

GRAVEL DEPOSITS IN THE WILLAMETTE VALLEY BETWEEN SALEM AND OREGON CITY, OREGON

By

J. L. Glenn*

Introduction

The Willamette Valley sand and gravel project was initiated in the summer of 1960 by the State of Oregon Department of Geology and Mineral Industries. The project was undertaken because increased development of the sand and gravel resource is a necessary prerequisite for continued industrial and urban growth in this area. The purpose of this report is to indicate some of the characteristics and the distribution of present or potential sand and gravel deposits in the lower Willamette Valley between Salem and Oregon City. Because the report is a preliminary review of the deposits, its use should be followed up by more extensive and thorough geologic investigations in any area where the need for sand and gravel may arise. Trimble (1957) has outlined the characteristics and distribution of similar deposits to the north in the adjacent Portland area.

Schlicker (1960) investigated the gravel resources in the Salem area. As a result of his report, it was recognized that further investigation of selected areas should be postponed pending the accumulation of basic data on the overall occurrence, characteristics, and origin of Willamette Valley sand and gravel deposits. This report summarizes data collected during the summer of 1961.

The area studied lies between the cities of Salem on the south and Oregon City on the north, the Cascade Mountains on the east, and the Salem-Eola Hills on the west (figure 1). Parts or all of the Salem, Stayton, McMinnville, Mount Angel, Molalla, Yamhill, Tualatin, and Oregon City quadrangles are included in this region.

The Cascade Range and to a lesser extent the Coast Range are the provenance areas for the majority of the sand and gravel deposits in the

*Graduate student in geology, Oregon State University.

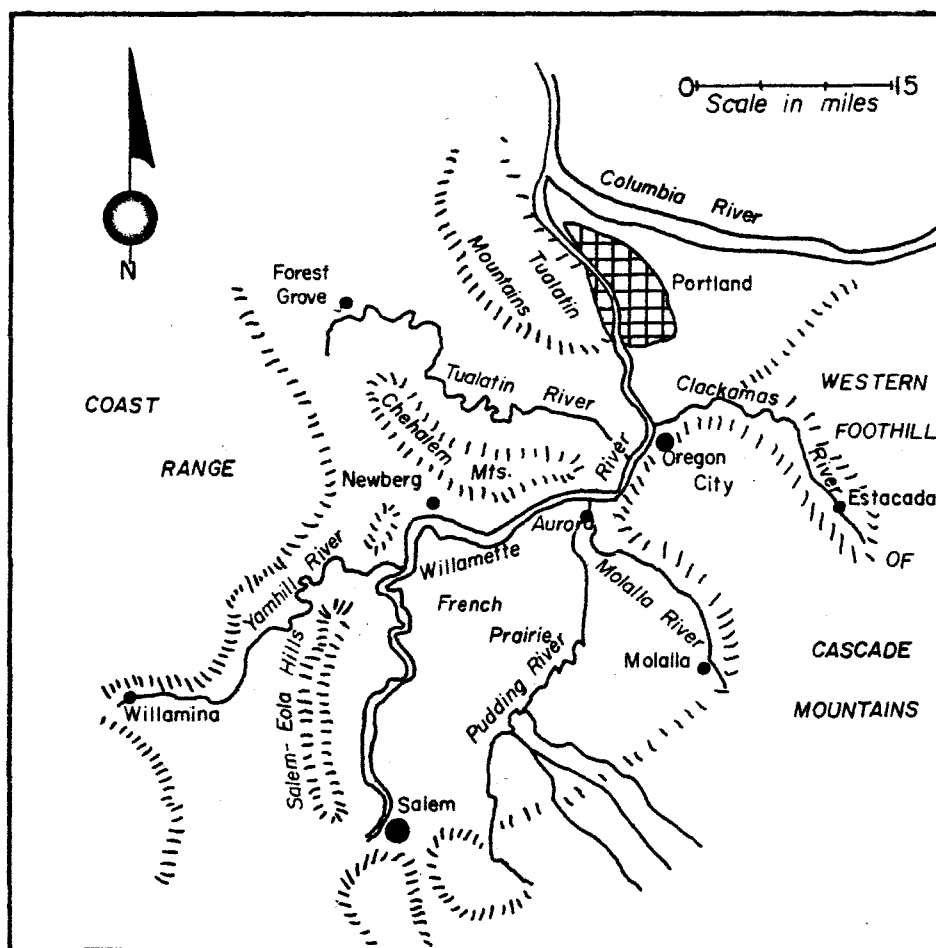


Figure 1. Sketch map of the lower Willamette Valley.

territory. The Cascades are composed chiefly of Tertiary continental volcanic rocks with some interfingering sedimentary rocks of both continental and marine origin. The Coast Range consists of marine sedimentary and volcanic rocks of older Tertiary age, with a scattering of basic dikes and sills. Basalts, andesites, and rhyolites, in that order of abundance, form the majority of the volcanic rocks in the gravel deposits.

The Willamette River, a major tributary of the Columbia River, roughly bisects the lower Willamette Valley in its northward course to a confluence with the Columbia north of Portland. The major tributary streams of the Willamette in the area of this report are the Yamhill River, which flows eastward from the Coast Range, and the Molalla River, which flows northwestward from the Cascade Mountains. The Pudding River drainage

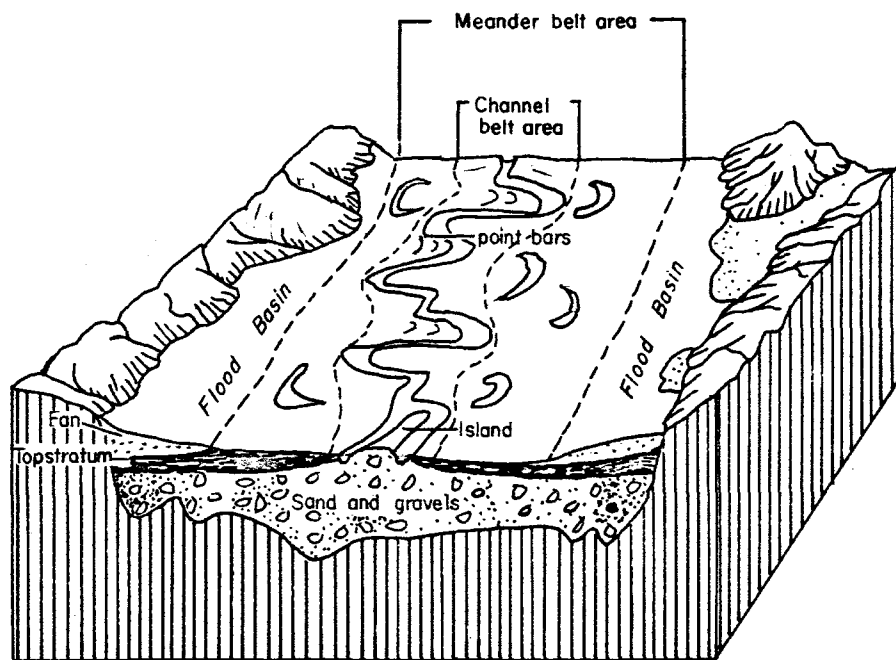


Figure 2. Sketch showing the stratigraphic and aerial relationship between channel belt, meander belt, and flood basin deposits.

system, including Silver, Abiqua, and Butte Creeks, is the only other important stream system in the area.

Origin and Occurrence of Deposits

Sand and gravel deposits in the lower Willamette Valley are related to present or past stream activities. The characteristics and distribution of these deposits are in large part controlled by the nature of the material available to the stream which deposited them, the time of deposition, and the manner in which they originated. With this in mind, one may divide the sand and gravel deposits in the lower Willamette Valley into the following types: (1) modern stream deposits, (2) flood-plain deposits, (3) fan deposits, (4) terrace deposits, and (5) abandoned channel deposits of the Labish lowland.

Modern stream deposits: Modern stream deposits are found principally in proximity to the Willamette and Molalla Rivers. Locally smaller, high-gradient Cascade Mountain streams such as Silver, Abiqua, and Butte

Creeks, may be important sources of gravel. The smaller streams deposit their loads as a result of gradient reduction in alluvial aprons apexing at the point where they flow out of the mountains and into the valley proper.

Both the larger and smaller streams presently transport gravel only during flood stage. During the major period of gravel transportation and deposition, which presumably coincided with the waning stage of the last period of mountain glaciation, these streams carried and deposited the greater bulk of the present deposits. Modern stream activity has resulted in the deposition of a thin veneer of younger gravels or in the reworking of older deposits. The upper Molalla River and Silver, Abiqua, and Butte Creeks all extend into the glaciated area. The Pudding River, which heads at a lower elevation in the Waldo Hills, never had access to glacial water and debris, which accounts for its relative unimportance as a source of sand and gravel.

Modern stream deposits of the Willamette and Molalla Rivers are either point bar or in-channel deposits. Neglecting for the moment petrographic differences, deposits of this manner of origin in both rivers vary principally in aerial extent with the maximum dimensions controlled by the size of the parent stream. Willamette deposits are hence larger and more extensive than those of the Molalla.

Point bar deposits are accretion deposits on the inside or concave banks of modern and abandoned stream channels. They may be recognized by their relationship to the channel and by their surface expression of alternating ridges and swales with a horizontal radius of curvature similar to that of the associated channel. On aerial photographs point bar deposits appear as alternating light and dark bands, the lighter areas marking ridge tops, the darker areas, swales.

In-channel deposits are represented by the various types of bars which may or may not have "above water" expression. They include many islands found along the course of the modern stream. These are characterized by extreme variability in size and form. They may be as large as Grand Island (3 by 5 miles) or as small as a few tens of feet in length. Islands generally are elongate bodies with the long axis parallel to the course of the stream. The upstream end of an island is ordinarily blunt while the lower end tapers gradually to a point. The maximum breadth normally occurs near the center portion of the island, where the maximum relief also occurs.

The reason for island formation is often obscure. Frequently islands originate by high-water scouring through a point bar swale and subsequent diversion of part of the stream's flow down the swale during lower

or normal river stages. The establishment of vegetation on an island helps to stabilize the island and to further promote its growth. Large islands, such as Grand Island, are the result of diversion of all but a small part of a stream's flow from an old to a new course of greater gradient.

Common in-channel sand and gravel deposits with little or no above-surface relief include so-called "blanket bars." These are relatively flat-topped tabular bodies which widen downstream and gradually decrease in elevation until they merge with deposits of the channel floor. These are most commonly found in the modern streams below impingement points and between the deflected channel thalweg (deepest portion of the channel) and the outer bank.

Flood-plain deposits: Point bar and in-channel deposits are characteristic of the channel belt or belt of active stream erosion and deposition. With continued migration of a stream, channel-belt deposits may become separated from the belt of active erosion and deposition. If this occurs, a fine-grained top stratum or overburden is laid down over the sands and gravels during flood stages of the stream. In this position, they become part of the meander-belt deposits. Between the area of recognizable meander-belt deposits and the valley margins, that is, the area of thickest top stratum, the deposits are said to be part of the back-swamp or flood basin environment of deposition. Channel belt, meander belt, and flood-basin deposits are actually types of flood-plain deposits and differ principally in the amount of masking fine-grained top stratum (fig. 2).

Terrace deposits: Terrace deposits are older stream deposits which have been dissected but not completely removed by later stream activity. These deposits are wide spread in the lower Willamette Valley and are included in this report because they represent a potential sand and gravel resource in the study area.

The importance of the terrace deposits to the sand and gravel resources in the lower Willamette Valley is twofold. First, where streams impinge against them, as at River Bend (sec. 1, T. 5 S., R. 3 W.), they serve as local sources for modern stream deposits. Secondly, the sand and gravel which occur beneath the terraces may extend and be encountered at depth beneath the modern stream gravels. Production from these gravel deposits in place is limited because of the thickness of overburden or because of their relatively more weathered character.

Fan deposits: Alluvial fans are stream deposits built up by streams of higher slope extending into a valley with lower slope. They are low,

cone-shaped areas which broaden down valley from a narrow head to a maximum width at the lower margin of the fan. The principal area of fan deposits occurs along a line between the Mill Creek Gap and Salem. These deposits are attributed to a former course of the Santiam River across the outlined area.

Abandoned channel deposits of the Labish lowland: The Labish lowland is an abandoned channel of the Willamette River extending northeast from Keiser to near Canby. The channel varies from one-half to 1 mile in width, with the maximum width in the center and lower portion. The Pudding River and Silver, Abiqua, and Butte Creeks enter and occupy the center and lower reaches of the abandoned channel. Deposits characteristic of this channel interfinger with Molalla River deposits in the Aurora-Canby area.

Description of Selected Deposits

Sand and gravel deposits in the lower Willamette Valley have been shown to have a variety of origins. On the basis of differing origin and characteristics, six types of sand or gravel deposits may be delineated. These are (1) Willamette River deposits, (2) Molalla River deposits, (3) Salem-Santiam fan deposits, (4) Silver-Abiqua-Butte Creek deposits, (5) Labish lowland deposits, and (6) terrace deposits. The accompanying map shows the distribution of each in the regions studied.

Willamette River deposits: The deposits of the Willamette River floodplain are the most widespread and easily exploited in the area. In general, these deposits coarsen with depth. Fragments as large as 10 inches in diameter are common in most gravel pits at depths below 18 to 20 feet. The maximum thickness of gravel is not known. Water-well logs commonly report sand and gravel thicknesses in excess of 40 feet; at least one well penetrated 229 feet of "sand and gravel." Present operations seldom produce from depths greater than 20 feet.

Willamette flood-plain gravels are fairly uniform in composition and quality from Salem to the mouth of the Yamhill River. Below the Yamhill, the quality of the gravel decreases somewhat due to progressive dilution by poorer grade materials from the Coast Range flow. The quality improves below the mouth of the Molalla River, principally in response to the load supplied by this stream. In general, materials derived from streams flowing from the Coast Range are of a poorer quality than similar materials from Cascade Mountain streams. This is primarily a reflection

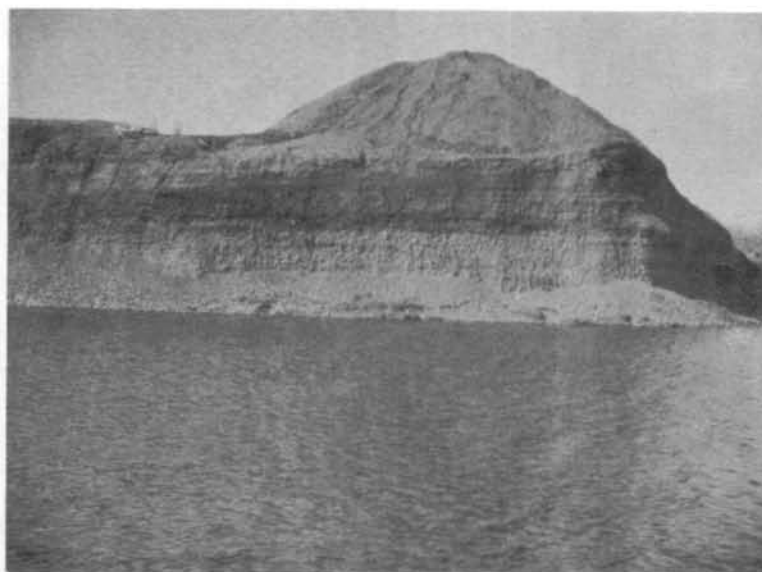
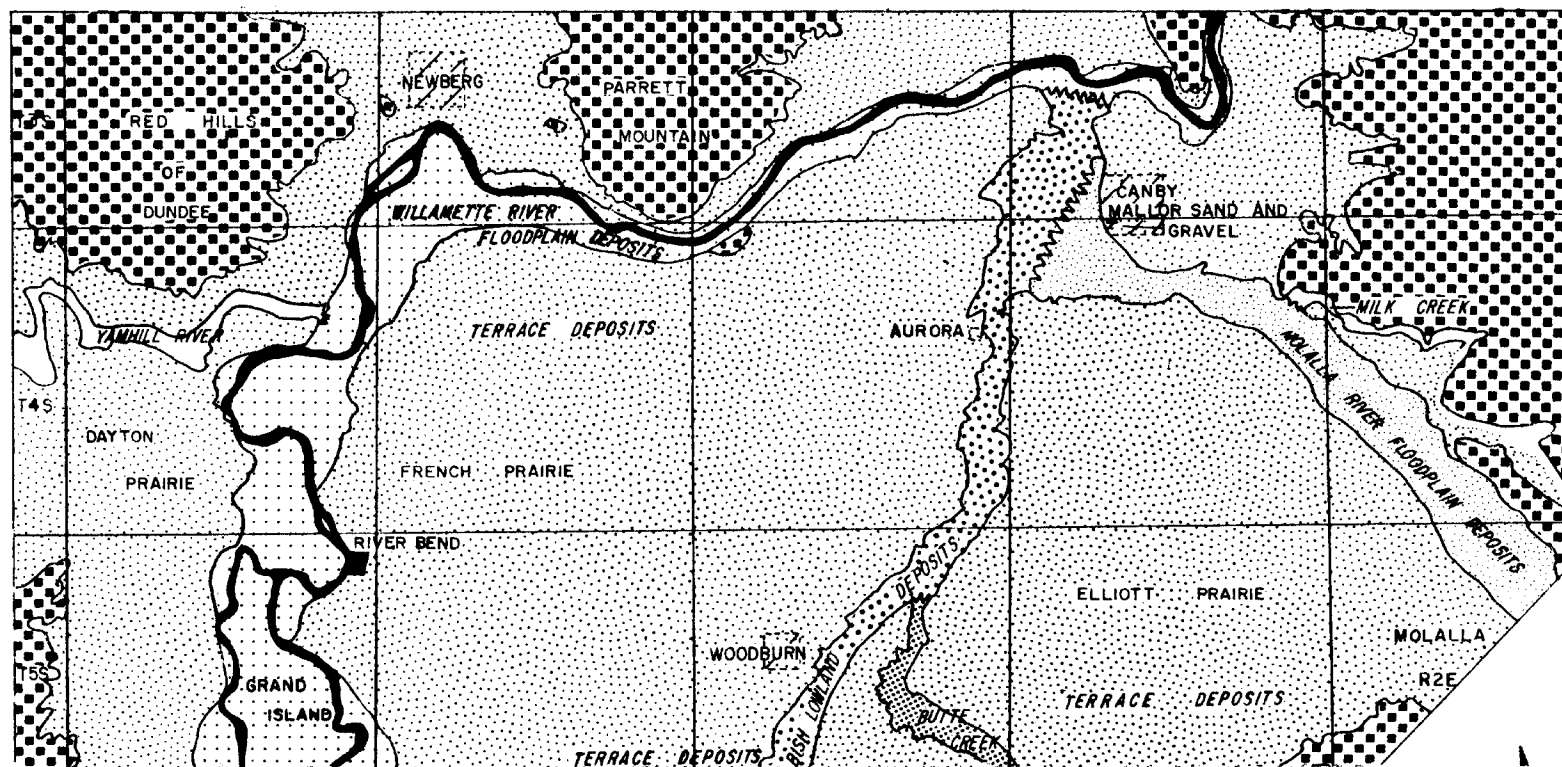


Fig.3. Typical Willamette River flood-plain deposits in the meander-belt area. The darker band near the center of the photo is an iron oxide cemented zone which is characteristic of those deposits farther removed from active stream erosion and deposition.



Fig.4. Typical Willamette River flood-plain deposits in the channel-belt area. Note the absence of cemented layers and the relatively greater amount of fine-grained (sand) matrix.

DISTRIBUTION OF SAND AND GRAVEL DEPOSITS IN THE WILLAMETTE VALLEY
BETWEEN SALEM AND OREGON CITY, OREGON



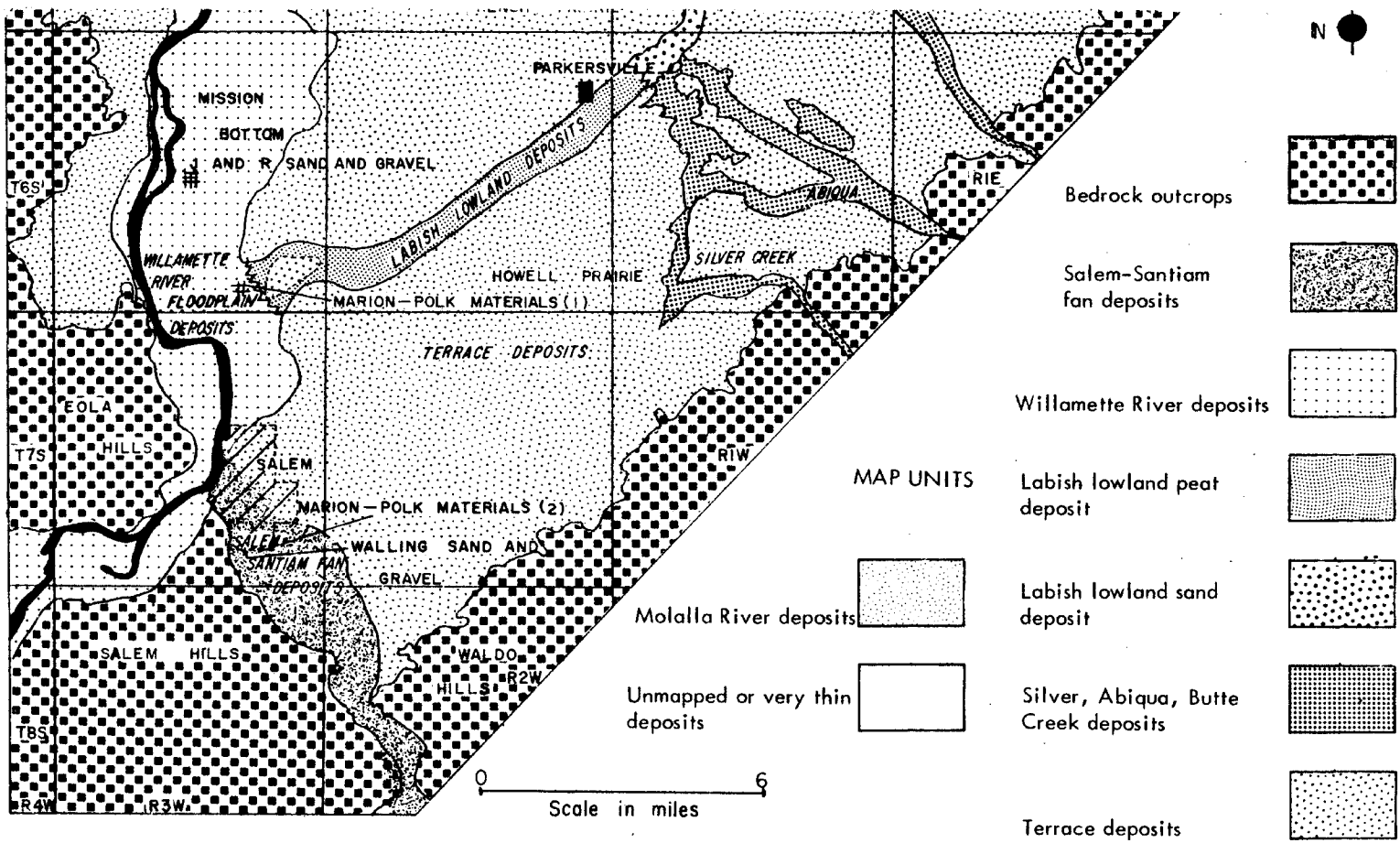




Fig.5. Typical Salem-Santiam fan deposits at the Walling Sand & Gravel operation. The pick head is approximately 2 feet below the upper weathered zone.



Fig.6. Typical Silver Creek stream gravel deposit near Silverton, Oregon. Bedrock is only about 2 feet below the surface here and gravels beneath the flood plain are only 6 to 7 feet thick.



of the type of bedrock materials found in both areas and of the fact that Cascade streams normally have a higher gradient and are more vigorous in their action.

Willamette River gravels typical of meander belt and channel belt are shown in figures 3 and 4. Figure 3 delineates the Marion-Polk Materials No. 1 pit in sec. 35, T. 6 S., R. 3 W., and figure 4 is at the J & R Sand and Gravel pit in sec. 21, T. 6 S., R. 3 W. The first of these produces from a meander-belt point bar, the second from an in-channel bar.

The gravels in each of these pits consist of rounded gray to black basalts and gray andesites with minor amounts of light-colored volcanics, mostly rhyolites, and siliceous fragments (chert, jasper, chalcedony). The basalts are uniformly fine grained with a thin white to red surface coating or weathering rim. The andesites are of two types, depending on the size of the phenocrysts.

The matrix material is principally sand-sized, angular rock fragments and minerals, quartz and dark minerals being especially noticeable among the latter. It is usually evenly distributed throughout the gravel deposit. However, occasionally, as in the J & R Sand and Gravel pit, lenses of variable thicknesses of essentially pure sand may be found. In general, those deposits in the channel-belt area have more sand-sized matrix and are less coarse than deposits in the meander-belt and flood-basin areas.

Cementation in these gravels is variable. In general, gravels of the channel belt area are loose and friable, at least in the upper production zone. Deposits in the meander-belt and flood-basin areas may be similar, or may show varying degrees of cementation produced by incorporated fines or by an iron oxide cementing agent. Cementation, and hence difficulty of production, increases with depth.

Molalla River deposits: Molalla River sand and gravel deposits are similar in origin to those of the Willamette. The major differences, such as coarseness, grade, and quality, are a reflection of the smaller, exclusively Cascade, drainage basin and higher gradient of the stream. Gravels interfinger with the deposits of the lower Labish lowland but in general are fairly uniform and wide spread adjacent to the Molalla River and beneath its flood plain.

The Mallor Sand and Gravel operation is typical of those in Molalla deposits. Production is from a number of shallow pits in the flood plain and from a bar in the modern river. The gravels are on the average more coarse than those of the Willamette and are principally dense, hard

basalts and andesites. The deposits appear to be more deficient in sand-sized matrix material than are similar deposits in the Willamette River. Molalla River gravels are probably the highest quality materials in the lower Willamette Valley although lacking somewhat in desirable grading characteristics.

The thickness of the gravels is not accurately known but well logs indicate that a maximum of 80 feet is present in the lower valley. The maximum thickness decreases upstream until only 2 to 4 feet are found near Molalla. Production from depths greater than 20 feet is seriously inhibited by the presence of large boulders and indurated clay-gravel lenses.

Salem-Santiam fan deposits: The Salem-Santiam fan deposits are the third most widespread and the second most intensively exploited in the southern part of the lower Willamette Valley. These deposits are found in a fan-shaped area extending from the head of Mill Creek Gap through the City of Salem, but they are equally widespread south and east of the study area, extending to the present Santiam River on the south and beyond Stayton on the east. The gravels are essentially uniform in composition along their entire mapped length and are overlain by a fine-grained top stratum of varying thickness, usually thin.

The gravels of the Salem-Santiam fan compare favorably in composition to those of the Willamette flood plain. Basalts and andesites in about equal amounts are the most prevalent gravel-sized fragments. These gravels differ from Willamette gravels in at least one important aspect. The gravels of the upper few feet are extensively oxidized and weathered. Almost all gravel-sized material has a weathering rim of varying thickness. This undoubtedly reflects the age of these materials and indicates that the Salem-Santiam gravels were deposited prior to the deposition or reworking of those in the modern Willamette flood plain.

The thickness of gravel in the Salem-Santiam fan is not accurately known, but production is developed to greater depths than in either the Willamette or Molalla deposits. Both the Marion-Polk Materials No. 2 and Walling Sand and Gravel operations, the two major producers from these deposits, operate to depths between 30 and 40 feet. Cementation is hence not a limiting factor at depth in the production of these gravels. Typical Salem-Santiam fan gravels at the Walling operation are shown in figure 5.

Silver, Abiqua, and Butte Creek deposits: The Silver, Abiqua, and Butte Creek gravels are the only significant deposits along the eastern

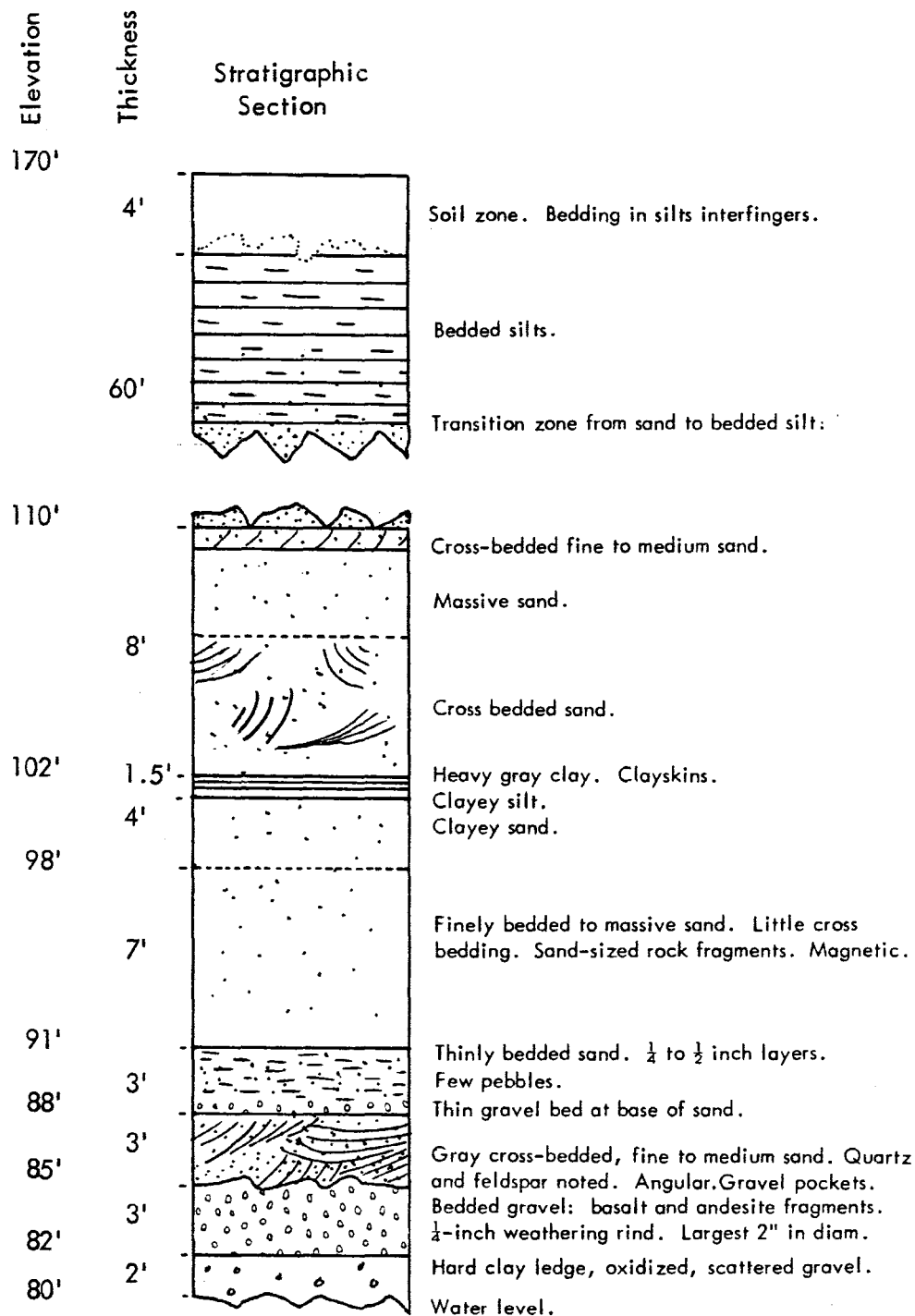


Figure 7. Stratigraphic section showing terrace stratigraphy at River Bend (sec. 1, T. 5 S., R. 4 W.) on the Willamette River.

valley margin between the Salem-Santiam fan deposits and the Molalla River deposits. In many respects, they are similar to the Molalla deposits, both in particle size and in composition. However, they are deficient in sand-sized matrix materials in comparison to other types of deposits in the study area.

The minor tributary stream deposits are the thinnest gravels in the lower Willamette Valley. Nowhere have they been found more than 20 feet thick and are usually 10 feet or less in thickness. Typical minor tributary stream deposits are shown in figure 6.

Labish lowland deposits: The diversion of the Willamette River from the Labish lowland course was accompanied by the deposition of a thick wedge of sand near the center reach of the abandoned channel. The damming of water above this sand deposit resulted in the formation of "Lake Labish", followed by the accumulation in the lake of a thick peat deposit (21 feet in the upper portion of the lowland). Downstream the sand deposit thins and is buried by younger fine-grained materials. Foundation excavations for the U.S.D.A. flood control project near Parkersville in the center portion of the Labish lowland (sec. 6, T. 6 S., R. 1 W.) revealed more than 18 feet of sand.

The sand in the center portion of the Labish lowland represents one of the two known relatively large pure sand deposits in the lower Willamette Valley. The significance of these deposits is in their potential use as a filler in conjunction with the gravels in the valley which lack desirable grading characteristics or in their exploitation when relatively pure sand-sized material is desired.

Terrace deposits: Terrace deposits are the most widespread but least exploited in the study area. This is attributed to their weathered character where they are near the surface, such as at Molalla, or to the depth of overburden, which may exceed 60 feet in the French Prairie area.

The typical terrace stratigraphic section (figure 7) begins at or near the present flood-plain level with a variable thickness of gravel which grades into a thick section of sand and then into silt. Most of the gravels are basaltic and andesitic in composition, although a higher percentage of acid volcanics is present than in previously discussed deposits. The gravels are moderately to well cemented, usually with a fine-grained (clay) matrix. Typical terrace sands may be seen near Pat's Acres, west of Canby, and at Aurora. The Aurora sand was investigated in the laboratory and found to consist of fine-grained rock fragments, feldspars, and quartz in that order of abundance. The heavy minerals are principally pyroxenes and amphi-

boles with minor amounts of magnetite, basaltic hornblende, garnet, sphene, and zircon.

Conclusions

On the basis of this reconnaissance survey of the sand and gravel deposits in the southern portion of the lower Willamette Valley, the following conclusions seem appropriate:

The Willamette flood-plain deposits are the most extensive. Their successful exploitation, however, is contingent upon recognition of the stratigraphic position of the pit site and of the limitations of each position. From this standpoint, channel-belt operations are the most promising, offering possible replenishment of the sand and gravel used. Flooding, however, may be a problem in this area. Both meander-belt and flood-basin deposits underlie a fine-grained overburden of varying thickness, and indurated layers may be encountered even within the upper production zone.

The Salem-Santiam fan deposits offer a potential source of sand and gravel to the Salem area for many years to come. Their production and exploitation offer few problems. The presence of an upper weathered zone of poorer quality material should be recognized.

Molalla River flood-plain gravels are the highest quality materials in the area studied. Production at depth is limited, and the grading characteristics are poorer than for other types of deposits.

Silver, Abiqua, and Butte Creek deposits as observed are thin and any exploitation for other than small local demands is limited.

The Labish lowland and terrace sand deposits offer a potential source of fine-grained material.

The economics of nonmetallic mineral resource production require that the deposits be close to the source of demand. Recognition of this fact is important if a continuing supply of sand and gravel in the lower Willamette Valley is to be insured. This is particularly true in or near metropolitan areas where conflicting interests often have resulted in the exclusion of sand and gravel operations from feasible areas. Adequate zoning is necessary for the protection of both civic interests and this important mineral resource.

References

- Schlicker, H. G., 1960, Gravel resources in relation to urban development in the Salem area. State of Oregon Department of Geology and Mineral Industries.
Trimble, D. E., 1957, Geologic map of the Portland, Oreg.-Wash. area. U.S.G.S., GQ 104.

* * * * *

OREGON MINING ASSOCIATIONS ELECT OFFICERS

The Eastern Oregon Mining and Minerals Association, at its February 14 meeting in Baker, reelected Calvin Suksdorf as chairman. Goff Smith, Ken Grabner, Lester Olson, and Cully J. Trickel were named to the board. Laurence Neault was elected treasurer and Jim Anderson was re-elected secretary. James Dickerson is the new vice-president.

The Northwestern Mining Council, Inc., with new headquarters at Jacksonville, held annual election February 1. Officers are as follows: Russell Mitchell, Medford, president; George Huffman, Talent, vice president; Dave Fraysher, Medford, treasurer; Irene Mitchell, Medford, secretary; W. H. Holloway, Medford, corresponding secretary; and Glenn Hall, Medford, George Brewer and Fred Adams, Jacksonville, and Cliff Green, Central Point, directors.

* * * * *

SEISMOLOGICAL OBSERVATORY NEAR BAKER

The Department of Defense announced March 14 that it will build a seismological observatory near Sparta, to be known as the Blue Mountain Seismological Observatory. It will be built and operated under management and supervision of the Air Force Technical Applications Center under the Vela-Uniform Program, which is concerned with the development of techniques and equipment to detect and identify underground nuclear weapons tests. Construction plans call for the completion of the observatory by summer. It will be situated on a 2,000-acre site about 25 miles east of Baker, where 21 seismometers will be located in water-tight vaults and covered by about 2 feet of earth. Ten will be arranged in a geometrical pattern to form an array. All will be monitored by associated amplification and recording equipment.

* * * * *

SMALL MINE BULLETIN AVAILABLE

The Idaho Bureau of Mines and Geology has issued an excellent publication, "Prospecting and Developing a Small Mine," which contains information useful to the prospector and small-mine operator. The bulletin was written by W. W. Staley, professor of mining engineering at the University of Idaho College of Mines and is available from the Bureau of Mines and Geology, Moscow, Idaho, for \$1.00 a copy.

* * * * *