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# OREGON'S MINERAL INDUSTRIES

## An assessment of the size and economic importance of mineral extraction in 1993

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## Contents

Page
Introduction ..... 1
Survey method and response rate ..... 1
Mineral production in Oregon in 1993 ..... 5
Regional economic impacts ..... 8
How minerals were shipped in 1993 ..... 10
Consumption of aggregates ..... 11
Supply of aggregates ..... 13
Mining on USFS and BLM lands ..... 14

## Figures

1. Sample of survey form ..... 2
2. Regions of the state as used in Tables 3 and 6 ..... 10

## Tables

1. Survey response rates and estimates ..... 4
2. 1993 Oregon mineral production ..... 5
3. Regional economic impacts of 1993 mineral production in Oregon ..... 9
4. How Oregon's minerals were shipped in 1993 ..... 11
5. How aggregate was shipped ..... 12
6. 1993 apparent consumption of agregates ..... 12
7. 1993 aggregate mining by public agencies ..... 13
8. 1993 mining on USDA Forest Service lands ..... 14
9. 1993 mining on Bureau of Land Management properties ..... 15

# OREGON'S MINERAL INDUSTRIES

## An assessment of the size and economic importance of mineral extraction in 1993

### Introduction

The Oregon Department of Geology and Mineral Industries has completed the most comprehensive survey of mineral production ever done in Oregon. It shows that, during 1993, Oregon's mineral industries produced $239.9 million worth of products and directly contributed $102.4 million to the state's economy.

The survey counted output from mines, quarries, sand and gravel pits, river dredges, gemstone deposits, public lands, and natural gas wells.

Production was measured at its point of removal—that is, before any processing by which physical properties, other than particle size and cleanliness, were changed. So-called downstream products, such as cement or cut gemstones, were not counted.

Our production data differ from figures reported by the U.S. Bureau of Mines (USBM) in its annual *Mineral Industry Surveys*. This is largely the result of differences in the types of mineral products covered in the surveys. The USBM data for Oregon include many downstream products, but they exclude natural gas. Our survey measures only raw mineral output, and it includes natural gas.

### Survey method and response rate

The survey was designed to get a good response rate. All information supplied was to be kept strictly confidential, and the forms were easy to fill out. In the end, 84 percent of the survey questionnaires had been returned. With this high response rate, we were able to answer more exactly than ever before two important questions: How big is Oregon's mineral industry, and what is its economic impact on the state?

The survey form (Figure 1) was simple and only one page long. It was sent to mineral producers. The form asked seven questions: What is your name? Did you produce any minerals in 1993? If you did, what did you produce? How much did you produce? What was its value? How many people worked for you? and finally, How did you ship your products?

We were not interested in collecting data on individual mines. Instead, we wanted totals for every county. That allowed us to calculate regional economic impacts. For that reason, separate forms were provided for each county. If producers had, for example, three mines in one county, they had to fill out only one form. Some producers received more than one form because they had mines in several counties. These were the exception, however. Most mines in Oregon are owned by individuals and small businesses. Over 95 percent of those surveyed operated in just one county and received a single form.

Half of all the active private mining businesses in 1993 had no more than one full-time employee. A small operation is an advantage in mining. Single-person operators can often opt out of workers' compensation coverage. That insurance is expensive, costing a minimum of $9.89 for every $100 paid to mine workers.

## BAKER COUNTY
## 1993 MINING INDUSTRY SURVEY

Please answer the four questions in this survey as best you can. Include only your mineral production from Baker County. If you have mines in other counties, fill out separate forms for those counties.

(1) What is the name of your mining company? _____.
In 1993, did you produce any minerals in Baker County? Check one: Yes __ No __.

(2) Please write the quantity and value of your 1993 mineral production in Baker County in the Table below. Report only production that was marketable or useable. If you are not sure what the value of your production was, give us your best estimate.

| Mineral Produced | 1993 Mine Production | Market Value of Production |
|---|---|---|
| Bentonite & common clays | tons | $ |
| Diatomite | tons | $ |
| Limestone for agricultural uses and cement plants | tons | $ |
| Pumice | tons | $ |
| Total aggregate from sand & gravel pits | tons | $ |
| Sand & gravel from rivers | tons | $ |
| Total aggregate from rock quarries | tons | $ |
| Other (Please fill in name): | (Please fill in amounts): | |
| _____ | _____ | $ _____ |
| _____ | _____ | $ _____ |

(3) How many people, on average in 1993, worked at your mine(s) in Baker County? Include only mine workers, supervisors and mine office personnel. Please fill-in the number of workers: _____.

(4) How did you ship your 1993 Baker County mine production to consumers? Please give us your best guess on what percentage of your production volume was shipped by different modes.

| Shipping Method | % of 1993 Shipments |
|---|---|
| Your own trucks | Percent |
| Trucks owned by others | Percent |
| Railroad | Percent |
| Barge or ship | Percent |
| Other (Please fill-in): | |
| _____ | _____ Percent |
| _____ | _____ Percent |

*Figure 1. Sample of survey form.*

The surveys were mailed to known producers and mine owners. The mailing list included mine permit holders registered with the Oregon Mined Land Reclamation Office and sites registered with Columbia County (This county regulates the reclamation activities of its own mining industry). Forms were sent to producers operating in waterways regulated by the Oregon Division of State Lands. A sampling of forest product companies received forms. Surveys were also sent to offices of the U.S. Bureau of Land Management (BLM), USDA Forest Service (USFS), State Forestry Department, and Indian Reservations.

In some cases, respondents were called to verify or correct their figures. Some responses were checked against numbers supplied by third party sources, such as competitors. Fourteen surveys were adjusted.

Private individuals and companies receiving surveys were assured that their responses would be kept strictly confidential. Only one person at the Department of Geology and Mineral Industries read the surveys. Once the data were tallied into running totals, the forms were destroyed. The results reported here were consolidated from enough surveys, so that no one person can discern the production or dollar sales of any individual producer in the state. The exceptions to this are reports from public agencies, such as county road departments, and from natural gas production. Both of these are public records.

The response rate to the initial mailing was 51 percent. Those that did not return surveys received a second letter asking for a prompt response. This raised the return rate to 72 percent. Phone calls went out to the remaining nonrespondents. If thought to be significant producers, they received a third letter and additional calls. In all, 738 surveys were returned to us.

In the end, 140 surveys remained unanswered. Of these, 55 were from mines with total exemptions. These are very small mines that are below the minimum size requirement for having to pay mining permit fees. The output of all the total exemption mines in 1993 amounted to only 1.1 percent of the state's mineral production.

Since the cost of pursuing information from small mines was high, relative to the benefit to our survey, we chose a sampling method to estimate nonrespondents. A random sample of 25 of the initial nonrespondents was selected. We aggressively followed up the sample mines with phone calls, faxes, and mailings. All but one were reached. This effort revealed that most of those who did not initially respond to our survey chose not to mail it back because they had little or no production in 1993.

The sampling averages were used to estimate data for the remaining 55 total exemption mines. The net effect on the mineral survey was small. The estimate added only $197,100 or 0.2 percent to the total value of Oregon's mineral production.

Of the regular permitted mines, 85 surveys were not returned. We used two methods to estimate their production. We applied either third-party judgments or made our own estimates using knowledge of local markets and mine visits.

Third-party estimates came from several sources. For some, we made calls to the nonrespondents' customers and competitors; for others, we contacted people who earned royalties on the mineral properties.

Internal estimates relied on public sources. We searched databases of newspapers, credit reports, court documents, and public hearings. This was followed up with phone calls to local road departments and Federal Government officials.

Of the 85 surveys not returned from permitted mines, 24 turned out to have had no production in 1993. Third-party sources allowed us to estimate $11.9 million in production for 33 of the missing surveys. For the remaining 28, our estimates place their total output at $21.9 million. Table 1 contains a summary of the survey responses.

Table 1. *Survey response rates and estimates*

**Number of surveys issued and returned**

| | |
|---|---|
| Surveys initially sent | 983 |
| Less duplicate and undeliverable surveys[1] | (105) |
| Net surveys Issued | 878 |
| Of which: | |
| Surveys returned | 738 |
| Nonrespondents | 140 |

**Response rate by type of recipient**

| | |
|---|---|
| Small, total exemption mines (174 of 229) | 76% |
| Regular mines and natural gas wells (495 of 580) | 85% |
| Other mineral producers[2] (69 of 69) | 100% |

**Value of mineral production of respondents and estimated values of nonrespondents**

| Type of respondent and nonrespondent | Production value in million dollars | Percent of total value for Oregon |
|---|---|---|
| Reported by small mines | 2.5 | 1.0 |
| Reported by regular mines and gas wells | 190.2 | 79.4 |
| Reported by other mineral producers | 5.6 | 2.3 |
| Nonrespondent small mines | 0.2 | 0.1 |
| Nonrespondent regular mines | 33.8 | 14.1 |
| Estimate of unsurveyed timber mines[3] | 3.7 | 1.5 |
| Estimate of other unsurveyed mining[4] | 3.9 | 1.6 |
| **TOTAL** | **$239.9** | **100.0** |

**Mineral production in Oregon in 1993**

Total mineral production in Oregon during 1993 was $239.9 million. Sand, crushed stone, gravel, and other construction aggregates accounted for 89 percent of the total. Ranking second was natural gas.

[1] Surveys to mines that are out of business or were sold to other parties are classified as undeliverable. Duplicate surveys occur when two properties are operated by a single entity but have permits under two or more different names.

[2] Production on BLM, USFS, Indian Reservation, and State Forest land that is not counted elsewhere in the survey.

[3] Small quarries and mines owned by timber companies and operated solely for the companies' own use do not have to file mining permits. Estimates of production from these sources are based on logging activities in the different counties.

[4] Estimates of aggregates, gold, and gemstones from small unpermitted producers, farms, ranches, and recreational miners.

Industrial minerals, such as clay, limestone, and pumice, accounted for most of the rest. These totals are shown on Table 2.

Oregon was the only western U.S. state, other than Hawaii, with no major working metal mines in 1993. Oregon did produce 2,021 troy ounces of gold, but all of it came from recreational and small seasonal mining operations. No gold mine provided year-round employment in 1993.

**Crushed rock and shale** production totaled 23.9 million tons and was valued at $115.5 million. The average selling price was $4.83 a ton. Prices varied greatly, however, depending on local conditions. Prices tended to be higher in the Portland and Bend markets, where construction activity was strong.

Crushed rock is used in roads and buildings. A familiar crushed rock product is asphalt pavement used in many parking lots and roads. Rock is mined in quarries and then fed into special rock crushing equipment. After crushing, it is cleaned, sorted by size, and stored for eventual blending to customer specifications.

Most crushed rock quarries in Oregon are idle except when local construction activity picks up. Then, portable rock-crushing equipment is brought in and operated as needed. Other quarries, especially in large markets, have permanent rock-crushing equipment nearby, which runs regularly.

Table 2. *1993 Oregon mineral production (in short tons unless otherwise noted)*

| Product | Quantity | Dollar value |
|---|---|---|
| Crushed rock and shale | 23,888,974 | $115,456,068 |
| Pit run rock | 2,103,315 | 3,418,975 |
| Decomposed granite | 362,763 | Combined[1] 2,346,856 |
| Cinders | 299,689 | |
| Sand and gravel from waterways | 3,096,980 | Combined[1] 90,895,172 |
| Sand and gravel from pits | 17,732,489 | |
| Fill material | 1,255,907 | 1,890,705 |
| Common clays and bentonite | 300,018 | 2,070,792 |
| Other industrial minerals[2] | N/A | 14,625,877 |
| Gold (in troy ounces) | 2,021 | 788,000 |
| Gemstones | N/A[3] | 1,336,743 |
| Natural gas (thousand cubic feet) | 3,534,243 | 7,072,554 |
| **STATE TOTAL** | | **$239,901,742** |

[1] Values were combined so that individual producer data can be kept confidential.
[2] Other industrial minerals are agricultural and industrial limestone, dolomite, diatomite, perlite, zeolites, emery, dimension stone, building stone, decorative stone, industrial silica sand, and soapstone.
[3] Not available.

The term “shale” is used in Oregon for both actual shale and some types of layered volcanic rock that break apart easily. This characteristic makes production of shale less expensive than production of the more common types of crushed rock. In Oregon, volcanic shale is used as a substitute for crushed rock, which is why we include it here. Most of it is mined in southwestern Oregon.

The production of **pit run rock** totaled 2.1 million tons and was worth $3.4 million in 1993. Pit run rock is rock that is quarried but not crushed. At an average price of $1.63, it is a low-value product. Pit run rock is used in construction where bulk, rather than product consistency, is important. Logging companies are also big consumers. Pit run rock makes rough, yet inexpensive logging roads that are adequate for log trucks. The USDA Forest Service, on the other hand, uses only crushed rock because it wants smooth roads that are accessible to smaller vehicles operated by recreational visitors.

Production of **decomposed granite** in the state totaled 362,763 tons. Decomposed granite is an unusual aggregate material found in Jackson County and surrounding areas. It is a deeply weathered granite. It compacts so readily that it is used in local construction for high-quality fill. One common use for fill is preparing and leveling ground for new buildings.

**Cinder** is a lightweight volcanic rock. It is usually reddish colored. In 1993, a total of 299,689 tons of cinder was mined. Cinder is crushed into small gravel that is used for sanding icy roads. Commercial landscapers use larger cinder gravel as a type of mulching stone. In central Oregon, where most of the cinder is mined, it is used for road pavement. Because it is so easily crushed, cinder gravel is considered a low-cost but inferior alternative to crushed rock.

**Sand and gravel** production totaled 20.8 million tons and was worth $90.8 million. Just under 3.1 million tons of the sand and gravel produced in Oregon came from waterways such as the Columbia and Willamette Rivers. The average mine price from all sources was $4.36 a ton.

Sand and gravel are mined from pits or are extracted from waterways by dredges. The material is then cleaned, sorted by size, stored, and later blended to customers' orders. Some producers will crush any large pieces they extract. This way, they can better match the demands of the local market for different particle sizes.

Unlike sand and gravel that are manufactured from crushing rock, natural sand and gravel tend to have particles with rounded edges and hard surfaces. This makes them ideal for concrete. Particle roundness allows the concrete to flow better when it is poured. Hard surfaces keep the particles from absorbing expensive cement.

Concrete is a mixture of cement, aggregate, and a few other ingredients. Cement is expensive. When you make concrete, it is worth while to mix in as little cement as possible. Using rounded sand and gravel, especially material mined from rivers, lets you economize on the amount of cement you have to add. Natural sand and gravel also usually make a concrete of better quality.

**Fill**, as defined in our survey, is unprocessed loose material that is sold for low-value applications such as road embankments and leveling-off land at construction sites. Soil and unprocessed sand are two common forms of fill. At some rock crushing plants, they sell very fine rock particles as fill. In 1993, 1.3 million tons of fill worth $1.9 million were produced in Oregon. The average price was $1.51 per ton. Prices varied from a few cents to over $2 a ton.

**Natural gas** production totaled 3,534,243 thousand cubic feet (MCF) and was worth $7.1 million. All of it was produced from the Mist Gas Field in Columbia County. Besides contributing to local employment, the County earned royalties from the wells and used the money to help fund its public schools.

The Northwest Natural Gas Company sells the production from the Mist field to its customers in Oregon. The company also uses the field to store gas bought from producers in other places when prices are low. Then it takes the gas out of storage during cold periods when demand rises and out-of-state gas prices become prohibitively high. Doing this helps save money and assures the state that it will have enough gas on hand for emergencies.

Oregon produced 300,018 tons of **common clays and bentonite** in 1993, with a value of $2.1 million. Most of the common clays were made into bricks. Bentonite, which is a special class of clay, went into engineering projects such as ponds and waste-disposal sites.

Collectively, $14.6 million worth of other industrial minerals was mined in Oregon. Industrial minerals are mined products that are not made into metals or used as common construction aggregate. The individual quantities and values cannot be shown because there are too few producers of each of them in Oregon. We can say, however, that over 90 percent of the production is attributable to three industrial minerals. They are diatomite, limestone, and pumice.

**Diatomite** is mined in Lake, Harney, and Malheur Counties. It is a rock that is formed from the skeletons of single-celled algae. Diatomite is used for filters in water purification and as an absorbent material. One well-known diatomite product is cat litter.

Most of the state's **limestone** is mined in Baker County. It is made into cement and agricultural lime. Some of it is also used in local beet sugar refineries.

**Pumice** is an air-filled volcanic rock common to central Oregon. Pumice is used in construction, landscaping, and horticulture, for stone-washing clothes, and as an additive for lightweight concrete.

Oregon produced several other industrial minerals in 1993. **Silica sand**, which is a quartz-rich sand, was mined in two places in the state. Most of it is used for making glass bottles. **Dimension and decorative stone** were produced in small amounts throughout Oregon and are used for landscaping and construction of buildings and walkways. **Zeolites** were mined in eastern Oregon. They are an unusual class of minerals used in certain chemical and industrial applications for their selective absorption properties. **Soapstone** was mined in southwestern Oregon. Soapstone is soft, attractive, and easy to carve. It is used by artists as a sculptural stone. **Perlite** was mined in eastern Oregon. Perlite is an unusual rock that puffs up when heated. You will find it in potting soils sold at most gardening shops. **Emery** was mined in Linn County. It is used for skid-resistant surfaces on sidewalks and bridges.

**Gold** production in 1993 totaled 2,021 troy ounces valued at $788,000. These are rough estimates based on surveys of producers, geologists, gold buyers, and various field experts. Most of Oregon's gold came from Baker and Grant Counties. All of Oregon's gold came from small seasonal operations. They physically extract gold from soil and gravel. Only a handful of gold producers mined more than 10 oz of gold in 1993.

**Gemstone** mining totaled $1.3 million. That makes Oregon the seventh largest producer in the United States. The output of gemstones is expected to more than triple in 1994 because of expanding markets for sunstones and opals. Those two gemstones accounted for 65 percent of Oregon's output in 1993.

Sunstones are clear feldspar crystals. They are found in Harney and Lake Counties. Sunstones come in a wide range of colors. They sometimes contain minuscule flecks of natural copper metal. The most valuable sunstones are red with copper flecks. Most Oregon sunstones are sent to Asia for faceting. The cut stones are then sold to jewelry makers around the world.

Oregon produces precious fire and blue opals. Most of the production comes from Morrow and Lake Counties. Small amounts are found elsewhere in the state.

Other gemstones mined in Oregon include agates, geodes, picture rock, jasper, obsidian, thunder eggs, and quartz crystals. Most of these are collected by individuals and are not extracted from regular mines.

## Regional economic impacts

In 1993, mineral production directly added $102.4 million to Oregon's economy. This came in the forms of payroll, employee benefits, operating profits, taxes, royalties, and fees. Worker payrolls and benefits accounted for 57 percent of the total. The industry had the equivalent of 2,039 full-time employees engaged in mineral extraction. In addition, it employed many workers for related activities such as trucking, operating asphalt plants, and marketing.

Economic impact is an appraisal of the benefits that activities have on an economy. It is essentially the money businesses pump into their communities. Sometimes this is called the value added to the economy.

In our analysis, we used industry averages, contacts with producers, state payroll data, and proprietary consolidated financial statements. With this information and our own survey we were able to estimate economic impacts.

Employment is a key variable. Most mines are seasonal. A mine with six workers may run, for instance, for two months. That equals 12 months of work in total or the equivalent of one full-time employee. For this analysis, we converted all part-time and seasonal labor into the equivalent of full-time employees working for a whole year.

Our survey revealed that while 2,938 people worked at Oregon's mines and natural gas field in 1993, the total amount of work done equaled 2,039 full-time workers.

Our estimate of mining and natural gas employment is 56 percent higher than the figure reported by the Oregon Employment Division. One reason for the difference is that the state collects data only on workers covered by unemployment insurance. Several hundred mining proprietorships and partnerships are not covered. The state agency also does not count all the county road and forestry workers, who engage in mining. They are classified as public workers rather than miners.

Unlike the Employment Division, we counted all the mine and natural-gas well employees, including part-time workers. The difference in coverage between our survey and the Division's is substantial. The number of mines reporting to the Employment Division in 1993 was about 100. Over 600 establishments reported workers to our survey.

Mining occurs in every county in Oregon, but most of it is concentrated along the Interstate 5 corridor. The highest dollar value of mineral production in 1993 occurred in the Portland metropolitan area. Washington County led the state in the value of minerals produced.

Statewide, besides the $102.4 million directly added to the economy, the mineral industry created indirect benefits. These result from the money spent in local communities that, in turn, creates more employment and spending.

One of the most important indirect impacts is found in transportation. From the survey, we estimate that 973 workers (mostly truck drivers) were used to ship Oregon's mineral products. Another large indirect impact is the work created at asphalt and concrete plants. These businesses depend on construction aggregates and employed 2,071 workers in 1993.

We cannot calculate total indirect benefits because of limitations on economic data. However, it is clear that local mining creates downstream jobs in shipping, concrete products, and many other areas.

Another way to view the economic impact is to consider what Oregon would be like if no mineral extraction occurred. The state would have to import all its minerals. Immediately, 2,039 direct jobs would be lost, as would $102.4 million in economic value. The indirect losses would also be great.

The biggest effect would be on construction. Since aggregates would have to be imported from long distances, price increases of several hundred percent would happen in many areas. This would be reflected in sharply higher building costs. Construction activity around much of the state would col-

lapse. Local governments would have to raise taxes to pay for more costly road and public works projects. In the end, Oregon's economy would be severely harmed.

Table 3 shows the direct economic impact of mining around Oregon. The state is divided into 11 groups of counties (Figure 2). This was done to ensure the anonymity of survey respondents.

Table 3. *Regional economic impacts of 1993 mineral production in Oregon*

| Region (counties) | Employment[1] | Value of production | Economic impact |
|---|---|---|---|
| **Central** (Crook, Deschutes, Jefferson, Wheeler) | 188 | $20,061,110 | $10,325,911 |
| **Inland southwest** (Douglas, Jackson, Josephine) | 228 | 21,312,023 | 9,894,261 |
| **North-central** (Hood River, Gilliam, Morrow, Sherman, Wasco) | 51 | 4,673,430 | 2,089,123 |
| **North coast** (Clatsop, Lincoln, Tillamook) | 115 | 9,724,597 | 4,620,201 |
| **Northeast** (Baker, Grant, Umatilla, Union, Wallowa) | 198 | 20,043,523 | 8,730,037 |
| **North Willamette Valley** (Marion, Polk, Yamhill) | 199 | 28,713,306 | 11,500,240 |
| **Portland Area** (Clackamas, Columbia, Multnomah, Washington) | 451 | 76,806,862 | 26,967,950 |
| **South-central** (Lake, Klamath) | 125 | 9,549,764 | 5,187,960 |
| **South coast** (Coos, Curry) | 115 | 7,541,531 | 4,216,523 |
| **Southeast** (Harney, Malheur) | 101 | 11,599,750 | 5,376,862 |
| **South Willamette Valley** (Benton, Lane, Linn) | 270 | 29,875,845 | 13,505,071 |
| **STATE TOTAL** | **2,039** | **$239,901,741** | **$102,414,141** |

[1] The equivalent number of full-time, year-round jobs directly in mining and mine supervision.

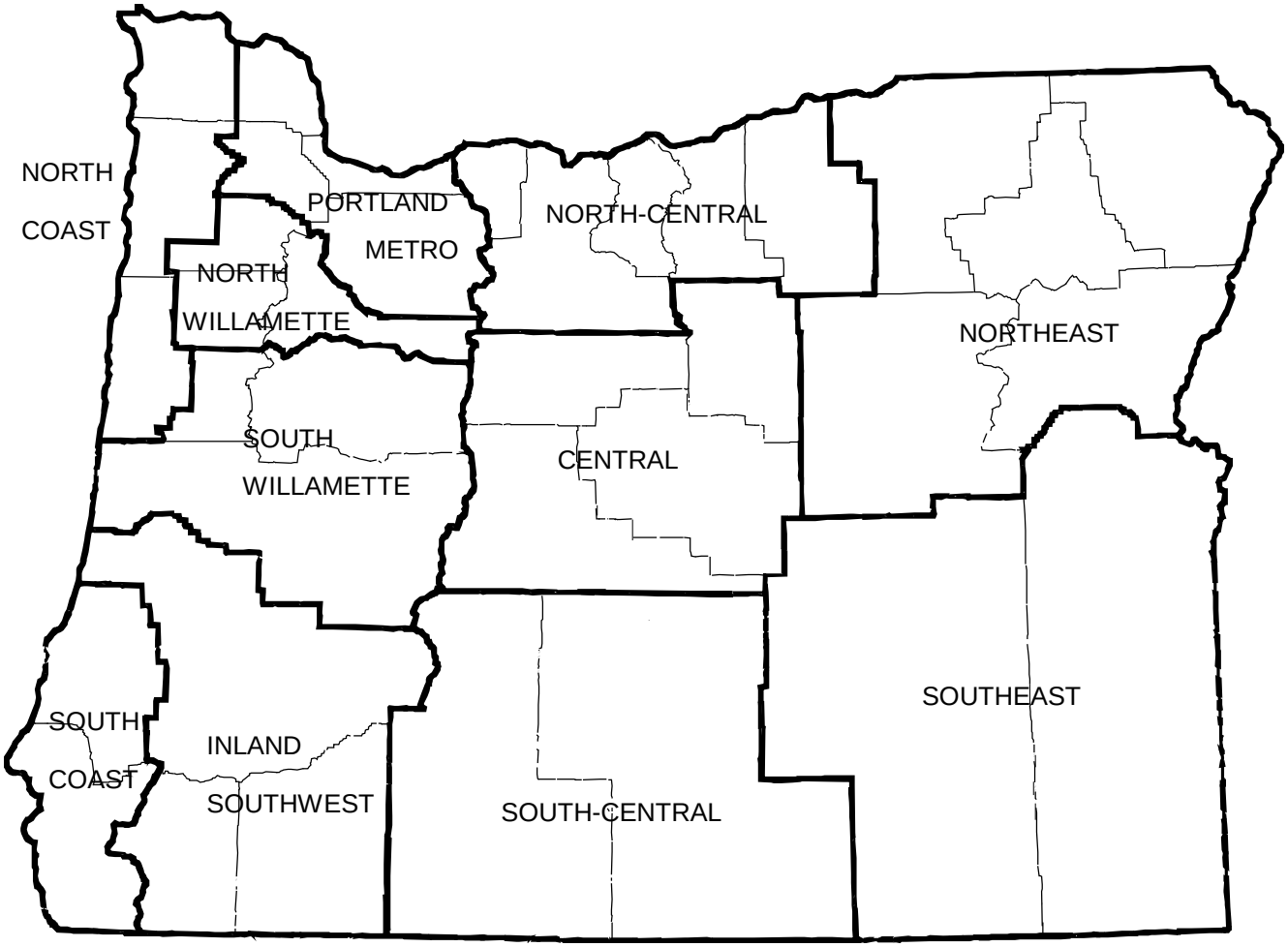


*FIgure 2. Regions of the state as used in Tables 3 and 6.*

## How minerals were shipped in 1993

Our survey asked producers about shipping. This was done because transportation is the biggest cost in marketing some minerals. Often mineral deposits can only be economically developed if they are close to shipping routes or consumers.

By far, trucking is the principal way minerals are shipped. Almost half of the state's output goes on trucks owned by mine operators. Another 41 percent is loaded on trucks owned by customers and independent haulers.

Water transportation, which is mainly by river barge, had a 5.8-percent share of the mineral market in 1993. Railroads carried only 3.3 percent. Another 3.0 percent was shipped by other means or not shipped at all. Most of this was natural gas being transported by pipelines from Columbia County.

Table 4 is a summary of how Oregon's mineral production was shipped in 1993. The shares and amounts are based on dollar values.

Table 4. *How Oregon's minerals were shipped in 1993*

| Mode of transportation | Value of minerals | % of total |
|---|---|---|
| Truck owned by producer | $113,635,658 | 47.4% |
| Truck owned by other entity | 97,265,499 | 40.5% |
| Railroad | 7,983,062 | 3.3% |
| Water | 13,928,842 | 5.8% |
| Other[1] | 7,088,680 | 3.0% |
| **TOTAL** | **$239,901,741** | **100.0%** |

[1] Shipment by natural-gas pipeline, U.S. mail, air freight, and delivery services. Also includes minerals used at production site.

Table 5 is a compilation of how construction aggregates were shipped from production sites. Unlike the previous table, the amounts and percentages on Table 5 are based on the tons of aggregates shipped.

In 1993, 92.1 percent of Oregon's aggregate production was shipped by truck. Nearly 44.9 million tons went on trucks. If the average load was 20 tons, that would amount to 2,244,843 individual truck shipments. This has a direct effect on road congestion and pavement damage. In addition to shipments from Oregon mines, much of the aggregate coming into the state from Washington was trucked in. These shipments are not counted in Table 5.

Most aggregate is trucked less than 15 miles. Shipping distances have been growing, however, because mines that are close to markets are being replaced by mines farther away. Consumers are compromising by using a combination of lower quality aggregate and shipping-in material from more distant mines. This directly increases the cost of road and building construction for communities.

## Consumption of aggregates

In Oregon, construction aggregates are usually used within a few miles from where they are produced. We do know, however, that aggregate crosses state lines. Some of it comes in by rail from long distances.

In an informal survey, we estimated the amount of construction aggregate that moved between regions in our state. This gave us apparent consumption figures for 11 regions in the state (Table 6).

Apparent consumption equals production plus imports and minus exports. Actual consumption can differ from this because of inventory fluctuations. For construction aggregates, however, such variations are rarely significant.

The biggest flow of aggregates across regional borders happens in the Portland area. That region imports, on a net basis, about 3.3 million tons of aggregate from Clark County in Washington and from Oregon counties to the south. Most of the aggregate from Washington State is trucked down Interstate 205 to Clackamas County.

Eastern Oregon exports sizable amounts of sand and gravel to Washington and Idaho. Southern Oregon exports a small amount to California. Railroads also ship aggregate across state lines. These shipments are mostly crushed rock that the railroads use themselves.

Aggregate consumption in Oregon totaled 51.2 million tons in 1993. That equals 16.8 tons per capita. The intensity of use ranged widely from area to area. It was generally greater in rural counties with low population densities. Consumption in southeastern Oregon, which includes Harney and Malheur

Counties, was 34.1 tons per capita. In urban areas, it was much less. In the Portland metropolitan area, the per capita consumption totaled 12.7 tons.

Table 5. *How aggregate was shipped in 1993*

| Mode of transportation | Tons | % of total | Est. number of loads[1] |
|---|---|---|---|
| Truck owned by producer | 25,212,424 | 51.7% | 1,260,621 |
| Truck owned by other entity | 19,684,435 | 40.4% | 984,222 |
| Subtotal for all trucks | 44,896,859 | 92.1% | 2,244,843 |
| Railroad | 1,029,265 | 2.1% | 10,293 |
| Water | 2,813,134 | 5.8% | 1,875 |
| Other[2] | 860 | 0.0% | 0 |
| **TOTAL** | **48,740,117** | **100.0%** | **2,257,011** |

[1] This assumes that the average truck carried 20 tons of aggregate, the average rail car carried 100 tons, and the average barge took 1,500 tons. The number of loads equals the number of one-way shipments.
[2] Aggregate which was mined and used on-site.

Table 6. *1993 apparent consumption of aggregates (in tons) for 11 regions in Oregon[1]. Regions and county allocation same as in Table 3 and Figure 2.*

| Region | Local production | Net imports (exports) | Apparent consumption | Per capita consumption[2] |
|---|---|---|---|---|
| **Central** | 3,808,519 | 62,000 | 3,870,519 | 32.7 |
| **Inland southwest** | 5,470,082 | (30,000) | 5,440,082 | 17.0 |
| **North-central** | 973,788 | 56,000 | 1,029,788 | 19.6 |
| **North coast** | 2,213,547 | 55,000 | 2,268,547 | 23.5 |
| **Northeast** | 3,446,588 | (317,100) | 3,129,488 | 26.4 |
| **North Willamette Valley** | 6,607,330 | (613,500) | 5,993,830 | 16.2 |
| **Portland area** | 13,346,057 | 3,292,500 | 16,638,557 | 12.7 |
| **South-central** | 2,098,955 | 0 | 2,098,955 | 31.0 |
| **South coast** | 1,688,712 | 40,000 | 1,728,712 | 20.6 |
| **Southeast** | 1,273,312 | (100,000) | 1,173,312 | 34.1 |
| **South Willamette Valley** | 7,813,227 | (12,000) | 7,801,227 | 16.7 |
| **STATE TOTAL** | **48,740,117** | **2,432,900** | **51,173,017** | **16.8** |

[1] Includes crushed rock, pit run rock, sand and gravel from all sources, cinder, fill and decomposed granite.
[2] Apparent consumption divided by mid-1993 population.

## Supply of aggregates

In addition to the aggregate produced by privately owned mines, large quantities are mined by or for public agencies. Significant amounts are also produced by forest products companies and Indian Reservations. This output is an important part of the state's aggregate supply.

In 1993, a total of 902,080 tons of aggregate was mined from BLM, USFS, and State Forest land. This does not include private, county, and State Highway Division mine production on those lands.

The Oregon Department of Transportation (ODOT) produced 2,011,120 tons in 1993. ODOT uses its own aggregate whenever commercial supplies are impractical. This tends to happen in eastern and central Oregon. That is where over 92 percent of ODOT's mining took place.

County road departments are major aggregate producers. Some counties also have forestry departments that occasionally run mines. A few cities and local governments have mines or river dredging operations. All of these counties and local agencies mined 1,952,723 tons of aggregate in 1993.

Table 7 is a list of these producers broken down by major regions.

Forest products companies need rock for their roads. Even if they are not logging, companies will put rock on roads that they use for forest management, fire prevention, and thinning.

Their need is greatest on main hauling roads that cross rough terrain in rainy areas. The need for aggregate by the timber industry is, therefore, greatest in the Coast Range. It is particularly high in the central Coast Range where the poor-quality local rock is soft and weathers quickly. It must be replaced often. As you move further east, the amount of aggregate needed for every mile of road declines. In parts of eastern Oregon, some logging roads use no mined aggregate at all.

Because forests are usually far from commercial mines and quarries, timber companies often mine their own aggregates. As long as the company does not sell the aggregate, it can mine without filing mining permits. It still must abide by forestry practices and regulations. Production of this type totaled 2,283,843 tons in 1993. The industry probably bought an additional 1,344,000 tons of aggregate from commercial mines.

Much of the aggregate produced on USFS and BLM land is used for logging roads. Together, these agencies' use in forestry is about 600,000 tons. Oregon's Forestry Department uses all its aggregate for logging roads. In 1993, the agency mined 243,538 tons. Indian Reservations mined 107,200 tons for their logging roads.

Table 7. *1993 aggregate mining by public agencies (in tons)*

| Region | BLM, USFS, State Forests[1] | ODOT | Counties and local governments |
|---|---|---|---|
| **Eastern Oregon**[2] | 308,188 | 1,031,900 | 648,730 |
| **Central Oregon**[3] | 101,631 | 853,605 | 835,320 |
| **Western Oregon**[4] | 492,261 | 125,615 | 468,637 |
| **STATE TOTAL** | **902,080** | **2,011,120** | **1,952,687** |

[1] Excludes production captured elsewhere in the survey from ODOT, county road departments, local governments and commercial mines operating on BLM and USFS lands.

[2] Baker, Grant, Harney, Malheur, Umatilla, Union, and Wallowa Counties.

[3] Crook, Deschutes, Gilliam, Hood River, Jefferson, Klamath, Lake, Morrow, Sherman, Wasco, and Wheeler Counties.

[4] Clatsop, Columbia, Clackamas, Multnomah, Tillamook, Washington, Yamhill, Marion, Polk, Lincoln, Linn, Benton, Lane, Douglas, Coos, Curry, Jackson, and Josephine Counties.

We estimate that, in total, the timber industry consumed 3,984,581 tons of aggregate in 1993. Of that total, 1,209,349 tons were approximated statistically and not directly surveyed. This was based on information from forest products companies, regulators, and consultants. We also relied on forest ownership and harvest data.

Indian Reservations mined a total of 176,276 tons of aggregate in 1993. The Warm Springs and Umatilla Reservations produced nearly all the aggregate from Reservations in Oregon.

## Mining on USFS and BLM lands

USDA Forest Service lands are an important source of minerals. We believe that, in 1993, the true market value of minerals mined on USFS lands was $3.5 million. This does not include mining by ODOT, county road departments, and a few commercial operators. Much of the net production of aggregates is used for maintaining and building roads on USFS land. Production for roads is down sharply from previous years because of budget constraints.

USFS lands were the main source of gold mined in Oregon. A small amount of decorative stone and perlite were also taken from USFS lands. This production is summarized in Table 8.

Table 8. *1993 mining on USDA Forest Service lands (in tons, unless otherwise noted)*

| Commodity | Production |
|---|---|
| **Net production of aggregates**[1] | |
| Crushed rock | 562,898 |
| Pit run rock | 33,792 |
| Sand, gravel and fill | 30,997 |
| Cinders | 16,027 |
| All aggregates (net) | 643,714 |
| Estimated production by counties, ODOT and private mines counted elsewhere | 315,000 |
| Gross production of aggregates | 958,714 |
| **Other minerals:** | |
| Decorative stone | 2,096 |
| Perlite | 50 |
| Gold (in troy ounces) | 1,657 |

Production on BLM lands in 1993 was well below the levels of past years. The estimated market value of net mineral production totaled only $272,887. The BLM used to be a major aggregate producer, but output has been sharply curtailed due to budget cuts and falling timber harvest revenues.

[1] Net production includes output for USDA Forest Service internal use on its roads, mining done by small producers, material taken from community pits, material removed by individuals with free-use permits, and production tied to timber sales. Production by ODOT, county road departments, local governments, and some commercial mining companies is not included in net production. These amounts are reported elsewhere in the survey.

The agency uses money from timber sales to pay for the crushed rock it produces for its own roads.The BLM, for several years now, has relied on old stockpiles of crushed rock and has supplemented it with small purchases from commercial sources.

Table 9 is a summary of BLM mineral production for 1993.

Table 9. *1993 mining on Bureau of Land Management properties (in tons, unless otherwise noted)*

| Commodity | Production |
|---|---|
| **Net production of aggregates**[1] | |
| Crushed rock | 17,593 |
| Pit run rock | 5,238 |
| Sand and gravel | 2,221 |
| Fill | 3,060 |
| Cinders | 26,716 |
| All aggregates (net) | 54,828 |
| Estimated production by counties, ODOT and private mines counted elsewhere | 259,880 |
| Gross production of aggregates | 314,708 |
| Of which: | |
| Negotiated sales | 31,840 |
| Timber sales | 2,065 |
| Commercial, free-use, and community pits | 259,880 |
| Other | 20,923 |
| **Other minerals** | |
| Decorative stone | 52 |
| Clay (free-use and community pits) | 2,925 |
| Gold (in troy ounces) | 1.657 |

[1] Excludes production for ODOT, county road departments, local governments, and commercial mining, which are included elsewhere in the survey.