



NDSU-North Dakota Forest Service

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Flood Damage Tree and Shrub Assessment Souris Valley Golf Course - Minot, North Dakota



Executive Summary

Flood waters from the Mouse River inundated the Souris Valley Golf Course during 2011, breaking a more than 130-year record for high water. The Minot Park District requested assistance from the State Forester's office to conduct an assessment of the trees and shrubs that were affected by the flooding. This report contains the results of the assessment, options for wood utilization, recommendations for reforestation and cost estimates for removal and replacement of plant materials.

The Souris Valley Golf Course is located on the western edge of Minot, North Dakota, and adjacent to the Mouse River. This publically owned golf course is managed by the Minot Park District.

A visual inspection conducted by the North Dakota Forest Service indicates 190 trees and shrubs were killed or severely damaged by the 2011 flood. The majority of the trees destroyed included Colorado blue spruce, ponderosa pine and green ash. The total estimated removal and replacement cost for the 190 trees and shrubs is \$97,250.

Introduction

The purpose of the assessment is to assist the Minot Park District in determining the approximate number of trees and shrubs that were lost due to flooding within the Souris Valley Golf Course. The information will aid the park district in determining the cost of removal and replacement of the plant material.

The Souris Valley Golf Course is located along the Mouse River on the western edge of Minot, North Dakota. Flooding within the City of Minot began on June 22, 2011, and the water did not recede until 21 days later on July 14. The flood broke a more than 130-year record for high water. The flood waters severely damaged trees and shrubs, and other green infrastructure, within the golf course.

A visual inspection was conducted by North Dakota Forest Service personnel to determine the number, species and sizes of trees and shrubs damaged or destroyed by the flood. The field inspection and data collection was conducted from September 8-10, 2011.

What was Found

The assessment evaluated the effects of flooding on 264 trees and shrubs within the Souris Valley Golf Course. A total of 190 trees and shrubs were severely damaged by the 2011 flood. Dead or dying plant materials with more than 50 percent of the canopy killed by flood waters were recommended for removal.

The flood waters negatively impacted trees and shrubs by filling the pore spaces in the soil, displacing air. Roots need oxygen for growth, respiration, and absorption of water and nutrients. Roots begin to decline within seven days of flooding. The longer the duration of the flooding, the more damage there will be to the root system.

Young trees within the Souris Valley Golf Course that were submerged by the flood waters were unable to survive. Trees that had part of the canopy above water will likely survive. However, the foliage that was covered by flood waters was severely damaged and in most instances killed. Trees that had more than 50 percent of their canopy killed may no longer be aesthetically appealing and will need to be removed. The ability of these trees to survive is also compromised by the decreased foliage. These trees may continue to decline and may eventually die due to the flood damage.

The following Extension Extra publication #6025 titled “Flood Damaged Trees” by Dr. John Ball, South Dakota State University Extension Forestry Specialist, states:

“Late spring and early summer flooding is the most harmful to trees, as they are the times when roots are actively growing. Standing in water, or even saturated soils, is harmful to all trees at this time of year. Flooding in late winter, while the tree is dormant, is the least harmful. Duration, depth, and water temperature and movement are all key factors in determining the impact of flooding on trees. The longer the water remains during the growing season, the greater the impact. If the flood-water recedes within a week, most trees will recover. If the waters remain for a month or two, many trees

will begin to decline and may die. The depth is also an important factor. Water on the trunks is considerably more harmful than water just covering the roots, so a good rule of thumb is the higher the water the greater the injury. Lastly, the water temperature and movement have an influence on the amount of oxygen carried in the water. The warmer the water and the less movement, the lower the oxygen level and the more potential for injury. Simply put, if the floodwaters become stagnant and remain for several weeks or more, covering the lower 2 or 3 feet of the tree's trunk, most likely the tree will decline and die, though this may take a year or more to occur."

The following July 1994 report by Dr. Kim Coder, University of Georgia, titled "Flood Damage to Trees," states:

"Tree root response to flooding is a reduction of root initiation and growth. Within seven days, there is noticeable root growth loss. Flooding causes a loss of extent, reach and health of the roots. Over time, decline, death and decay are the results. In other words, the longer an area is flooded, the more damage you can expect to the root system. Trees stand erect against most wind and flood conditions on the basis of tree weight, stiffness of the main trunk, width of the base, amount of fluid dynamics drag, fluid velocity and fluid mass. In air, the tree tends to sway back and forth as it is loaded and unloaded. The period of the sway is set by the mechanical properties of the tree. The swaying can loosen tree roots from the soil and lead to toppling under light winds in saturated soils."

The following images represent the tree and shrub flood damage found within the Souris Valley Golf Course.



The left image shows a linden tree that was killed by the flood waters. The right image shows spruce trees that were partially covered by water and unable to survive the flood.



The ponderosa pines on the left were completely covered by water and did not survive. The image on the right show a Colorado spruce which died and three ponderosa pines where more than half of their foliage died. These trees, if they survive, will not be aesthetically pleasing and should be removed.



These three Colorado spruce were standing in deeper water and two-thirds of the canopy were killed. These trees should be removed.

The image to the right shows where the water level was, and all branches on the evergreens below the water line are dead. The amount of damage was more severe on smaller trees.





The branches of this green ash (left image) that were submerged under the flood waters should be pruned off. The damage was minor and the tree will recover. The ponderosa pine (right image) also had lower branches that were killed by the flood waters. These branches should be pruned off and the trees will still be aesthetically pleasing.



There were a few trees that were washed out or floated in to the golf course like these trees, which came to rest next to a standing tree.

Diversity

The assessed golf course tree population is dominated by conifers, including Colorado spruce - 51 percent and ponderosa pine - 18 percent. The remaining trees are mostly deciduous species including green ash - 10 percent and boxelder - 6 percent. There is a need to increase the number of species located on the golf course. Increasing species diversity will help insure that if an invasive insect or disease were to be introduced into the park, not all the trees would be affected by the insect or disease.

Recommended species that have varying degrees of tolerance to flooding are: boxelder - *Acer negundo*; Manchurian Alder Prairie Horizon - *Alnus hirsuta* 'Harbin'; Northern Tribute™ River Birch - *Betula nigra* 'Dickinson'; hackberry - *Celtis occidentalis*; thornless honeylocust - *Gleditsia triacanthos var. inermis*; American hophornbeam - *Ostrya virginiana*; bur oak -

Quercus macrocarpa; laurel leaf willow - *Salix pentandra* and other willow species; and Prairie Expedition American elm - *Ulmus americana* ‘Lewis & Clark’.

Assessment Numbers

Table #1 indicates 190 trees and shrubs were destroyed by flooding in the Souris Valley Golf Course and are recommended for removal.

Table #1: Trees and Shrubs Destroyed in Souris Valley Golf Course

Tree species	Number
American linden, <i>Tilia americana</i>	2
Black Hills spruce, <i>Picea glauca var. densata</i>	3
boxelder, <i>Acer negundo</i>	11
Colorado spruce, <i>Picea pungens</i>	97
common lilac, <i>Syringa vulgaris</i> (shrub)	4
dogwood, <i>Cornus spp.</i> (shrub)	1
green ash, <i>Fraxinus pennsylvanica</i>	20
little leaf linden, <i>Tilia cordata</i>	3
ponderosa pine, <i>Pinus ponderosa</i>	34
poplar, <i>Populus spp.</i>	2
Russian olive, <i>Elaeagnus angustifolia</i>	7
Scotch pine, <i>Pinus sylvestris</i>	1
Siberian elm, <i>Ulmus siberica</i>	1
silver maple, <i>Acer saccharinum</i>	2
willow, <i>Salix spp</i>	2
Total	190

Table #2 estimates the cost to purchase and replant 2-inch caliper trees and container shrubs that were destroyed by flooding will be \$79,900.

Table #2: Replanting Costs

Plant Material	Number	Tree Stock \$300 average cost per tree 2" caliper B&B	Planting and Staking \$130 average cost per tree	Total Replacement Costs
Trees	185	\$55,500	\$24,050	\$79,550
		Shrub Stock \$45 average cost per shrub (5 gal. container)	Planting \$25 average cost per shrub	
Shrubs	5	\$225	\$125	\$350
	190	\$55,725	\$24,175	\$79,900

Wood Utilization

This natural disaster has created waste wood that will have to be disposed of or used. The task of removing trees will involve prioritizing the areas for clean-up, determining uses for the wood, establishing areas to store product and debris, and contracting the work. The following website may aid the park district in answering some of these questions: North Dakota Department of Health, Division of Waste Management (www.ndhealth.gov/wm/publications/), provides information on options for waste disposal, as well as a list of wood processing/recycling facilities and equipment vendors that offer services within the State of North Dakota.

Possible Uses for Wood

Wood Mulch for Landscaping

Considering the species composition, size and quality of the trees destroyed by the flood, wood mulch may be the best product produced from the waste wood material. Table #3 indicates the 185 damaged and destroyed trees would yield approximately 4,452 cubic feet of mulch suitable for use around other trees and shrubs within the golf course. The mulch would benefit the trees and shrubs by retaining moisture, controlling weeds, and reducing the likelihood of mechanical damage from lawn mowers and string trimmers. Mulching would also reduce mowing costs associated with trimming around trees and shrubs.

Precautions should be taken when chipping and piling waste wood material for mulch. Operators should avoid piling the chips higher than 10- to 15-feet, and never compact the piles with heavy equipment. Compaction increases the likelihood for “hot spots” to be created inside a pile resulting in spontaneous combustion. Large chip piles should be closely monitored for excess heat. If high temperatures are encountered, the piles should be opened, leveled and watered to dissipate the heat, and then re-piled. Further information on storing wood chips may be obtained at: <http://amerimulch.com/content/avoiding-fires-caused-spontaneous-combustion>.



Firewood

Although most of the trees marked for removal are conifers, which are not as desirable for heating, firewood could be another possible use for the waste wood. Table #3 indicates an estimated 21 cords of firewood could be generated from the 185 trees destroyed by the flood.

Table #3: Volume of Wood

Tree Size Class	Number of Trees	Volume of Firewood	Volume of Mulch
6"	91	3 cords	636 cu. ft.
6" - 12"	71	7 cords	1,484 cu. ft.
12" - 18"	12	3 cords	636 cu. ft.
18" - 24"	6	3 cords	636 cu. ft.
24" - 30"	4	4 cords	848 cu. ft.
30" - 36" (boxelder)	1	1 cord	212 cu. ft.
Totals	185	21 cords	4,452 cu. ft.

Wood Chip Conversion Factor: one cord equals an estimated 212 cubic feet of wood mulch.

Costs of Tree Removals

Table #4 estimates the cost of tree removals will be \$17,350. The cost is based on estimates from local contractors.

Table #4: Tree Removal Costs

Tree Size	Number of Trees	Cost/Tree	Total Removal Cost
<6" - 12"	162	\$75	\$12,150
12" - 24"	18	\$150	\$2,700
24" - 36"	5	\$500	\$2,500
Totals	185		\$17,350

These totals are conservative estimates. Variables such as distance to disposal site and landfill costs could increase total costs of removal and clean-up.

References

Dr. John Ball, South Dakota State University, "Extension Extra" publication #6025 - Revised June 2011, *Flood-Damaged Trees*

Dr. Kim D. Coder, University of Georgia, Extension Publication FOR 94-061, July 1994, *Flood Damage to Trees*

Additional Information

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Disclaimer

The assessment was limited to visual inspection of accessible subject trees within the defined areas as noted for the purpose of evaluating and estimating losses, costs of removal, and costs of replanting.

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