



Assessment of the Effects of Conservation Practices on Cultivated Cropland in the Pacific Northwest Basin - Summary of Findings

National Resources Conservation Service
Conservation Effects Assessment Project

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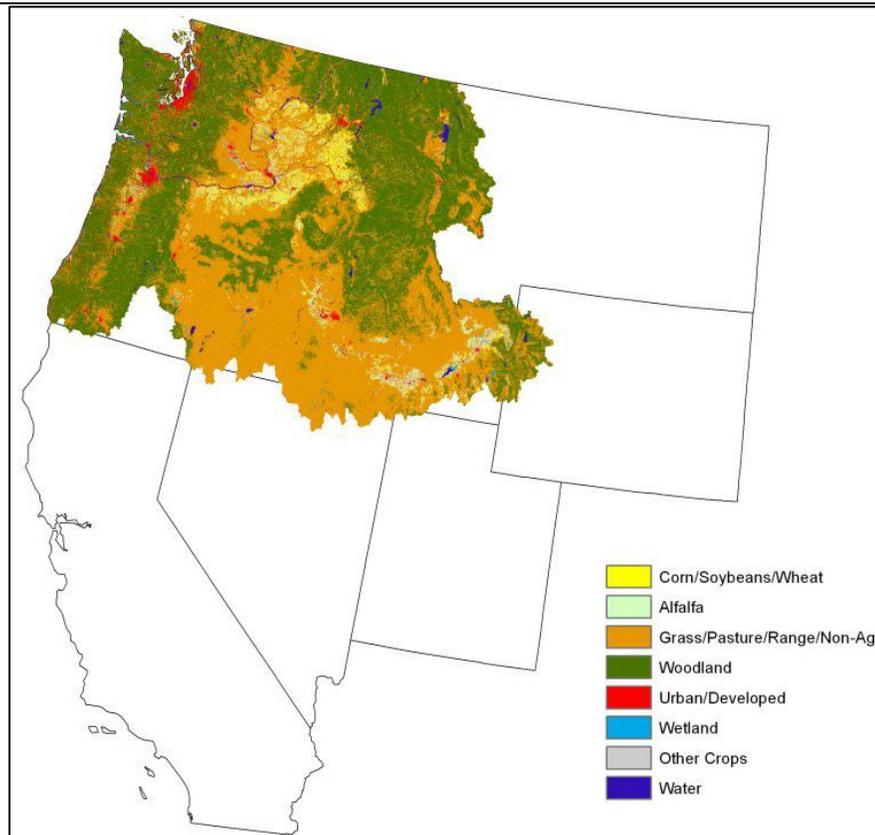
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The U.S. Department of Agriculture’s Conservation Effects Assessment Project (CEAP) has undertaken a series of studies designed to quantify the effects of conservation practices on cultivated cropland in the conterminous 48 States. The eighth study in this series is on the Pacific Northwest Basin.

The Pacific Northwest Basin drains some 277,000 square miles (178 million acres) in the northwestern United States into the Pacific Ocean. It includes all of Washington, most of Oregon and Idaho, part of western Montana, and small parts of California, Nevada, Utah, and Wyoming (fig. 1).

Only about 9 percent of the region is cultivated cropland. The main crops are wheat and other small grains, hay, potatoes, barley, and sugar beets. The region produced nearly half of the U.S. potato crop and about one-quarter of the barley crop in 2007. The landscape is dominated by range and forest lands.

Figure 1. Location of and land cover in the Pacific Northwest Basin

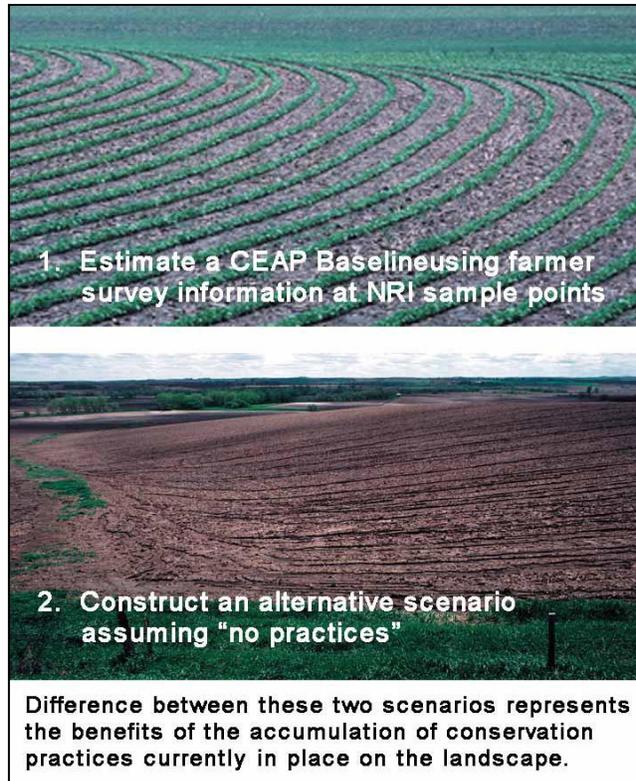


SOURCE: TEXAS AGRILIFE RESEARCH, TEXAS A&M UNIVERSITY (USDA-NASS DATA)

To view or download a PDF version of the full report, visit the NRCS Web site, <http://www.nrcs.usda.gov>, and follow links to Technical Resources / Natural Resources Assessment / CEAP

Study Methodology

The assessment uses a statistical sampling and modeling approach to estimate the effects of conservation practices. The National Resources Inventory (NRI), a statistical survey of conditions and trends in soil, water, and related resources on U.S. non-Federal land conducted by USDA's Natural Resources Conservation Service, provides the statistical framework for the study. Physical process simulation models were used to estimate the effects of conservation practices that were in use during the period 2003 to 2006. Information on farming activities and conservation practices was obtained primarily from a farmer survey conducted as part of the study. The assessment includes not only practices associated with Federal conservation programs but also the conservation efforts of States, independent organizations, and individual landowners and farm operators. The analysis assumes that structural practices (such as buffers, terraces, and grassed waterways) reported in the farmer survey or obtained from other data sources were appropriately designed, installed, and maintained.



The national sample for the farmer survey consists of 18,700 sample points with 918 of these sample points located in the Pacific Northwest Basin. This sample size is sufficient for reliable and defensible reporting at the regional scale and for large watersheds within the region, but is generally insufficient for assessments of smaller areas.

The modeling strategy for estimating the effects of conservation practices consists of two model scenarios that are produced for each sample point.

1. A baseline scenario, the "baseline conservation condition" scenario, provides model simulations that account for cropping patterns, farming activities and conservation practices as reported in the NRI-CEAP Cropland Survey (2003–06) and other sources.
2. An alternative scenario, the "no-practice" scenario, simulates model results as if no conservation practices were in use but holds all other model inputs and parameters the same as in the baseline conservation condition scenario.

The effects of conservation practices are obtained by taking the difference in model results between the two scenarios. The need for additional conservation treatment was evaluated using a common set of criteria and protocols applied to all regions in the country to provide a systematic, consistent, and comparable assessment at the national level.

Study Findings

The findings summarized below represent the baseline conservation condition, using conservation practices reported in the 2003–06 NRI-CEAP Cropland Survey.

Voluntary, Incentives-Based Conservation Approaches Are Achieving Results

Farmers have reduced sediment, nutrient, and pesticide losses from farm fields through conservation practice adoption throughout the Pacific Northwest Basin, compared to losses that would be expected if no conservation practices were in use. Structural practices for controlling water erosion are in place on 33 percent of all cropped acres in the region, including 40 percent of highly erodible land. Fifty-nine percent of cropped acres meet criteria for mulch till, and 21 percent meet criteria for no-till. Ninety-two percent of cropped acres have structural or tillage and residue management practices, or both. Farmers meet criteria for good nitrogen management—appropriate rate, timing, and method of application—on 44 percent of the cropped acres and good phosphorus management on 43 percent.

Conservation practice adoption—whether through Federal or State programs or through landowners’ initiative—has reduced edge-of-field sediment and nutrient losses and sediment and nutrient loads delivered to rivers and streams from cropland and to the Pacific Ocean from all sources, as shown in table 1.

Table 1. Reductions in edge-of-field sediment and nutrient loss from cropped acres, reductions in sediment and nutrient loadings delivered to rivers and streams from cropland sources, and reductions in sediment and nutrient instream loadings from all sources to the Pacific Ocean, Pacific Northwest Basin

Reduction	Sediment loss		Nitrogen loss		Total phosphorus loss	
	Windborne	Waterborne	Windborne	With runoff		
	----- Percent reduction -----					
Edge-of-field	25	37	23	40	48	46*
To rivers and streams from cropland		53		57		60
To Pacific Ocean from all sources		5		16		8

* Phosphorus lost to surface water, which includes sediment-attached and soluble phosphorus. Soluble phosphorus includes not only phosphorus in runoff but also leaching to loss pathways such as tile drains and natural seeps. Much of this lost phosphorus eventually returns to surface water.

NOTE: Not all edge-of-field losses of sediment and nutrients reach rivers and streams. Some are captured by buffers, wetlands, or other nonagricultural lands. Reductions in loadings to the Pacific Ocean are smaller because conservation practices affect only the cultivated cropland share of total instream load.

Opportunities Exist to Further Reduce Soil Erosion and Nutrient Losses from Cultivated Cropland

Despite the obvious progress, further reductions are possible. The need for additional conservation treatment in the region was determined by imbalances between the level of conservation practice use and the level of inherent soil vulnerability. Three levels of treatment need were estimated:

- **A high level of need** for conservation treatment exists where the loss of sediment and/or nutrients is greatest and where additional conservation treatment can provide the greatest reduction in agricultural pollutant loadings. *Some 390,000 acres—only 3 percent of the cropped acres in the region—have a high level of need for additional conservation treatment.*
- **A moderate level of need** for conservation treatment exists where the loss of sediment and/or nutrients is not as great and where additional conservation treatment has less potential for reducing agricultural pollutant loadings. *Approximately 8.2 million acres—70 percent of the cropped acres in the region—have a moderate level of need for additional conservation treatment.*

- **A low level of need** for conservation treatment exists where the existing level of conservation treatment is adequate compared to the level of inherent soil vulnerability. *Approximately 3 million acres—27 percent of the cropped acres in the region—have a low level of need for additional conservation treatment.*

There is no single most critical conservation concern in this region. Most cultivated cropland needs additional treatment to reduce sediment *and* nutrient losses. Of the 8.6 million acres having a high or moderate level of need for additional treatment, significant further reductions in sediment and nutrient loss from baseline levels could be achieved through implementation of suites of conservation practices that include *both* erosion-control practices and nutrient management. Table 2 shows potential for further reductions (beyond 2003–06 baseline levels) in *edge-of-field* sediment, nitrogen, and phosphorus losses.

Table 2. Potential further reductions in edge-of-field sediment and nutrient loss from high- and moderate-treatment-need cropped acres, in sediment and nutrient loadings to rivers and streams delivered from cropland sources, and in sediment and nutrient instream loadings to the Pacific Ocean from all sources, Pacific Northwest Basin

Reduction	Sediment loss		Nitrogen loss		Through leaching	Total phosphorus loss
	Windborne	Waterborne	Windborne	With runoff		
----- Percent reduction -----						
Edge-of-field	24	85	22	59	49	59*
To rivers and streams from cropland	73			47		41
To Pacific Ocean from all sources	2			5		3

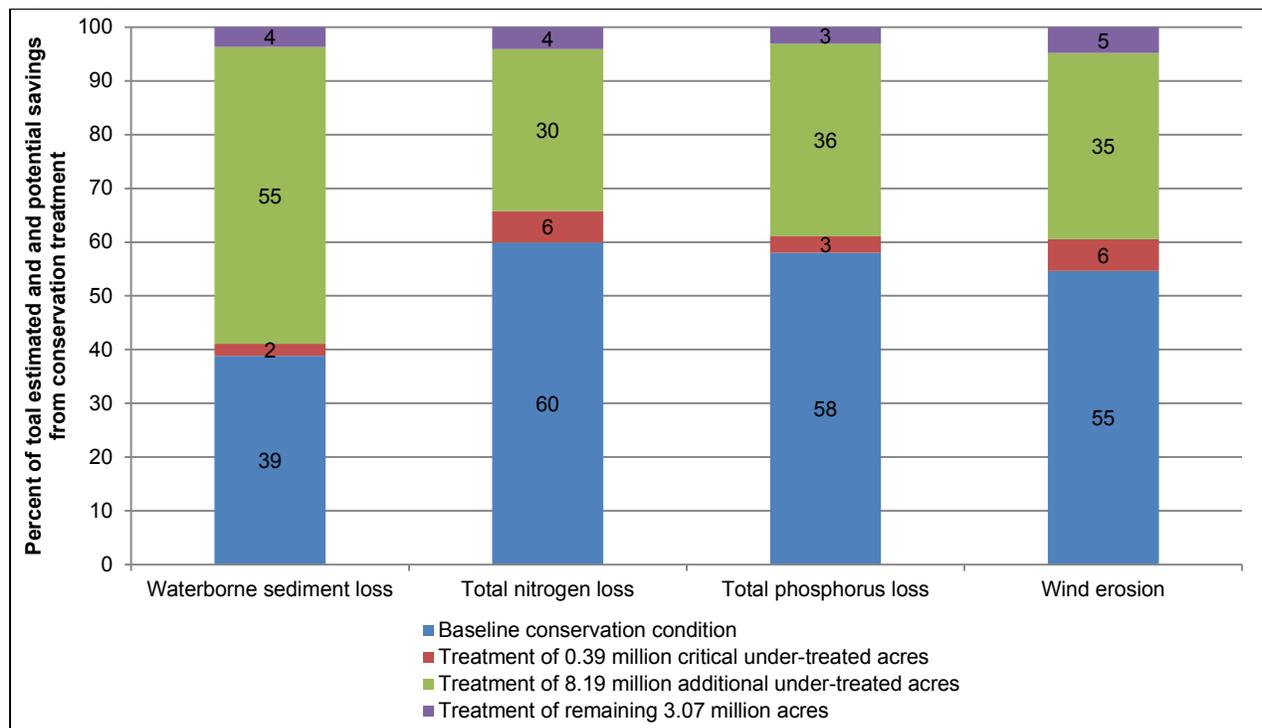
* Phosphorus lost to surface water, which includes sediment-attached and soluble phosphorus. Soluble phosphorus includes not only phosphorus in runoff but also leaching to loss pathways such as tile drains and natural seeps. Much of this lost phosphorus eventually returns to surface water.

Comparing the reductions already achieved (displayed in table 1) with potential reductions through application of comprehensive conservation treatment (table 2) show that there are significant opportunities for additional gains.

Comprehensive Conservation Planning is Needed, and Targeting Enhances Effectiveness and Efficiency

The edge-of-field reductions in sediment and nutrient loss shown in table 1 represent average annual declines in sediment and nutrient loss resulting from conservation practices in use during the period 2003 to 2006, when compared to the no-practice scenario. As a share of potential savings (total tons saved) through full conservation treatment on all cropped acres, these reductions represent about 39 percent of potential reductions in sediment loss with runoff, 60 percent of potential reductions in nitrogen loss, 58 percent of potential reductions in phosphorus loss, and 55 percent of potential reductions in windborne sediment loss (fig. 2). Targeting critical acres does not significantly improve the effectiveness of conservation practice implementation in this region because of the small number of acres with a high need for additional treatment. Significant additional per-acre reductions in sediment and nutrient losses could be achieved by focusing on the 8.6 million high- *and* moderate-treatment-need cropland acres. Use of additional erosion- and nutrient-control practices on acres that have a high need for additional treatment—acres most prone to runoff or leaching and with low levels of conservation practice use—can reduce most edge-of-field losses by about twice as much or more compared to treatment of acres with a moderate level of need. Treating the 27 percent of cropped acres that have a low level of need for additional conservation treatment would achieve little additional benefit.

Figure 2. Comparison of estimated edge-of-field savings for the region (total tons saved) due to practices in use in 2003-06 and potential savings with additional water erosion control and nutrient management treatment of cropped acres in the Pacific Northwest Basin



Conservation Practice Effects on Water Quality

Reductions in field-level losses due to conservation practices, including land in long-term conserving cover, are expected to improve water quality in streams and rivers in the region. Figures 3, 4, and 5 summarize the extent to which conservation practices on cultivated cropland acres have reduced sediment, nitrogen, and phosphorus loads in the Pacific Northwest Basin, on the basis of the model simulations. On all three figures—

- “no-practice scenario” refers to conditions that would be expected if no conservation practices were in use;
- “baseline conservation condition” refers to estimates of conditions based on farming and conservation practices in use during the period 2003–06;
- “all under-treated acres” refers to land with high and moderate levels of conservation treatment need, as defined on page 3; and
- “background” refers to expected levels of sediment and nutrient loadings if no acres were cultivated in the region. Estimates of background loadings simulate a grass and tree mix cover without any tillage or addition of nutrients or pesticides for all cultivated cropland acres in the watershed. Background loads also include loads from all other land uses—hayland, pastureland, rangeland, horticultural land, forest land, and urban land—and point sources.

The effects of practices in use during the period 2003 to 2006 are determined by contrasting loads for the baseline conservation condition to loads for the no-practice scenario. The effects of additional conservation treatment on loads are determined by contrasting the loads for the baseline condition to loads for treatment of cropped acres with a *high* or *moderate* level of treatment need (8.6 million acres).

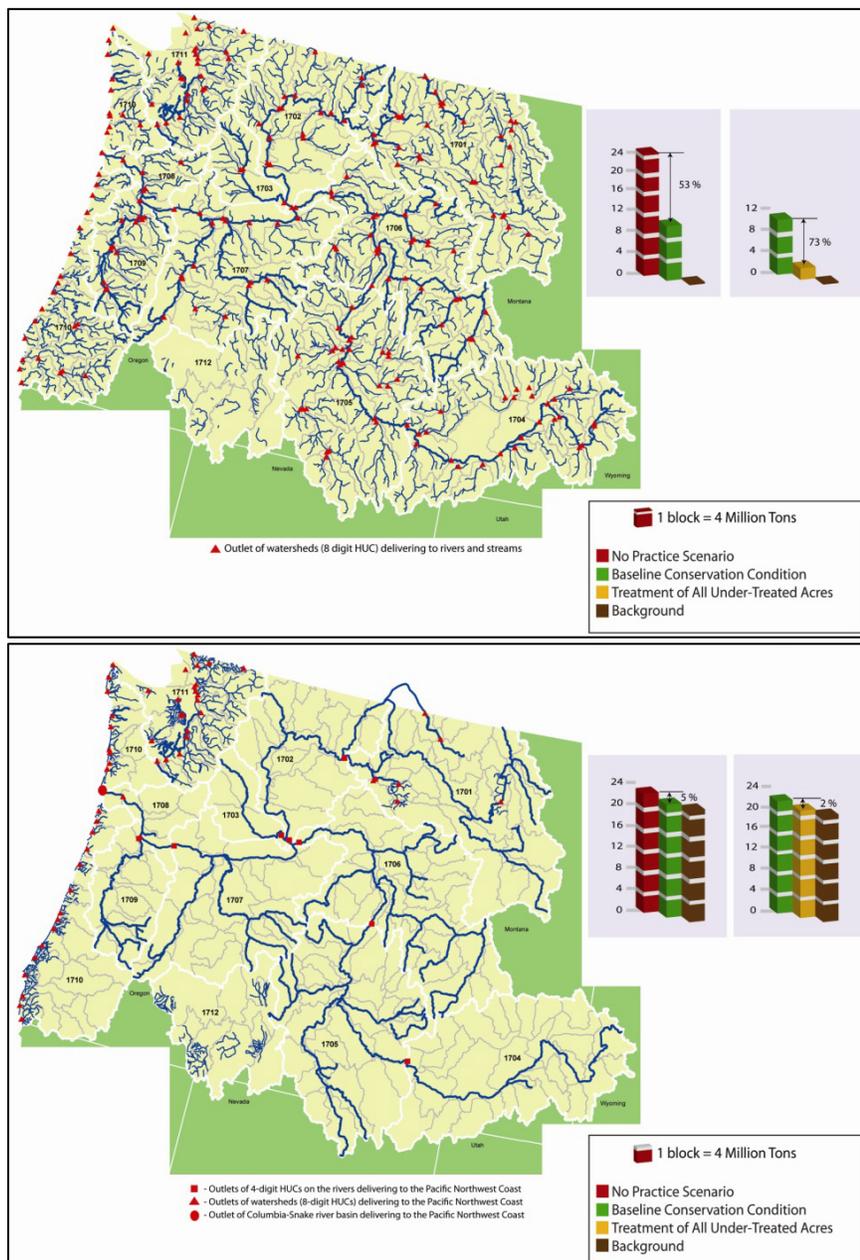
The impact of conservation treatment on cultivated cropland with respect to reduced loadings to rivers and streams and ultimately to the Pacific Ocean is limited because cultivated cropland makes up only about 9 percent of the area of this region. Other sources—forest land, pasture and range lands, and urban land—contribute significant amounts of sediment and nutrients to rivers and streams in the region.

Sediment Loss

The top map in figure 3 shows that the use of conservation practices has reduced **sediment loads delivered from cropland to rivers and streams** in the region by 53 percent from conditions that would be expected without conservation practices. Application of additional conservation practices on the high- and moderate-treatment-need acres would further reduce sediment loads to rivers and streams by 73 percent from baseline levels.

The bottom map shows that the use of conservation practices on cropland has reduced **sediment loads delivered from all sources to the Pacific Ocean** by 5 percent from conditions that would be expected without conservation practices. Application of additional conservation practices on the high- and moderate-treatment-need acres would further reduce sediment loads to the Pacific Ocean by 2 percent below baseline levels.

Figure 3. Summary of the effects of conservation practices on sediment loads delivered to rivers and streams from cultivated cropland in the Pacific Northwest Basin (top) and instream loads delivered to the Pacific Ocean from all sources (bottom), and potential for further reductions with application of additional conservation treatment on high- and moderate-treatment-need cropland

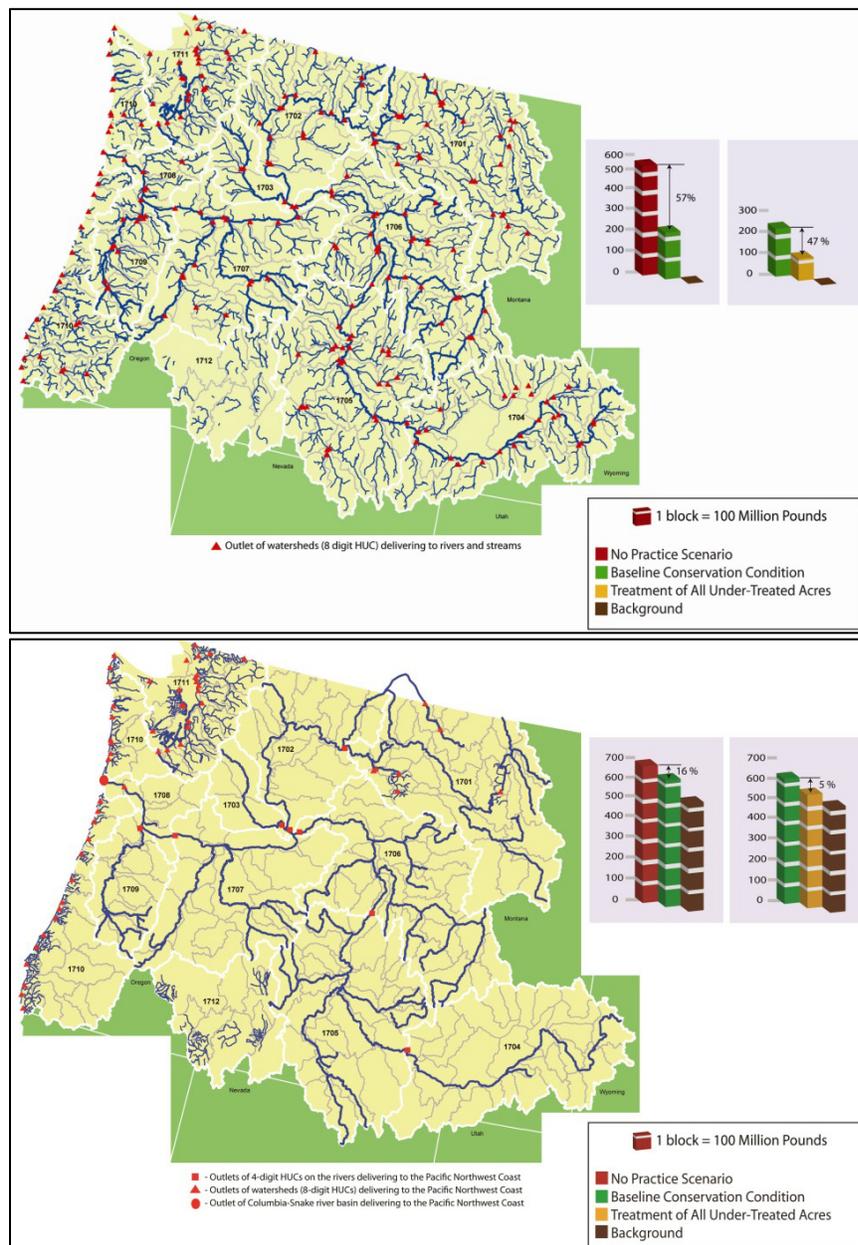


Nitrogen Loss

The top map in figure 4 shows that the use of conservation practices has reduced **total nitrogen loads delivered from cropland to rivers and streams** in the region by 57 percent from conditions that would be expected without conservation practices. Application of additional conservation practices on the high- and moderate-treatment-need acres would further reduce nitrogen loads to rivers and streams by 47 percent from baseline levels

The bottom map shows that the use of conservation practices on cropland has reduced **nitrogen loads delivered from all sources to the Pacific Ocean** by 16 percent from conditions that would be expected without conservation practices. Application of additional conservation practices on the high- and moderate-treatment-need acres would further reduce nitrogen loads to the Pacific Ocean by 5 percent below baseline levels.

Figure 4. Summary of the effects of conservation practices on nitrogen loads delivered to rivers and streams *from cultivated cropland* in the Pacific Northwest Basin (top) and instream loads delivered to the Pacific Ocean *from all sources* (bottom), and potential for further reductions with application of additional conservation treatment on high- and moderate-treatment-need cropland

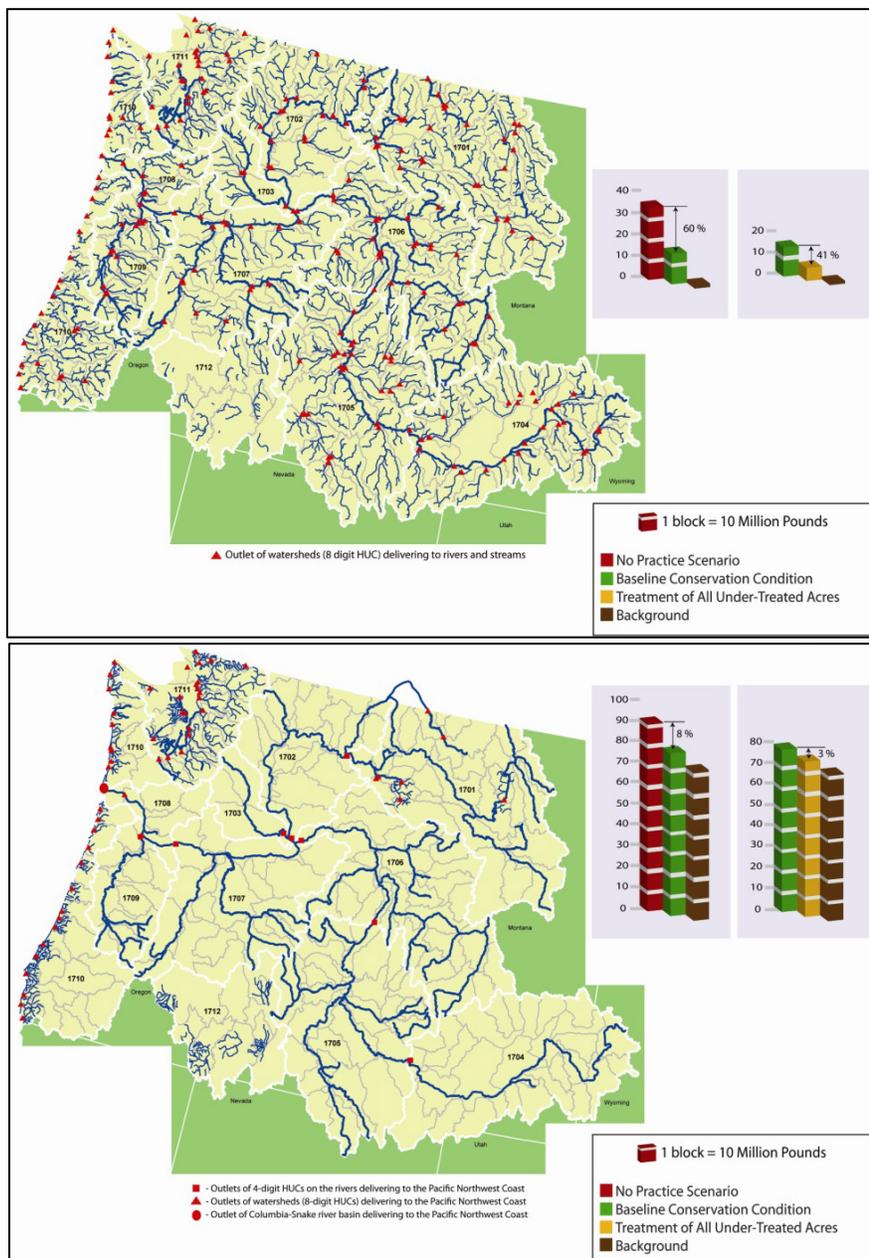


Phosphorus Loss

The top map in figure 5 shows that the use of conservation practices has reduced **total phosphorus loads delivered from cropland to rivers and streams** in the region by 60 percent from conditions that would be expected without conservation practices. Application of additional conservation practices on the high- and moderate-treatment-need acres would further reduce nitrogen loads to rivers and streams by 41 percent from baseline levels

The bottom map shows that the use of conservation practices on cropland has reduced **phosphorus loads delivered from all sources to the Pacific Ocean** by 8 percent from conditions that would be expected without conservation practices. Application of additional conservation practices on the high- and moderate-treatment-need acres would further reduce nitrogen loads to the Pacific Ocean by 3 percent below baseline levels.

Figure 5. Summary of the effects of conservation practices on phosphorus loads delivered to rivers and streams from cultivated cropland in the Pacific Northwest Basin (top) and instream loads delivered to the Pacific Ocean from all sources (bottom), and potential for further reductions with application of additional conservation treatment on high- and moderate-treatment-need cropland



Regional Comparisons

- The Pacific Northwest Basin is larger than all other water resource regions of the United States except for the Missouri River Basin and is about the same size as the South Atlantic Gulf Basin.
- Cultivated cropland makes up only 9 percent of the area of the Pacific Northwest Basin. This is similar to the extent of cropland in the South Atlantic Gulf Basin and the Chesapeake Bay Region but considerably less than in most other regions. For example, cultivated cropland makes up more than half the area of the Upper Mississippi River Basin and at least 20 percent in the other basins in the Mississippi River drainage area.
- The percentage of cultivated cropland with some combination of structural practices for reducing soil erosion and reduced tillage practices is consistent with that in most other regions of the nation. Likewise, the percentage of cropland where good nutrient management practices are in use to reduce field-level losses of nitrogen and phosphorus is similar to that in other regions.
- Estimated reductions in sediment loss due to conservation practice use are lower in the Pacific Northwest Basin than in most other regions. This is true for both wind erosion and water erosion losses. Reductions in nutrient losses, however, are similar to such reductions in most other regions, except that reductions in nitrogen leaching tend to be higher in the Pacific Northwest.
- We estimate that only 3 percent of the cultivated cropland in the Pacific Northwest Basin has high need for additional conservation treatment. The percentage of high-treatment-need cropland is lower only in the Missouri River Basin (1 percent) and the Souris-Red-Rainy Basin (0 percent). Conversely, 33 percent of cultivated cropland in the Lower Mississippi River Basin, 51 percent in the South Atlantic Gulf Basin, and 24 percent in the Ohio-Tennessee River Basin have a high level of treatment need.
- In contrast to the other regions studied, the Pacific Northwest Basin has no single most critical conservation need. Conservation treatments are needed to reduce soil erosion by water and wind as well as nutrient losses through surface and subsurface pathways. In the Great Plains, the principal conservation concern is wind erosion. In the East, Mideast, and South, the principal concern is the loss of nutrients with runoff or through leaching.

River Basin Cropland Modeling Study Reports The U.S. Department of Agriculture initiated the Conservation Effects Assessment Project (CEAP) in 2003 to determine the effects and effectiveness of soil and water conservation practices on agricultural lands. The CEAP report *Assessment of the Effects of Conservation Practices on Cultivated Cropland in the Lower Mississippi River Basin* is the sixth in a series of studies covering the major river basins and water resource regions of the conterminous 48 United States. It was designed to quantify the effects of conservation practices commonly used on cultivated cropland in the Pacific Northwest Basin, evaluate the need for additional conservation treatment in the region, and estimate the potential gains that could be attained with additional conservation treatment. This series is a cooperative effort among USDA's Natural Resources Conservation Service and Agricultural Research Service, Texas AgriLife Research of Texas A&M University, and the University of Massachusetts.

Upper Mississippi River Basin (draft released June 2010, revision completed July 2012)

Chesapeake Bay Region (released March 2011)

Great Lakes Region (released September 2011)

Ohio-Tennessee River Basin (released February 2012)

Missouri River Basin (released August 2012)

Arkansas-White-Red River Basin (April 2013)

Lower Mississippi River Basin (August 2013)

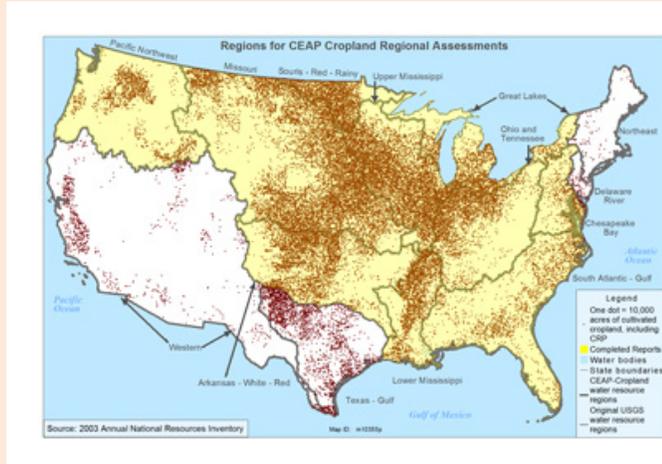
Pacific Northwest Basin (June 2014)

South Atlantic-Gulf Basin (June 2014)

Texas Gulf Water Resource Region

Souris-Red-Rainy Basin

Delaware River Basin



The Northeast and Western Water Resource Regions cannot be completed because there are too few National Resources Inventory sample points for reliable statistical estimation.



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