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## Introduction

Communities along the Willamette River have attempted to control the movement of the river since the floods of 1860 and 1861. Large stone is placed in riprap, wing deflectors, and levees to redirect the flow of the river and to prevent banks from eroding. While such revetments make sense to property owners on the edge of the river because they protect land at a specific location, they are inconsistent with the natural tendency of a river to erode and deposit sediments. Channel meandering is a natural process by which a river dissipates its energy during floods. Channel straightening and hardening of banks tends to increase the energy of the river during floods and potentially creates accelerated erosion at other locations.

## Sources of Information

To identify the channel modifications that have occurred along the mainstem Willamette River, we digitized U.S. Army Corps of Engineer maps of structures on the Willamette River for 1850, 1895, 1932, and 1995. We worked with USACE to verify all channel modification projects from 1865 to 1995 on the GIS maps of the Willamette River. We then field surveyed all revetments and identified all non-Corps revetments. Total extent of revetment was determined from these GIS maps of Corps and non-Corps revetments.

## Extent of Revetments

In the Willamette River, more than 96 miles of revetments have been constructed (Fig. 46). Approximately half of the length of revetments were constructed by the U.S. Army Corps of Engineers and are managed by the Corps or by the Corps and sponsors of the projects (Fig. 43). Revetments downstream of Newberg are not operated or constructed by the Corps of Engineers. The Corps has constructed and maintains the majority of revetments in the middle reach of the river. Revetments in the upper river are a combination of Corps project and cooperative efforts between the Corps and sponsors. Most revetments built and/or sponsored by the Corps were constructed between 1938 and 1968.

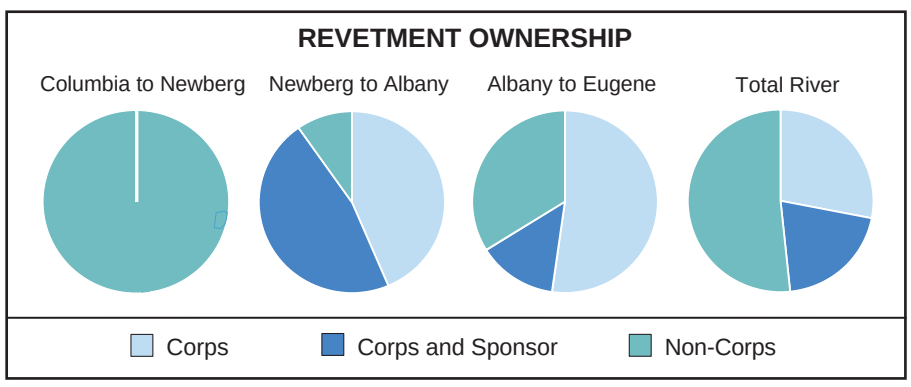


Figure 43. *Revetment ownership along the mainstem Willamette River in the different river reaches. The responsibility for maintenance varies, with the U.S. Army Corps of Engineers being largely responsible for those in the middle and upper portions. "Corps only" revetments are both built and maintained by USACE. "Corps and sponsor" structures are constructed by USACE, but maintained by a sponsor. "Non-corps" revetments are both built and maintained by an entity other than USACE. However, the Corps must issue permits for the construction of these revetments.*

| LENGTH OF REVETMENTS BY MAINTENANCE TYPE IN THE MAINSTEM WILLAMETTE RIVER | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Corps Only | | Corps & Sponsor | | Non-Corps | | Total | |
| Reach | km | miles | km | miles | km | miles | km | miles |
| Columbia to Newberg | 0.00 | 0.00 | 0.00 | 0.00 | 62.38 | 38.76 | 62.38 | 38.76 |
| Newberg to Albany | 18.44 | 11.46 | 4.95 | 3.08 | 11.94 | 7.42 | 35.33 | 21.95 |
| Albany to Eugene | 24.92 | 15.48 | 26.75 | 16.62 | 5.63 | 3.50 | 57.30 | 35.61 |
| **TOTAL RIVER** | 43.36 | 26.94 | 31.71 | 19.70 | 79.95 | 49.68 | 155.02 | 96.32 |

Table 11. *Length of revetments in the Willamette River.*

As a result of the attempts by agencies and communities to control the river, more than 25% of the length of river has revetments on one or both banks (Table 12). The lower river, near the Portland metropolitan area, is more heavily revetted, and the middle reach of the river contains the least channel control. Revetments in the lower river tend to be located adjacent to built or urban lands (Table 13).

Though almost three quarters of the length of the Willamette River has no riprap or bank revetment on either bank, the degree of channel control is

| PERCENT OF RIVER LENGTH | | | |
|---|---|---|---|
| Reach | Unrevetted | One Side | Both Sides |
| Columbia to Newberg | 54.2 | 10.2 | 35.6 |
| Newberg to Albany | 85.4 | 13.5 | 1.1 |
| Albany to Eugene | 76.3 | 19.0 | 4.7 |
| **TOTAL RIVER** | 73.5 | 14.5 | 12.0 |

Table 12. *Percent of bank length revetted in the Willamette River. A given length of the mainstem river can have revetments on both sides, one side only, or no revetments at all.*

| REVETMENTS AND LAND USE | | | | | |
|---|---|---|---|---|---|
| | Number of Revetments Adjacent to: | | | | |
| Reach | Bare | Forest | Ag | Built | Total |
| Columbia to Newberg | 7 | 31 | 11 | 89 | 138 |
| Newberg to Albany | 4 | 39 | 44 | 30 | 117 |
| Albany to Eugene | 3 | 16 | 69 | 25 | 113 |
| **TOTAL RIVER** | 14 | 86 | 124 | 144 | 368 |

Table 13. *Number of revetments in three main reaches of the Willamette River, and the features they are designed to protect.*

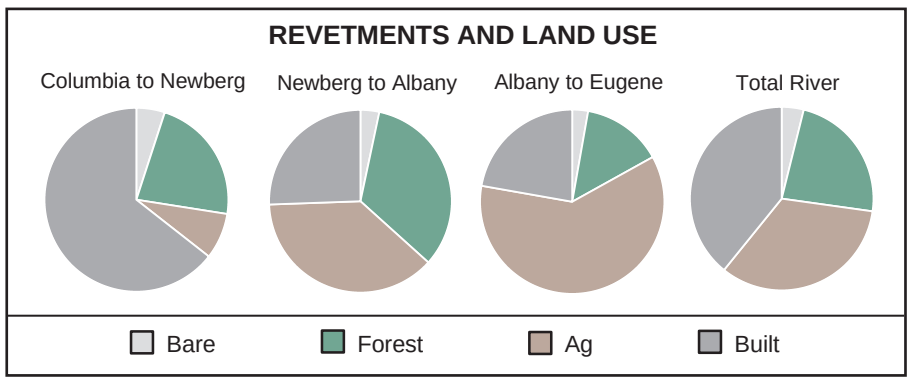


Figure 44. *Land use adjacent to revetments along the mainstem Willamette River. The "built" category refers to both municipal and rural residential land uses. "Forest" refers to occurrence of tree cover and not necessarily commercial industrial forest land use.*

far greater than this statistic may imply. Changes in river channels occur at meander bends and side channels. Even though only 26% of the length has bank revetments, 65% of the meander bends are revetted. The majority of the dynamic sections of the river have been armored to eliminate or reduce change in channel form and position. This diminished ability of the channel to adjust its bed and sediment storage coupled with the active elimination of side channels has greatly simplified the river and diminished the complexity and abundance of aquatic habitats.

Revetments in the middle reach are located in urban, agricultural, and forest lands to roughly equal extents (Fig. 44). Most of the revetments in the upper river are located adjacent to farm lands and were constructed to prevent loss of agricultural lands. The potential for social pressure to continue channel control projects is high, especially in view of the projected increase of the human population over the next 50 years in the Willamette Basin. Almost three billion dollars has been spent in channel alteration and dam operation in the Willamette Basin since 1860 (Fig. 45). Costs for additional control and flow modification should be evaluated relative to the degree of protection possible and the potential loss of habitat, aquatic and terrestrial communities, and floodplain function.

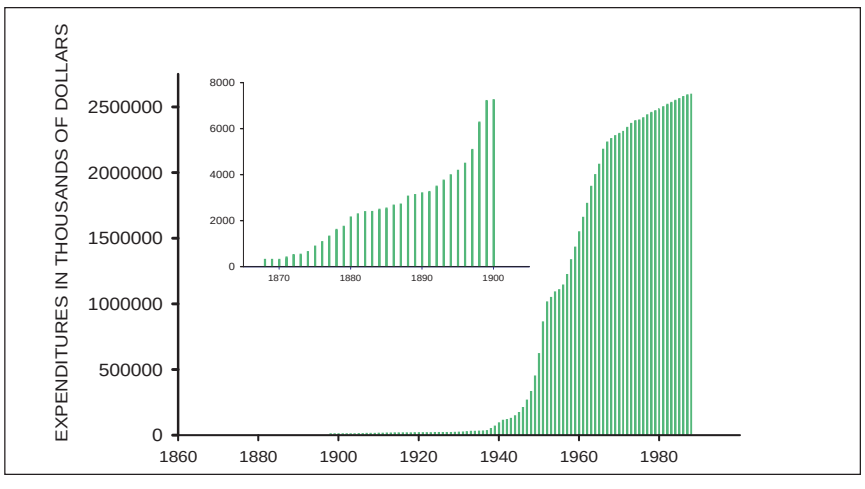


Figure 45. *Cumulative dollars spent by USACE on modifications to the Willamette River and its tributaries. Amounts are expressed in 1995 dollars (adjusted for inflation). The sharp increase in the 1950s reflects the cost of construction and maintenance of the major flood control dams on Willamette tributaries, as well as costs for revetments and other bank protection measures.*

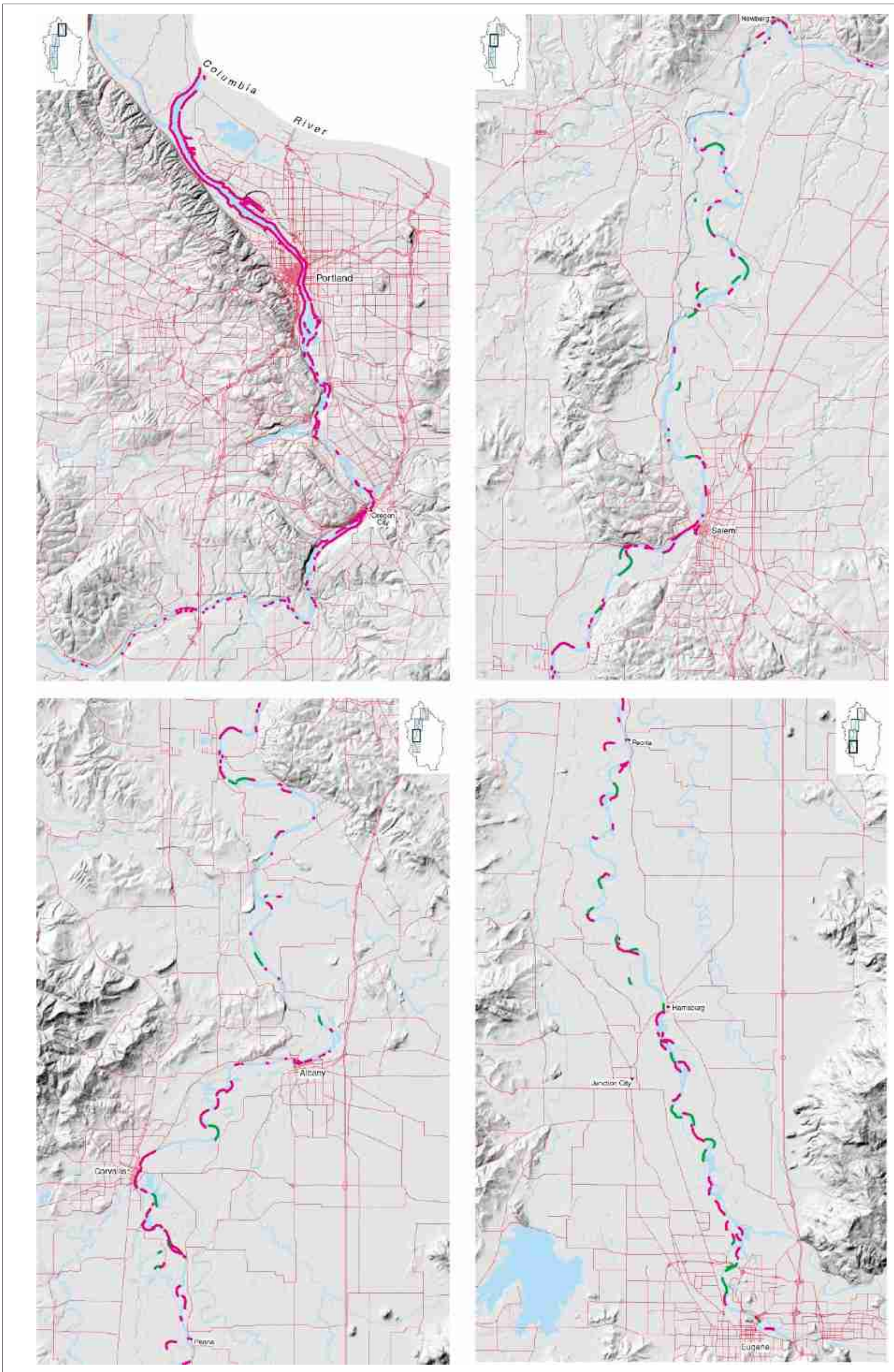


Figure 46. *Location of built structures in the mainstem Willamette River. These structures are revetments, wing dams, docks or pilings, which may be constructed of rock, wood, concrete, metal, earth or some combination of these materials. Note that most revetments are located at the bends of the river.*