Testimony to the Oregon House Land Use Committee
Re: HB 2201 and HB2202

Gravel mining on Willamette Valley prime farmland

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Summary

Hundreds of acres per year of the Willamette Valley's best farm soils are permanently lost to gravel mining. Such destruction of farm production capacity is unnecessary because alternative aggregate supplies are abundant from operating basalt quarries in and near the Valley bottom.

The best farm soils are Class 1, Class 2, Prime and Unique – soils that mantle Valley bottomlands and typically produce crops of high value such as vegetables, berries, filberts, nursery stock, and orchard fruits like apples, cherries, peaches, prunes and pears. Oregon needs to protect what's left of its best farm soils. Willamette Valley farms are near their markets, thus minimizing energy demand for food production, and they are a fundamental part of a sound economic system to support the current and future citizens of Oregon for food, employment, and the economic value of farm production.

Aggregate is essential for construction of highways, buildings, bridges and railroads, but the rock does not have to come from the valley floor. Nearly half of Willamette Valley aggregate comes from sand and gravel pits on floodplains of the Willamette River and its tributaries. A substantial majority of the pits cut into Class 1 and 2 soils that were productive farmland before being mined for gravel. Of all places on the planet, the Willamette Valley is one of best for supplying aggregate by quarrying basalt from the hills while preserving the best soils for agricultural production. Valley quarry basalt currently meets more than half of the demand for aggregate at fully competitive costs, and can readily supply much more. Just as other regions of the country have done, it is time for Oregon to step into the 21st century by shifting aggregate production from sand and gravel to quarried basalt and thereby meet its obligation to current and future generations by preserving our very best farm soils for farm production while we still have them to preserve. We either save the soils now or lose them forever.

Overview of Oregon aggregate sources and production: Round rock and crushed basalt

Oregon is endowed with modest aggregate resources in the form of sand and gravel, "round rock" (Figure 1), but very large resources of basalt , which is crushed for use as aggregate (Figure 2). In the Willamette Valley alone, as for the state as a whole, somewhat more than half

Figure 1. Alluvial aggregate ("round rock").

Figure 2. Crushed basalt ("quarry rock").

of the aggregate production is crushed basalt and the rest is sand and gravel, as shown by DOGAMI data in Table 1.

Willamette Valley Aggregate production (tons)
(Data from DOGAMI, Dec 2006 and Dugdale, 2007)

Year	1996-97	1997-98	1998-99	1999-00	2000-01
Basalt	19,315,389	15,911,847	14,873,522	14,845,659	14,342,209
Sand and Gravel	11,706,351	13,831,462	11,655,086	12,282,310	10,770,761
Total	31,021,740	29,743,309	26,528,608	27,127,969	25,112,970

Year	2001-02	2002-03	2003-04	2004-05
Basalt	11,987,258	11,800,446	12,508,306	14,348,255
Sand and Gravel	10,279,621	9,750,750	11,620,461	12,906,523
Total	22,266,879	21,551,196	24,128,767	27,254,779

Table 1. Aggregate production in Willamette Valley Counties (Benton, Clackamas, Columbia, Lane, Linn, Marion, Multnoma, Polk, Washington, Yamhill; Lane county production includes small production from the coast). Year column headings indicate year within which the 12-month reporting period ended, the month of which differs from one producer to another.

In the Willamette valley, most sand and gravel is mined from pits in the active floodplain of the Willamette River. Crushed basalt is mined from basalt rock layers deposited by ancient volcanic activity. Such basalts underlie the Salem Hills and hills of Portland, as well as many other hills within the Willamette Valley and along its edges, providing a ready source of hard rock for quarrying (e.g. Figure 3).

DOGAMI data for aggregate production statewide is broken down by region in Table 2, showing that production from the Willamette Valley region is, by far, the largest in the state at 66% of the state total. The concentration of production in the Willamette Valley reflects the concentration of population and urban areas in the Willamette Valley, where agricultural production from Class 1 and 2 soils is also concentrated. The DOGAMI data also show that, statewide, 56% of production is basalt and 44% is sand and gravel. A similar split applies to the Willamette Valley [1], with 53% basalt and 47% sand and gravel.

Figure 3. Basalt quarry in the southern Willamette Valley. The hill is underlain by basalt that is mined and crushed on site. Soils overlying such uplands within and along the Willamette Valley are largely poor for farming, Class 5 and higher, with some areas of Classes 3 and 4. Basalt deposits such as the one pictured here are typically much more than 100 ft thick, providing a large amount of rock from a small area of disturbed land.

A quarry such as the 139-million-ton Springfield quarry can supply an amount of aggregate equivalent to that mined from 2000 acres of prime farmland.

[1] *Valley Counties: Benton, Clackamas, Columbia, Lane, Linn, Marion, Multnomah, Polk, Yamhill and Washington. Coast Counties: Clatsop, Tillamook, Lincoln, Coos and Curry Counties. Southern Counties: Douglas, Josephine and Jackson Counties. Eastern Counties: Hood River, Wasco, Sherman, Gilliam, Morrow, Umatilla, Wallowa, Union, Baker, Grant, Malheur, Harney, Lake, Klamath, Deschutes, Crook, Wheeler, and Jefferson.

Aggregate Production by Region (year 2004-2005)				
Region	Production (tons)	% of state	% sand & gravel	% basalt
Willamette Valley (10 counties)	27,254,779	66	47	53
Coast (5 counties)	2,131,152	5	26	74
Southern Oregon (5 counties)	4,212,655	10	48	52
Central & Eastern Oregon (18 counties)	7,895,372	19	36	64
Oregon Total	41,493,958	100	44	56

Table 2. Summary of total production by region and the percentage of commercial sand gravel mined versus crushed basalt mined for 2004-2005 in Oregon's four regions. Data show that 56% the Oregon's aggregate comes from crushed stone (rock from hard rock quarries) and 44% comes from sand and gravel sites (data from DOGAMI (Marshall), 2006, 2007) and Dugdale, 2007) [1].

Comparison to other states

Oregon can readily meet the aggregate demand from crushed basalt quarry rock and existing gravel sites. Other states have already made the shift so as to preserve their river bottom lands. For example, North Carolina gets 85% of its aggregate from crushed quarry stone and 14% from sand and gravel[2]. Similarly, in the mid-Atlantic region 83% of aggregate came from quarry rock in 1995, up from 68% in 1975[3].

Additional research by the Oregon Farm Bureau aggregate workgroup member Bill Austin shows that a third of the states that provided aggregate source data[4] meet more than 70% of their

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[2] North Carolina Geologic Survey (http://www.geology.enr.state.nc.us/Default.htm): "Crushed stone makes up 85 percent of [N.C.] aggregate production; construction sand and gravel, about 15 percent. North Carolina is the eighth largest crushed stone producing state in the U.S. Aggregate is produced from about 135 crushed stone quarries and about 500 sand and gravel sites throughout the state."

[3] Gilpin R. Robinson, Jr., and William M. Brown, *U.S. Geological Survey Open-File Report 02-350,* p. 13: "Changes in the aggregate industry profile for the Mid-Atlantic region from 1975 to 1995 illustrate some recent industry trends. In 1975, 116 natural aggregate companies were active in the Baltimore-Washington region (Valentin Tepordei, written communication, 1999). These companies produced 36 million metric tons (39.7 million tons) of aggregate from 135 sand and gravel pits (32 percent of total aggregate production for the region) and 78 crushed stone quarries (**68 percent** of total aggregate production for the region). In 1995, 53 natural aggregate companies were active in the Baltimore-Washington region and produced 76 million metric tons (84 million tons) of aggregate from 61 sand and gravel pits (17 percent of total aggregate production for the region) and 89 crushed stone quarries (**83 percent** of total aggregate production for the region). . . . These changes also illustrate a regional **shift in the source of aggregate from sand and gravel, which is supplied by many aerially extensive but low volume operations such as shallow open pits in alluvial deposits, to crushed stone,** which is supplied by quarries that produce aggregate in large volume from aerially more restricted deep quarries or underground mines. Tepordei (2001, p. 13) notes that **since 1974, more crushed stone than sand and gravel has been produced in the United States, reflecting a national trend toward greater reliance on rock quarries for aggregate."** (Emphasis added).

[4] Bill Austin surveyed State DOT's in fifty states and received responses from sixteen on the question of how much of their aggregate comes from quarry rock, river rock and recycled rock sources. One more state, Iowa,

aggregate demand from quarry rock resources (Arkansas, Louisiana, Massachusetts, Oklahoma, Tennessee, Wisconsin). The suggestion from Oregon river gravel producers that crushed quarry rock is not suitable to meet Oregon aggregate demand is highly questionable, especially when we recognize that Oregon's quarry rock, basalt, is one of the best aggregates available[5]. Further, the Portland area has already largely shifted to use of crushed basalt, as pointed out by Jaeger (2006): ". . . few alluvial sand and gravel mines still operate in the Portland metro area: the vast majority of aggregate consumers in the Portland metro area already rely on crushed rock from quarries that do not generally conflict with high-value farmland."

Distribution of <u>alluvial</u> aggregate resources in the Willamette Valley

Essentially all Willamette Valley production of sand and gravel (Tables 1, 2) comes from the young alluvial deposits in the 100-year floodplains of the Willamette River and its tributaries, as shown on the map in Figure 4. The green color (along rivers) on the map shows the areal extent of the post-Pleistocene alluvium deposited as the rivers meandered across their floodplains during the past 10,000yr (geology of gravel deposits is largely from the USGS geologists O'Connor, et al., 2001). This young gravel is fresh, little weathered, and of good quality for making concrete. Beneath this young alluvium and laterally adjacent to it in beige color, lies older alluvium that filled the Valley during the Pleistocene and earlier times. Much of this older rock is poor quality for concrete, but some of it is suitable for base aggregate.

The red dots on the map (Figure 4) show the locations of all currently and formerly permitted alluvial gravel pits in the Valley as tabulated by DOGAMI. It is quite evident that the gravel pits closely track the distribution of the young alluvium (green), reflecting the interest in mining the relatively thin layer (20 to 40 ft thick) of concrete-grade gravel along the rivers. The near absence of mining in the older alluvium (beige) reflects the lack of interest in mining the poor quality older rock.

One general point to recognize is that some round rock makes good aggregate and some is poor. Most of the Valley alluvial deposits are poor quality, but the rock along the river floodplains where the soils are best is good quality, thus the gravel miners seek it.

Distribution of <u>basalt</u> aggregate resources in the Willamette Valley

In contrast to sand and gravel, the supply of basaltic rock in the Valley is enormous, as shown by the tan color on map Figure 5. The basalts shown on the map include a variety of types, including the widespread and famous Columbia River basalts that underlie the Salem Hills, Portland Hills, and some of the hills along the Columbia River north of Portland, as well as huge areas of Central and Eastern Oregon and Washington. Other basalts and related rocks (diabase, gabbro) underlie most of the hills and knobs of the Valley floor, parts of the Cascade foothills, parts of the Coast Range, and additional hills in the Portland area (Boring lavas of SE Portland).

The black squares on the map (Figure 5) show the locations of all currently and formerly

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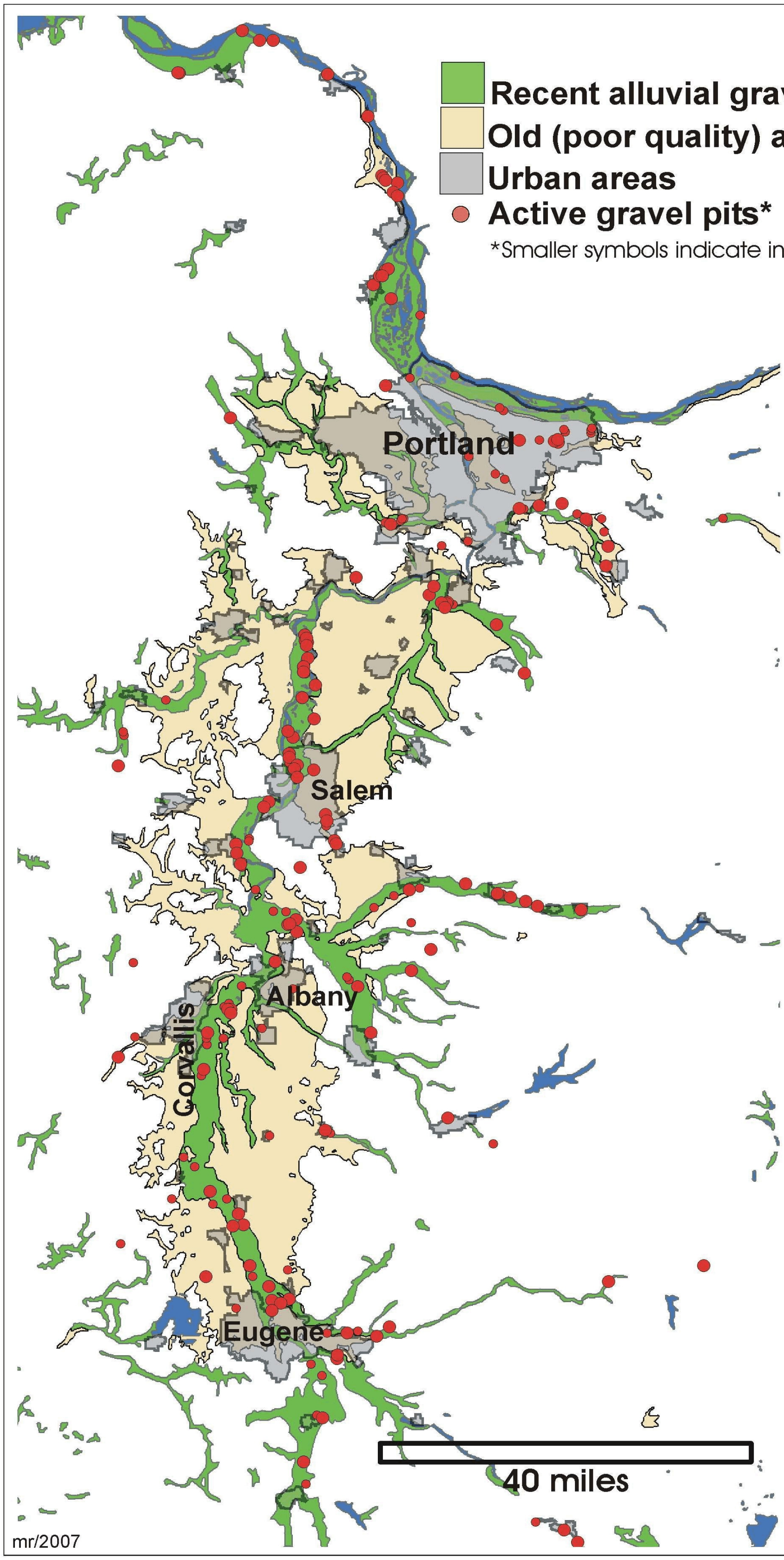
gets more than 50% of its aggregate from quarry sources.

[5] Numerous studies of aggregate qualities have found that basalt (or "trap rock", as it is commonly called in the East) is makes especially good aggregate because it is dense, non-porous, tightly crystalline (making it tough), hard, and it bonds well to cement.

Willamette Valley Alluvial Gravel Pits

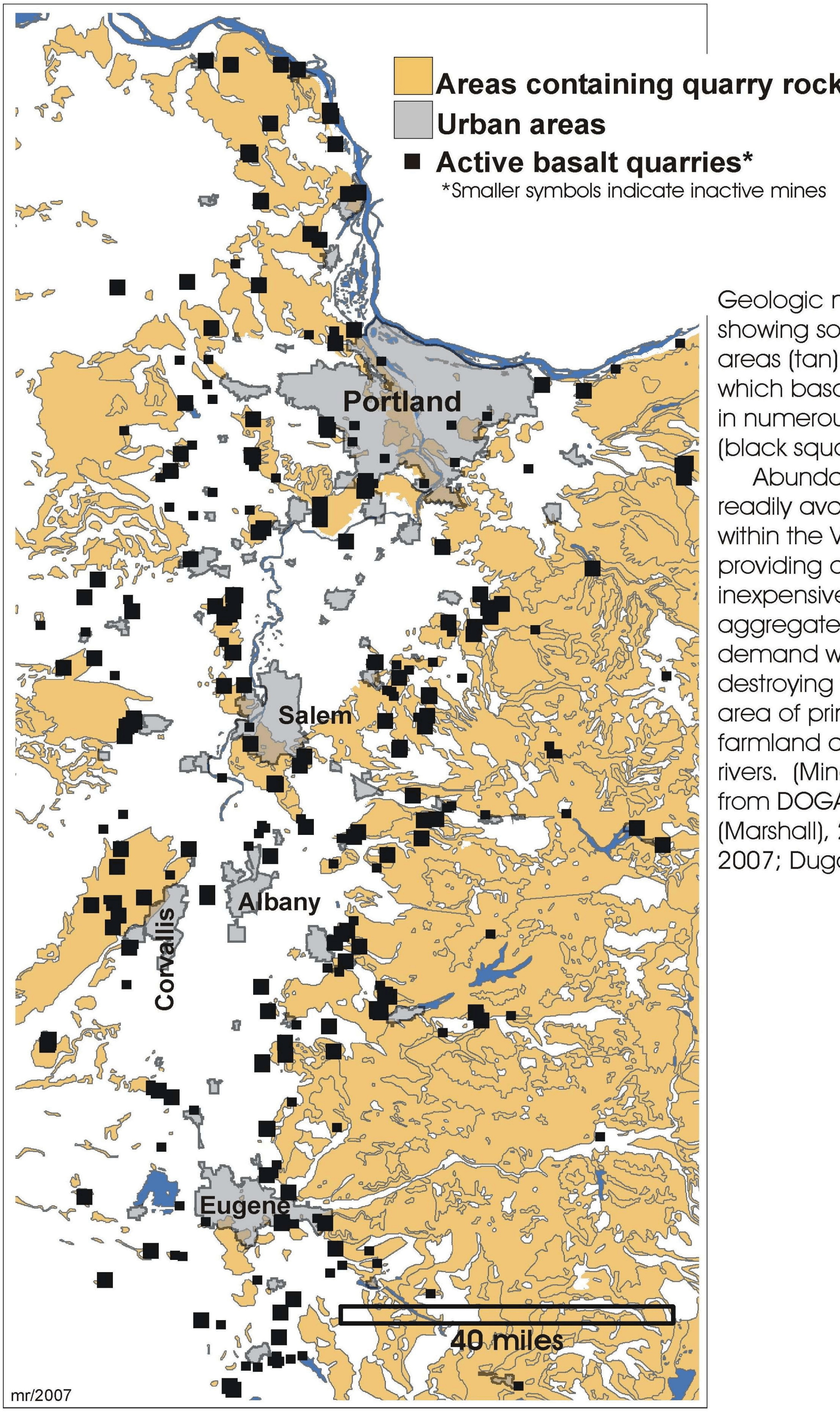


Geologic map showing young river alluvium (green) where nearly all gravel is mined (red circles) and showing older river alluvium (beige) that is generally poor in quality for aggregate.

The best farming soils, used to grow fruits and vegetables, overlie the young alluvium (green). Generally lower quality farming soils, used for rye grass and wheat, overlie the older alluvium. (Mine data from DOGAMI (Marshall), 2006, 2007; Dugdale, 2007)

Figure 4

Willamette Valley Basalt Formations and Quarries



Geologic map showing solid rock areas (tan) from which basalt is mined in numerous quarries (black squares).

Abundant basalt is readily available within the Valley, providing an inexpensive source of aggregate to meet demand without destroying the limited area of prime farmland along the rivers. (Mine data from DOGAMI (Marshall), 2006, 2007; Dugdale, 2007)

Figure 5

permitted basalt quarries in the Valley as tabulated by DOGAMI (2005, 2006; Columbia County quarries are located by DOGAMI but permitting is separate). The rock units shown in tan are shown only if they contain rock quarries, i.e. if a particular formation is not mined for basalt aggregate, that unit is not shown on the map. It is apparent from the map that one reason more than half of Valley aggregate production is basalt is that basalt is plentiful in the Valley.

As for round rock, some basalts make good aggregate and others do not. Just like the basaltic aggregate produced elsewhere in the country (e.g. the "trap rocks" of New England), much of the Oregon basalt make excellent aggregate, which accounts for its large production in the Valley and in the state as a whole.

Round rock producers argue that round rock makes better concrete because it can be more easily smoothed. However, smoothing of crushed rock concrete is an art that finishers have mastered just about everywhere but Oregon, apparently, for example in building the tarmacs of Dulles Airport, O'Hare Airport, Indianapolis Airport, to name three where crushed rock aggregate is used, plus curbs, sidewalks and streets all over the eastern US, and elsewhere.

Estimates of farmland destroyed

W. Jaeger (2006) has estimated the demand for aggregate in Oregon based on various economic trends. Using his estimate for demand, the area of land destroyed by mining can be estimated, as shown in Figure 6. The estimate takes into account the Chapin Factor, 62%, an

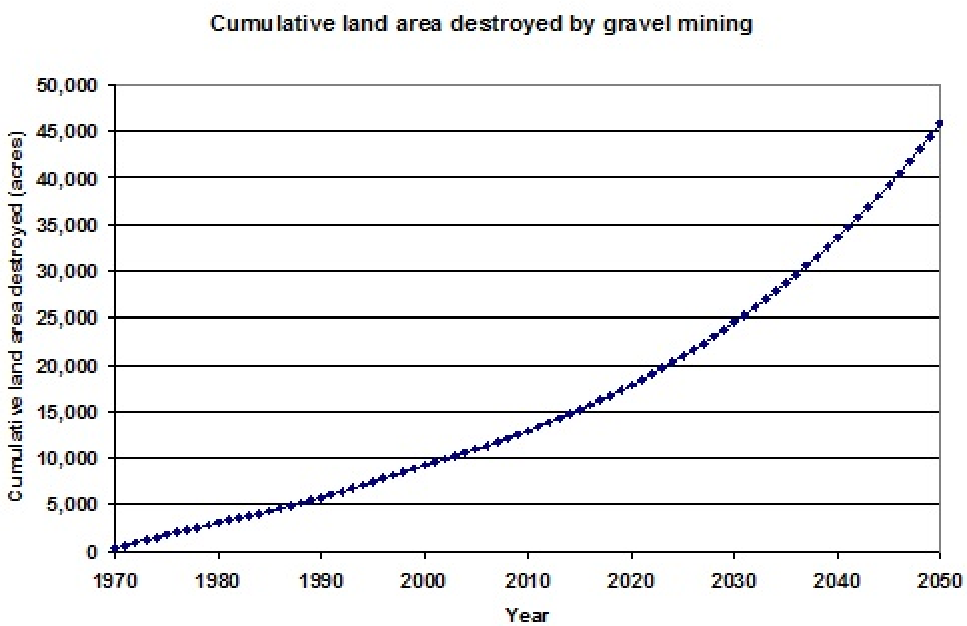


Figure 6 Cumulative land area of Willamette Valley land destroyed since 1970 by gravel mining projected to the year 2050. The graph assumes: a) continued production of 46% of Willamette Valley aggregate from sand and gravel sources, b) an average mined thickness of 20 ft, c) an areal mining efficiency of 62% (Chapin Factor, see text), and d) a mining rate intermediate between the extremes estimated by W. Jaeger (2006). Historic production is smoothed.

estimate by Bruce Chapin of the typical area actually mined relative to the minimum area necessary to yield a given volume of rock assuming vertical mining to total depth; i.e. the factor accounts for sloped mine walls, setbacks, islands, processing areas, roadways, and the like.

Conclusion

Willamette Valley aggregate can be fully supplied by production from basalt quarried in the Valley and along the Columbia River, as is already the case in Portland and much of the rest of the country. Oregon's best farmland, which lies in the floodplains along the rivers of the Willamette basin, is irreplaceable and essential to production of food–all the more so as transportation energy costs continue to rise into the future. Protection of the remaining farmland for current and future agricultural production would be most prudent.

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