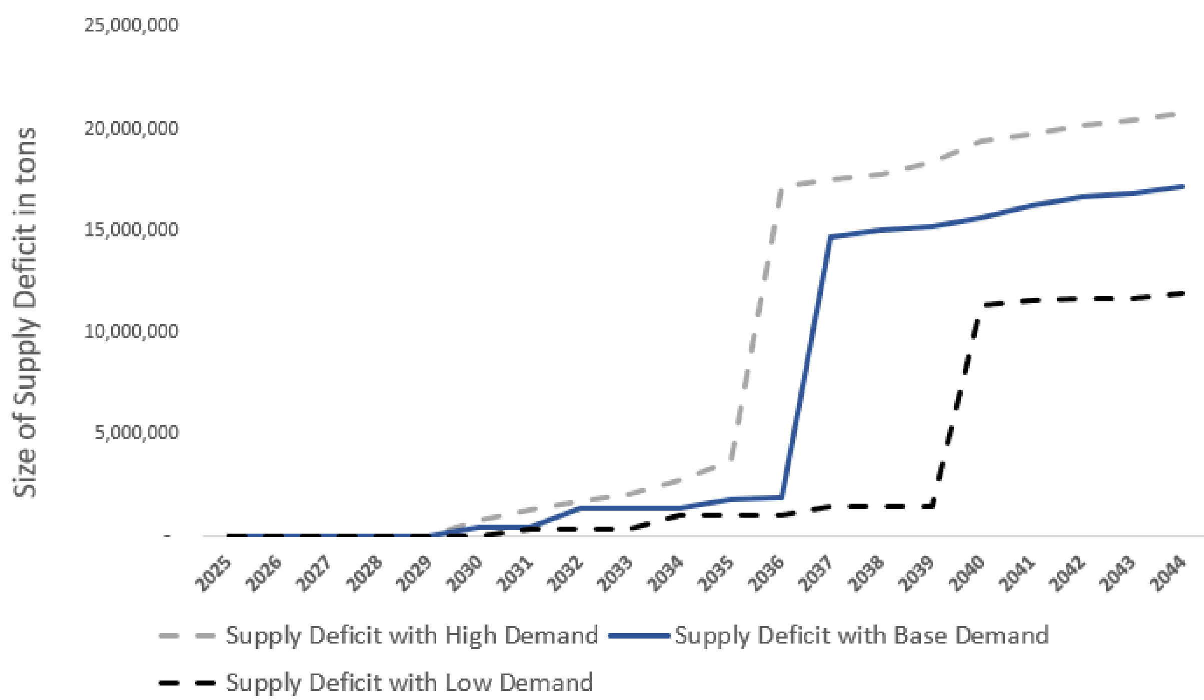
In conducting the annual gap analysis, Stantec assumed that producers would initially maintain their respective market share as demand grows and that once a quarry's resources became depleted, production from other quarries would be increased to make up for the supply shortfall. Stantec estimated the maximum production of each quarry based on our assessment of each quarry's property size and production capabilities. Stantec analyzed the difference that would result between supply and demand, based on the assumed base case, low demand forecast, and high demand forecast, as these quarries become depleted and/or reach their respective production capacities.

4.1 Annual Gap for Quarries that Currently Supply Salt Lake County

Based on the analysis, the largest quarries currently within the County (i.e., at Beck Street and Point of the Mountain) will likely be depleted or significantly reduced in capacity between 2034 and 2039.[20] This reduction of current production will create an annual supply gap for quarries that currently supply Salt Lake County of 15 Mt by 2044. ***Figure 5*** shows the gap analysis for aggregates produced by existing quarries currently supplying the County. The chart shows that, initially, aggregate suppliers will produce amounts equal to market demand. Demand, however, will begin to outpace supply by between 0 and 5 million tons annually, depending on the demand scenario. A significant supply shortage for the quarries that currently supply the County begins between 2035 and 2039 when the two largest quarries (Staker Parsons Beck Street and Geneva Rock Point of the Mountain) are projected to be depleted.

[20] These quarries include (1) those around Beck Street: Staker Parson/Beck Street (depletion/substantial reduction projected for 2036), Lakeview Rock Products/Beck Street (depletion/substantial reduction projected for 2036), Utah Sand and Gravel/Beck Street (depletion/substantial reduction projected for 2030); and 2) those around Point of the Mountain: Geneva/Draper (depletion/substantial reduction projected for 2036), Kilgore/Draper (depletion/substantial reduction projected for 2034), and Staker Parson/Draper (depletion/substantial reduction projected for 2035).

Figure 5. Annual Gap Analysis for Quarries That Currently Supply Salt Lake County



5 Future Supply

Stantec also conducted a future supply analysis, both within and outside the County, to highlight potential areas to meet the future supply gap. As a general rule of thumb, aggregate companies attempt to replenish their resources as they deplete resources at existing properties. Companies try to purchase and permit large properties that are in reasonable shipping distance of the market so that they can transition supply to those quarries as current operations are depleted.

5.1 Future Sources Within the County – GIS Analysis

Stantec based its future supply analysis for sources within the County on:

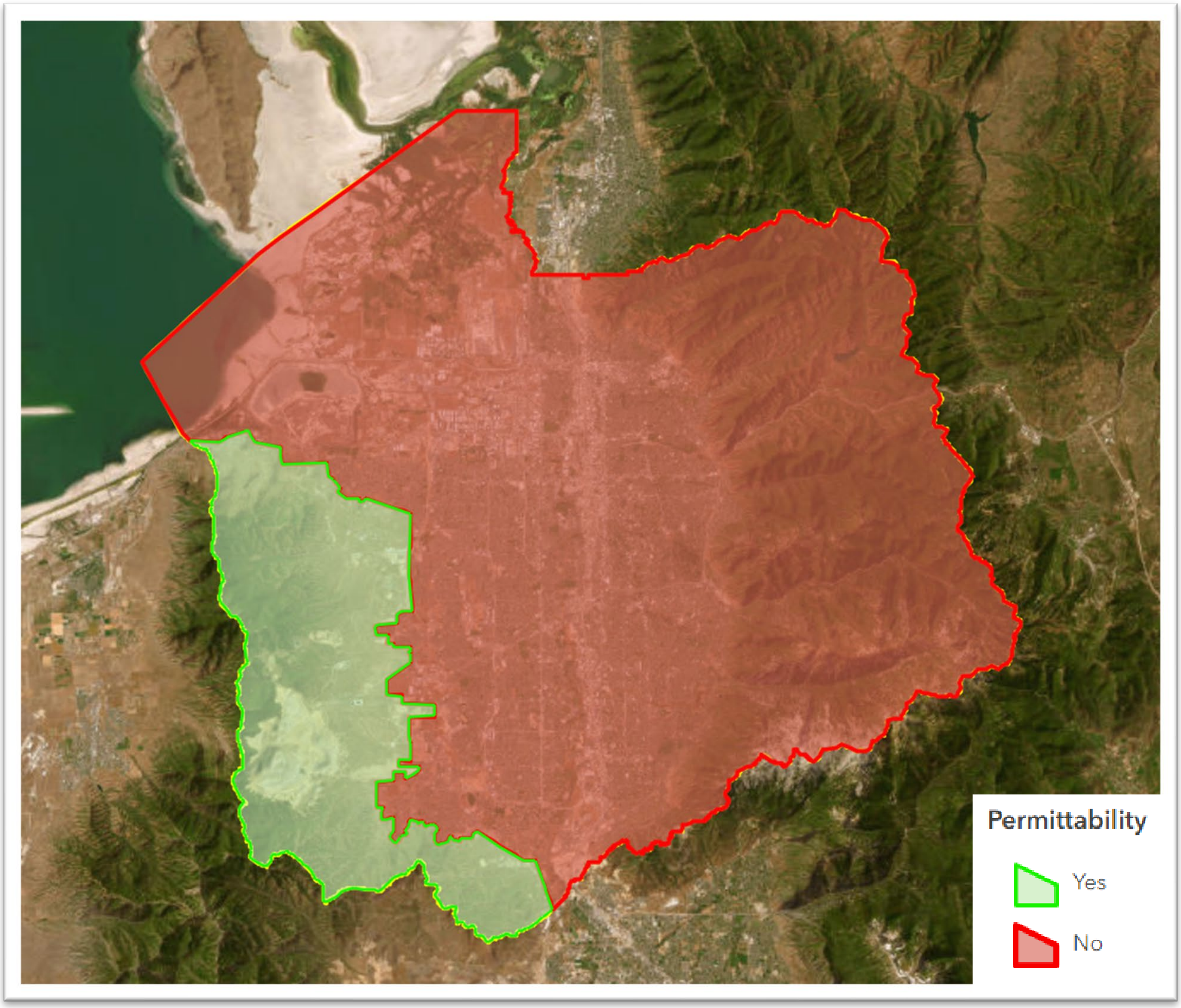
1. Geographic areas with potential likely aggregate resources.
2. Permittability.
3. Visibility.

Figures 6, 7 and ***8*** below depict Stantec's findings on these topics.

Figure 6. Likely Aggregate Resource

Figure 6 – *Likely Aggregate Resources Based on Geology.* Quarries can only be developed in locations where aggregate resources are present. Site considerations included geologic quality, extent, and material types of present and historically producing quarry operations to identify potential sources to best meet resource needs for construction materials. Stantec relied on Utah Geologic Survey unit mapping to identify locations that fit these criteria.

Figure 7. Areas Likely to Receive Permits[1]



1 The data used in these maps offer a high-level overview of areas in Salt Lake County that, in Stantec's opinion, may have potential for permittability. However, this dataset is for general informational purposes only and does not consider factors such as, but not limited to, land ownership, land use, or local regulations. Significant limitations apply, and multiple regulatory approvals are required at the state, federal, county, and municipal levels before permittability can be assessed. This dataset should not be relied upon as a definitive guide to determine the feasibility in any specific location.

Figure 7 *– Areas Likely to Receive Permits (or "Permittability"):* To run an active quarry, approvals are required from various regulators at the state, federal, county, and municipal levels. In Stantec's opinion, some areas in the County are extremely unlikely to receive approval, such as those along the Wasatch front or in canyons used regularly for travel into the mountains. Active operations in canyons or along the Wasatch front could pose a risk to air quality, increase truck traffic in already congested areas, and impact the views of the mountains throughout the valleys and in scenic canyons. Each of these concerns, and others, are taken into consideration during review by regulators. As such, Stantec expects that permits in these areas will likely not be granted in the future.

Figure 8. Visible Quarry Locations

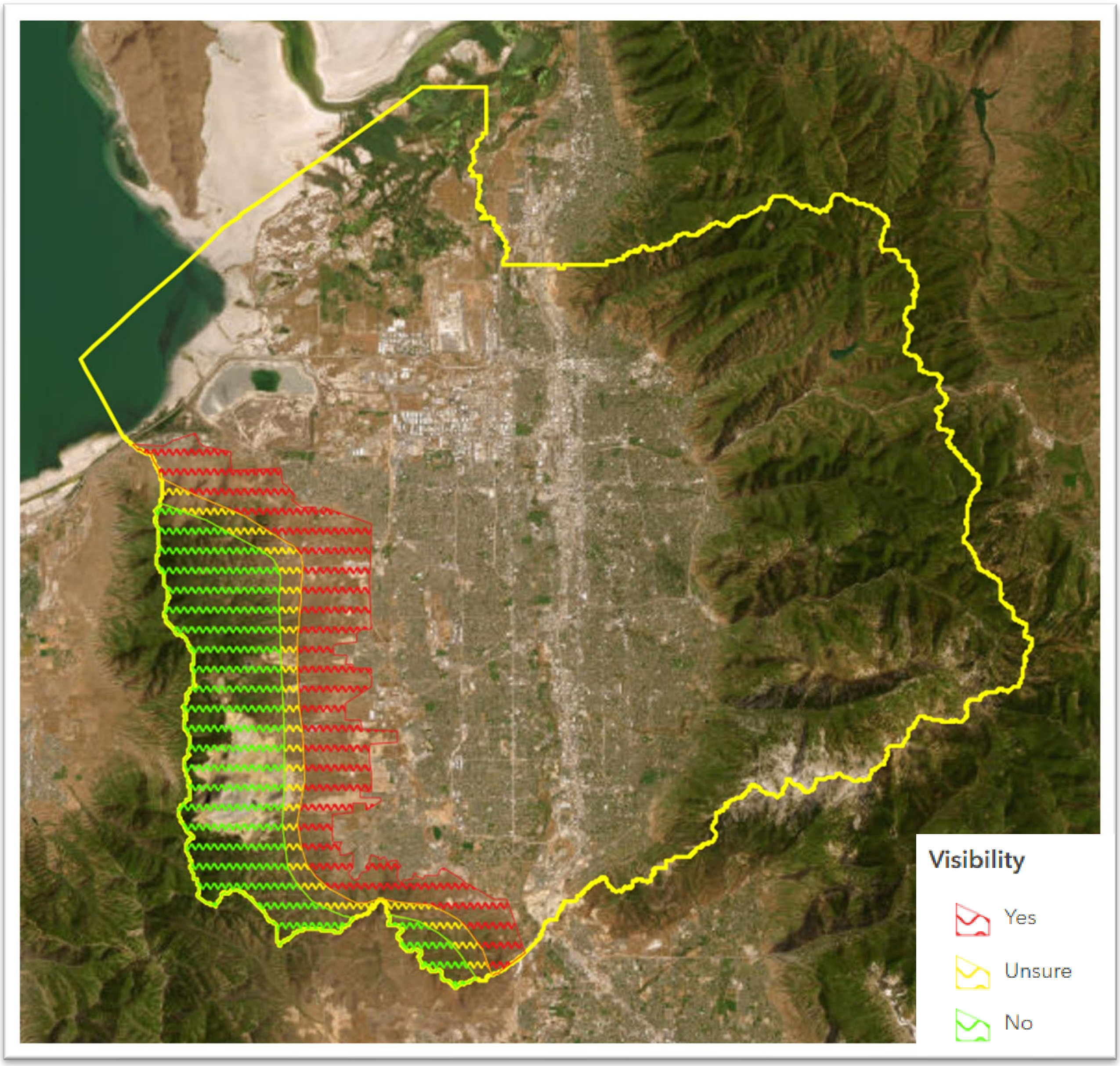


Figure 8 – *Visibility.* ***Figure 8*** is a rough version of a "view shed" (with limited precision) in areas that are likely to receive permits. Visibility is a large factor in gaining a social license for a potential quarry and is important to local communities. Visibility can be a risk to economic growth as active operations can impact scenic gateways and outdoor recreation sites. Without a social license, a potential quarry is less

likely to be successful. Valley-wide visibility of quarry operations along prominent locations or mountain slopes may preclude development of some locations.

Based on the high-level GIS mapping of potential resources within the County, and the areas likely to experience the greatest growth and demand for material, the area along the western side of the valley may be the most attractive for future resources. Quarries in some locations on the west side of the valley may have quality aggregate resources, may not be visible to most of the valley, provide quick access to the growth areas in the southwest corner of the County, and are in areas that are likely permittable (since they are not in the middle of development or in canyons with heavy traffic).

5.2 Future Resources Outside of the County

Stantec focused its analysis of future sources outside of the County on areas known to be owned by major aggregate producers, as well as areas with general availability of aggregate resources.

There are significant potential resources in Tooele, Box Elder, Cache, Utah and Summit counties, some of which are likely to supply the County in the future. In Stantec's opinion, supply gaps in the County will likely be met primarily by resources in Tooele County, given its relatively small local demand and proximity to Salt Lake County. Potential resources in Box Elder, Cache, Utah and Summit counties are likely to supply growth within those respective counties and other closer areas. In addition, supplies in Box Elder, Cache, and Summit County are further away from Salt Lake County, giving supply from Tooele a transportation cost advantage. While resources exist in Utah County close to the southern border of Salt Lake County, future growth in the northern part of Utah County is likely to absorb most of this supply. The limited resources in Davis, Weber and Morgan counties are unlikely to supply a significant portion of Salt Lake County's future demand. See below for a more detailed assessment of each of those counties.

Stantec notes that we did not apply the GIS Analysis/Criteria used for the "Future Sources Within the County" section above to this section regarding "Future Sources Outside of the County." That decision was due to the limited nature of the scope of work for this Report. The County might want to consider pursuing an analysis of that nature in the future.

Tooele County

There are significant potential resources in Tooele County that are owned by major aggregate producers. The amount of these resources is not publicly available but could likely supply aggregate to the County for at least 30 years and exceed a billion tons if permitted and developed. These resources are at least 20 road miles from the northwestern edge of the County and 40 road miles from the growth areas in the southwestern corner of the County.[21] One of the future resources in Tooele County is an approximately

[21] Future rail transport may be a possibility from these locations.

640-acre operation in Grantsville that has been publicly announced and is zoned for extractive operations.

Box Elder and Cache Counties

There are significant resources in Box Elder and Cache counties. The amount of these resources is not publicly available but could likely supply the County for at least 30 years. The resources, however, are at least 60 miles north of the County.

Utah County

There are significant resources in Utah County, but Stantec assesses that they are likely to primarily supply the growth expected in Utah County.

Summit County

There are no significant resources in Summit County that could reasonably supply the County and are permittable. This is in part due to Stantec's assessment's that permitting in Summit County is difficult, and permitting in areas deeper into the mountains to traverse canyons with large amount of truck traffic is not feasible.

Davis and Weber Counties

Davis and Weber Counties have limited resources available and are projected to experience growth, so Stantec anticipates that most of the future resources in those counties will supply the projected growth in the respective county.

Morgan County

Morgan County has limited resources available and Stantec has concerns about the permittability of those resources and transportation logistics, so we believe it is unlikely for Morgan County's resources to significantly supply Salt Lake County's needs in the future.

6 Key Findings and Recommendations

6.1 Key Findings

- The County is expected to consume about 365 Mt of aggregates between now and 2044, reaching about 20 Mt in annual demand by 2044. Large construction projects may cause brief spikes in demand during this period.
- There are likely around 321 Mt of resources remaining in quarries that currently supply the County (within and outside of the County). The gap between the total demand projection and that total supply projection over a 20-year period equates to 44 Mt.

- The primary sources of aggregate currently supplying the County are those at the Point of the Mountain and near Beck Street. These quarries are expected to be depleted or significantly reduced in capacity between 2034 and 2039, leading to a potential 15 Mt annual supply gap by 2044.
- Potential future resources exist to fill the gap created on account of those constraints, and Stantec predicts that operations to meet that gap will most likely be developed in Tooele County and on the west side of the Salt Lake valley.
- The lack of publicly available data regarding existing quarry production and projected resources posed some challenges in conducting the supply analysis in this Report. Stantec, however, believes the supply estimates in this Report are based on sound methodology and Stantec relied upon its expertise in the industry to refine the analysis.

6.2 Recommendation

Given the limited scope of the consulting agreement for this Report, the complex nature of an aggregate supply and demand analysis, and limitations on the reliability of available data, Stantec recommends that the County consider exploring the future topics of investigation set forth in the “Executive Summary” section above as a means to better understand the aggregates market and how to prepare for any gaps in supply.

Appendix A Econometric Analysis

Stantec reviewed the literature for econometric analysis of aggregate demand, identified key variables that could correlate with demand, and conducted an analysis to identify variables with statistically significant explanatory power. The goal was to develop a second demand model to compare to the population-based model.

A.1 Similar Studies

Nasser conducted their study in 1987 to forecast aggregates demand and supply for the Denver Metro Area. He concluded that population correlates tons per capita to a population growth rate. He found that high consumption rates occurred during periods of high population growth, which leveled off at the point of urban maturity.[22] Any spikes that were not due to population development were because of large construction jobs in the region. Arjan, et al.[23] conducted their study in 2019 to econometrically model supply and demand of aggregate for the South Sulawesi region of Indonesia. They concluded that the length of the roads, population, and number of buildings are employed to model demand for construction aggregates.

A.2 Methodology

Stantec developed two datasets to construct the analysis. Dataset 1 includes estimated demand values from the USGS for 1971 to 2023. Dataset 2 includes the same data but excludes data from 1997 to 2008, which comprises the outlier spikes in demand discussed in the previous section. This data was excluded because of the volatility during the period that can be observed empirically in the data. The spike in aggregates consumption arose from I-80, I-15, and I-85 construction work, construction of infrastructure for the 2002 Winter Olympics, and an increase in overall construction starting in 2005. *Figure 9*, *Figure 10*, and *Figure 11* help illustrate Stantec's observations. *Figure 9* shows the population and consumption that are represented in Dataset 1, while *Figure 10* shows that represented in Dataset 2. *Figure 10* shows a substantial improvement in the fit of the model, represented by a higher correlation (R^2), than that in *Figure 9.* In *Figure 11*, only data from 1997 to 2008 are plotted and the chart shows that there is no relationship between the population and aggregates consumption in this period. Nonetheless, both datasets were tested in the analysis.

[22] Supply/Demand Analysis of Aggregates in the Denver Metro Area. (n.d.). Retrieved February 26, 2024, from https://www.jeffco.us/DocumentCenter/View/13197/Supply-Demand-Analysis-of-Aggregates-Report.
[23] Arjan, A., Nurhusna Afifah, A., Andrew Patila, Y., & Virtanti Anas, A. (2019). Econometric Model of Supply and Demand for Mining Construction Materials in the Jeneberang River, Gowa Regency, South Sulawesi [Review of Econometric Model of Supply and Demand for Mining Construction Materials in the Jeneberang River, Gowa Regency, South Sulawesi]. International Journal of Engineering Research & Technology (IJERT), 8(6), 1060–1062. https://doi.org/10.17577/IJERTV8IS060555

Figure 9. Population vs Aggregates Consumption, 1988-2023

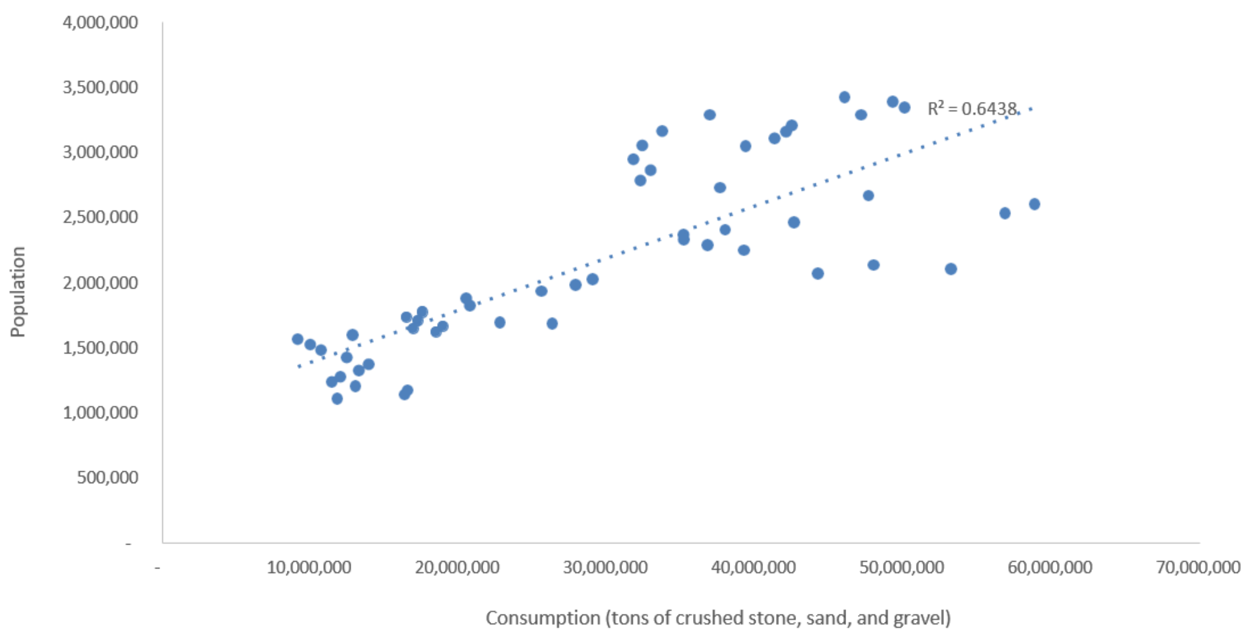


Figure 10. Population vs Aggregates Consumption, excluding 1997-2008

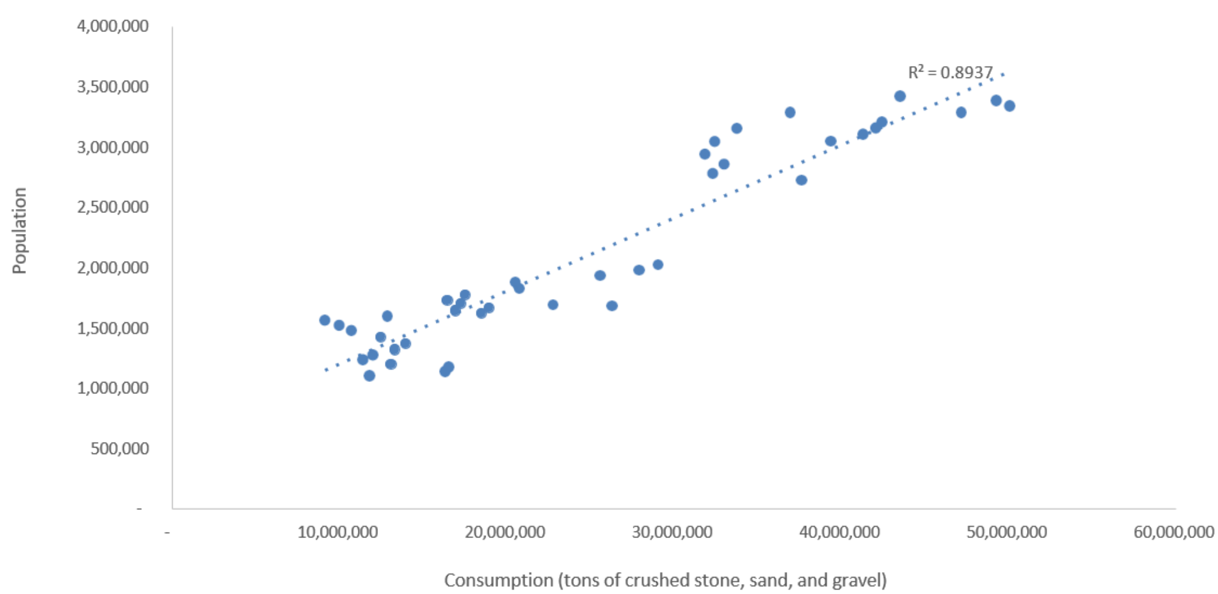


Figure 11. Population vs Aggregates Consumption, 1997-2008

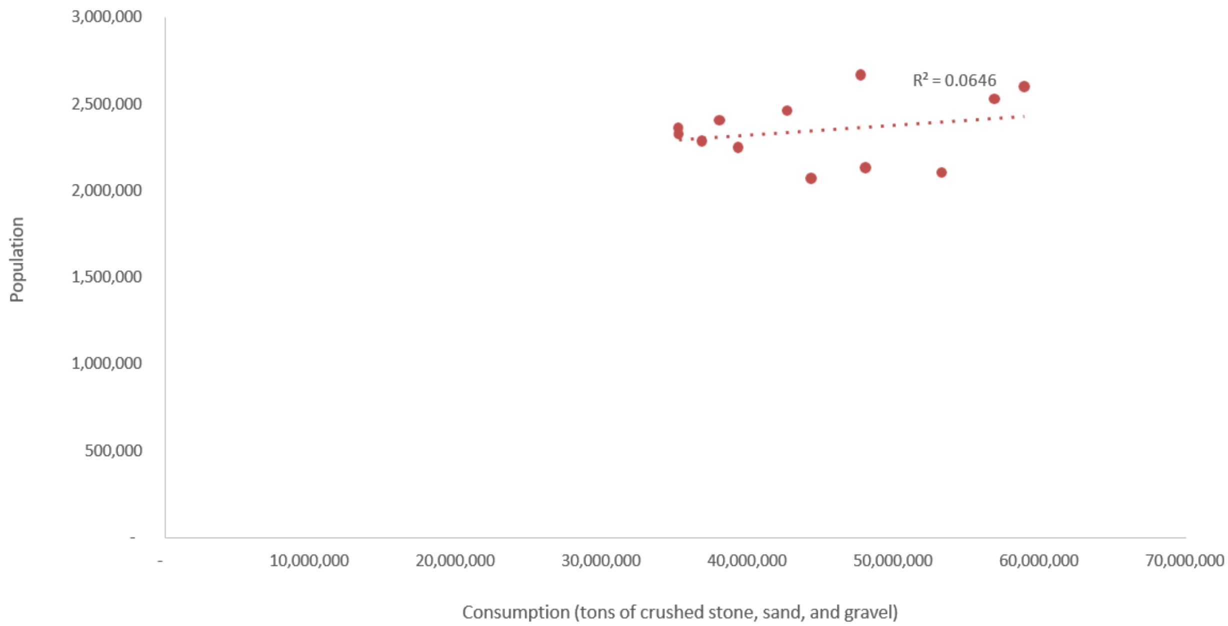


Table A1 shows the variables that were included in the datasets, as well as the null and alternative hypothesis for their respective effects in an Ordinary Least Squares (OLS) model.

Table 4. Model Variables and Hypotheses

Variable	Null Hypothesis	Alternative Hypothesis
Population	$\beta_1 \leq 0$	$\beta_1 > 0$
Population Change	$\beta_2 \leq 0$	$\beta_2 > 0$
Housing Permits Issued	$\beta_3 \leq 0$	$\beta_3 > 0$
Federal Funds Rate	$\beta_4 \geq 0$	$\beta_4 < 0$
Per Capita Construction Aggregates Demand	$\beta_5 \leq 0$	$\beta_5 > 0$
Population Density	$\beta_6 \leq 0$	$\beta_6 > 0$
Total Construction Aggregates Demand	$\beta_7 \leq 0$	$\beta_7 > 0$
Unemployment Rate	$\beta_8 \geq 0$	$\beta_8 < 0$
% of Population that are Homeowners	$\beta_9 \leq 0$	$\beta_9 > 0$
Miles of Public Road	$\beta_{10} \leq 0$	$\beta_{10} > 0$

Miles of Bridges	$\beta_{11} = 0$	$\beta_{11} > 0$
Road Condition	$\beta_{12} \geq 0$	$\beta_{12} < 0$
Gross Domestic Product (GDP)	$\beta_{13} \leq 0$	$\beta_{13} > 0$

To use OLS analysis, the model must meet the requirements of Being the Best Linear Unbiased Estimator (BLUE). To Be the BLUE, the model must meet the following requirements, set forward by a framework called the *Gauss Markov Theorem*[8]:

1. The linear regression model is linear in its parameters.
2. There is random sampling of the observations.
3. The conditional mean should equal zero.
4. No multicollinearity (independent variables are correlated with each other).
5. No heteroskedasticity (the difference Between the predicted and actual terms has constant variance) and no autocorrelation (variable values are correlated with their past values).

Optional: Error terms should be normally distributed.

A violation of any of these requirements makes the model unreliable.

When constructing the linear regressions, Stantec carefully considered the variables selected to avoid multicollinearity. For this reason, none of the equations contained both the unemployment rate and GDP, due to their inverse relationship via the Phillips curve. The same applies to population, population change, and per capita construction aggregates demand.

Several OLS models were developed for both the limited and full dataset. Selection of the OLS was dependent upon identifying the model that satisfied the Gauss-Markov theorem, provided a large adjusted R^2, and where the difference between the predicted and actual values was minimized (measured by the residual standard error).

The road condition, miles of bridges, miles of public road, and percent of population that are homeowners were deemed to be important to estimating aggregates demand but were excluded due to incomplete data. Stantec also examined whether there would be value in examining whether construction demand is impacted by its own lagged values and external regressors in a statistical model called Autoregressive Integrated Moving Average (ARIMA). By taking the difference between the values year over year, Stantec can then evaluate the lagged past values and lagged error values to see whether it improves Stantec's demand estimates.

A.3 Results

When running an OLS model using Dataset 1 (all years of data), none of the independent variables had a significant impact on total aggregates demand. Stantec suspects that this is due to the outliers present in the years 1997 to 2008. Stantec therefore constructed an OLS model on Dataset 2 which excluded the outliers.

The analysis on Dataset 2 showed that population, new housing permits, and the federal funds rate have statistically significant explanatory power on aggregate demand. The ARIMA analysis on Dataset 1, produced was an ARIMA of (0,0,0)- which indicates that future demand is completely random and not impacted by external regressors. This would suggest that the best estimate for demand next year is demand this year.

Stantec used R for the econometric analysis. R is both a language and an environment for statistical analysis. The program was run on the graphical user interface (GUI) RStudio.

Several combinations of variables were included or excluded with the intent of finding the combination that yields the best adjusted R2, RSE, and F-statistic.

Figure 12 shows an example of a model run on dataset 1 that produced no statistically significant variables.

Stantec used several combinations on variables on dataset 2. The *Figure 2* shows the model which produced the best fit.

Figure 12. Dataset 1 Model Example

```
lm(formula = AggDemand ~ PopChange + Unem + HousingPermit, data = Data1)

Residuals:
      Min        1Q    Median        3Q       Max
-15357655  -3515403  -1136130   4077666  16045283

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)    36562988   11017754   3.319  0.00268 **
PopChange     127083944  187279431   0.679  0.50340
Unem           -1420497    1261140  -1.126  0.27030
HousingPermit      3825       3147   1.215  0.23514
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 7914000 on 26 degrees of freedom
Multiple R-squared:  0.2163,    Adjusted R-squared:  0.1259
F-statistic: 2.393 on 3 and 26 DF,  p-value: 0.09141
```

Figure 13. Dataset 2 Model

```
Call:
lm(formula = AggDemand ~ Pop + Permit + FedFunds, data = Data1)

Residuals:
     Min       1Q   Median       3Q      Max 
-3238270 -2174857   656531  1260472  5360591 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept) 15097436    5783393   2.610  0.02055 *  
Pop             4075       2246   1.815  0.09106 .  
Permit          7009       1286   5.449 8.58e-05 ***
FedFunds    -1478269     462183  -3.198  0.00644 ** 
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2760000 on 14 degrees of freedom
Multiple R-squared:  0.8801,	Adjusted R-squared:  0.8544 
F-statistic: 34.26 on 3 and 14 DF,  p-value: 1.059e-06
```

The ARIMA Model utilizes a combination of the lagged values of the dependent variables and the moving average of the error of the dependent variable to provide a time series forecast. These models can optionally include external regressors. When examining the data, if the observation of the data depends on the time period observed, then the first difference in the data is taken. In our analysis, regardless of whether external regressors were included, the model always produced white noise. This means that the average mean is zero, standard deviation is constant, and at any given time t, the value of t +1 is random.

This indicates that aggregates demand tomorrow is random and does not depend on any past values. *Figure 14* shows two outputs of the model.

Figure 14. ARIMA Outputs

```
Series: diffdem
ARIMA(0,0,0) with zero mean

sigma^2 = 2.436e+13:  log likelihood = -286.13
AIC=574.25   AICc=574.52   BIC=575.08

Training set error measures:
                    ME    RMSE     MAE MPE MAPE      MASE         ACF1
Training set -462352.9 4935537 3177647 100  100 0.8150425 -0.008713816
```

```
Series: diffdem
Regression with ARIMA(0,0,0) errors

Coefficients:
           xreg
      11950.414
s.e.   6113.937

sigma^2 = 2.113e+13:  log likelihood = -284.4
AIC=572.8   AICc=573.66   BIC=574.47

Training set error measures:
                   ME    RMSE     MAE      MPE     MAPE      MASE      ACF1
Training set 583166.3 4459774 2395121 64.13946 70.70126 0.6143305 0.1067045
```

A.4 Data sources

Variable	Source
Population	Gardner Institute
Population Change	Calculated from Population
Housing Permits	Federal Reserve Economic Data (FRED)
Federal Funds Rate	Federal Reserve Economic Data (FRED)
Aggregates Demand	USGS
Per Capita Aggregates Demand	Calculated from Population and Aggregates Demand
Population Density	U.S. Census Bureau
Unemployment	Federal Reserve Economic Data (FRED)
% Homeownership	Federal Reserve Economic Data (FRED)
Miles of Public Road	Federal Highway Administration
Miles of Bridges	Federal Highway Administration
Road Condition	Federal Highway Administration
GDP	Federal Reserve Economic Data (FRED)

Stantec

Stantec is a global leader in sustainable architecture, engineering, and environmental consulting. The diverse perspectives of our partners and interested parties drive us to think beyond what’s previously been done on critical issues like climate change, digital transformation, and future-proofing our cities and infrastructure. We innovate at the intersection of community, creativity, and client relationships to advance communities everywhere, so that together we can redefine what’s possible.