SELENIUM MANAGEMENT

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Selenium Management

Table of Contents

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Selenium Management

Natrona County Conservation District

Conservation districts were established nationwide in the 1940's to coordinate local conservation efforts and priorities. The work performed by conservation districts contributes to the economic and social viability of the counties they serve by improving and protecting natural resources and the environment.

The primary objective of the Natrona County Conservation District (NCCD) is to use a functional and realistic approach to identify and address the best use of local resources. Locally led with culture and customs in mind, the District aims to ensure the long-term sustainability of resources for agriculture, commercial, residential, recreational and tourism use. For almost two decades, NCCD has been a leader in the efforts to document, control and reduce selenium migration to the North Platte River.

Working in coordination with the Natural Resources Conservation Service (NRCS), Natrona County, City of Casper, Casper Alcova Irrigation District (CAID), and local landowners, NCCD is the lead agency for implementation of the Watershed Management Plan, including Best Management Practices for non-point source water pollution control. While many of the programs specifically address rural landowners, other programs provide urban residents education and assistance to reduce the human impacts on our natural resources.

NCCD is governed by a five-member, publicly elected Board of Supervisors representing urban and rural interests. For more information, visit www.nccdwyoming.com.

Selenium Management

What Is Selenium

Periodic Table of Elements

Selenium (Se) is a naturally occurring element found in various forms in nearly every part of the world. If you were to look at a standard periodic table, you would notice that selenium (Se) has an atomic number of 34 and is listed as a heavy metal. Heavy metals are unique in their ability to bio-accumulate in plant and animal tissue. In very small quantities, this is desirable and necessary for a healthy immune system; however, an overabundance of selenium in human, animal and particularly marine birds and aquatic species' diets can have serious toxic effects with long term exposure.

Due to large deposits of Cody Shale in the underlying geology of Natrona County, selenium is quite prevalent in our soil and waterbodies. Because of the ability of a heavy metal like selenium to become soluble in water, the North Platte River and its associated drainages are quite vulnerable to high levels of selenium.

There are many misconceptions regarding selenium in Natrona County. Selenium is not a salt. While salinity refers to salt, selenity refers to selenium. Also, oftentimes the white crusty soil that is seen in so many locations in Natrona County is mistaken for selenium. Although small amounts of selenium may exist in these areas, these crusty deposits are actually products of salts, salt compounds and alkali.


Surface Cody Shale

Selenium Management

Naturally Occurring

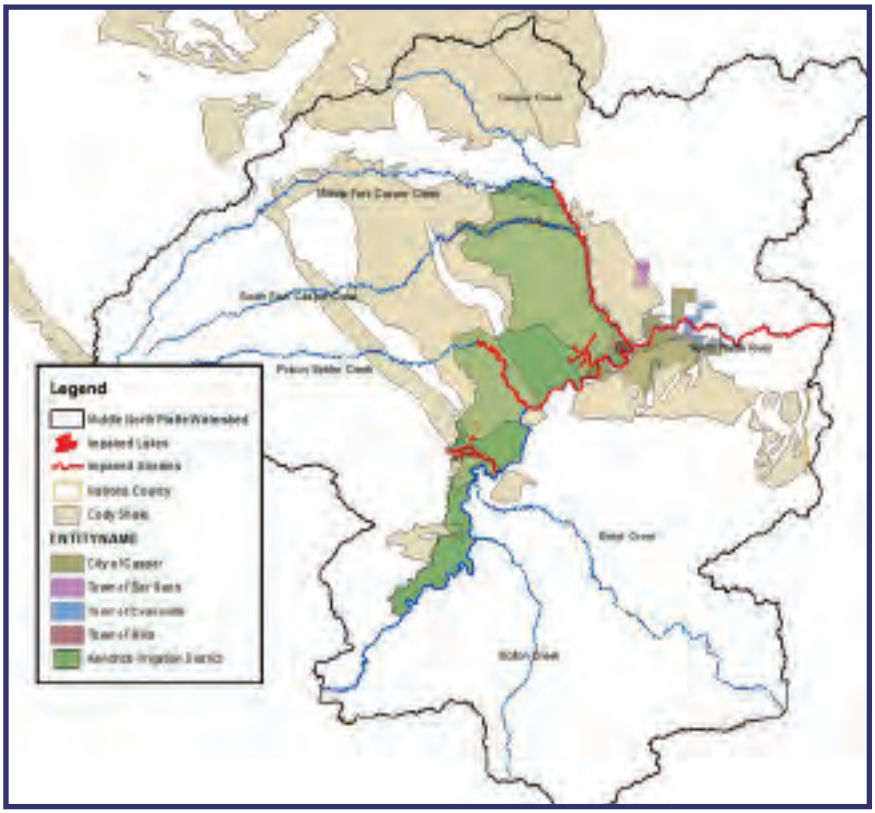
Selenium can be found in rocks and soils throughout the West, naturally occurring in volcanic and coal deposits and marine shales. The geological occurrence of selenium in Wyoming is widespread due in part to the inundation of seawater millions of years ago that produced extensive marine shale deposits.

In Natrona County, selenium is most often associated with the Cody Shale. Selenium weathered from this deposit, as well as that found in soils, can be absorbed by plants and crops, or dissolved and transported by storm water, subsurface ground water, irrigation runoff and/or other human activities that disturb the soil. As selenium moves across the landscape, it can combine with the naturally occurring selenium in-place resulting in concentrations that can dramatically change the health and condition of the watershed. Selenium can accumulate and form deposits in the topsoil, altering the beneficial use of the land. High concentrations of selenium on stream banks and in river-bottom silt can be harmful to the health of waterways and aquatic life.

Selenium Management

Middle North Platte River Watershed

Natrona County encompasses the majority of the geographic boundary known as the Middle North Platte River Watershed (MNPRW). As water drains to the lowest point in each watershed, it picks up pollutants and debris. These pollutants combine with similar and other contaminants as the water flows to downstream rivers and lakes where the effects of the cumulative pollutants can be significant. Whether the source of selenium is natural, e.g., stormwater runoff, or caused by human activity, e.g., agricultural irrigation, combined impacts of selenium loading to our waterways can be significant.



Selenium Management

How Does Selenium Effect Natrona County Residents

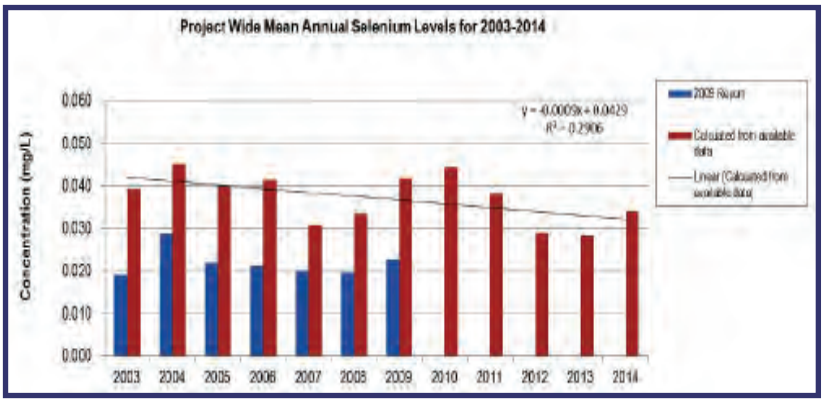
As a result of a statewide surface water quality assessment in 1998, the Wyoming Department of Environmental Quality (WDEQ) placed 37 miles of the North Platte River (within Natrona County) on its Impaired Waters 303(d) List due to elevated concentrations of selenium in the river. In 2000, four tributaries to the North Platte River and four ponds/reservoirs were placed on the Impaired Waters List, also due to elevated concentrations of selenium. These include Casper Creek, Poison Spring Creek, Poison Spider Creek, Oregon Trail Drain, Goose Lake, Rasmus Lee Lake, Thirty-three Mile Reservoir and Illco Pond. These waterbodies along with the North Platte River do not meet the U.S. Environmental Protection Agency (EPA) standards for their designated use: cold water game fishery and aquatic life other than fish.

Due to the widespread occurrence of selenium-bearing Cody shale within the MNPRW, EPA has chosen to treat this issue through their relatively inexpensive nonpoint source pollution program. Non-point sources of pollution refer to those inputs and impacts which occur over a wide area and are not easily attributed to a single source. They are often associated with particular land uses, such as irrigation. Natrona County must make a documented effort to reduce selenium loading to the North Platte River and its tributaries through concerted efforts by landowners and concerned agencies. Failure to meet the designated use(s) of these waterbodies could result in municipalities within

the county being forced to treat excessive selenium concentrations through end-of-pipe water and wastewater treatment plants. Municipalities are considered point source since they are a single identifiable source of pollution. The treatment of selenium by municipalities would require expensive and unnecessary updates to treat the selenium-laden water as well as increased fees to water users for each gallon treated.

Collection of Water Quality Data

As a result of these 303(d) listings, NCCD launched a comprehensive watershed sampling and analysis project in 2001 to identify the specific geographic locations of selenium concentrations and analyze the new data against historic data to document the concentrations and movement of selenium in the soil, ground water and surface water. Monthly sampling provides a long-term hydrologically based data set showing the trends in the selenium concentrations and its movement.

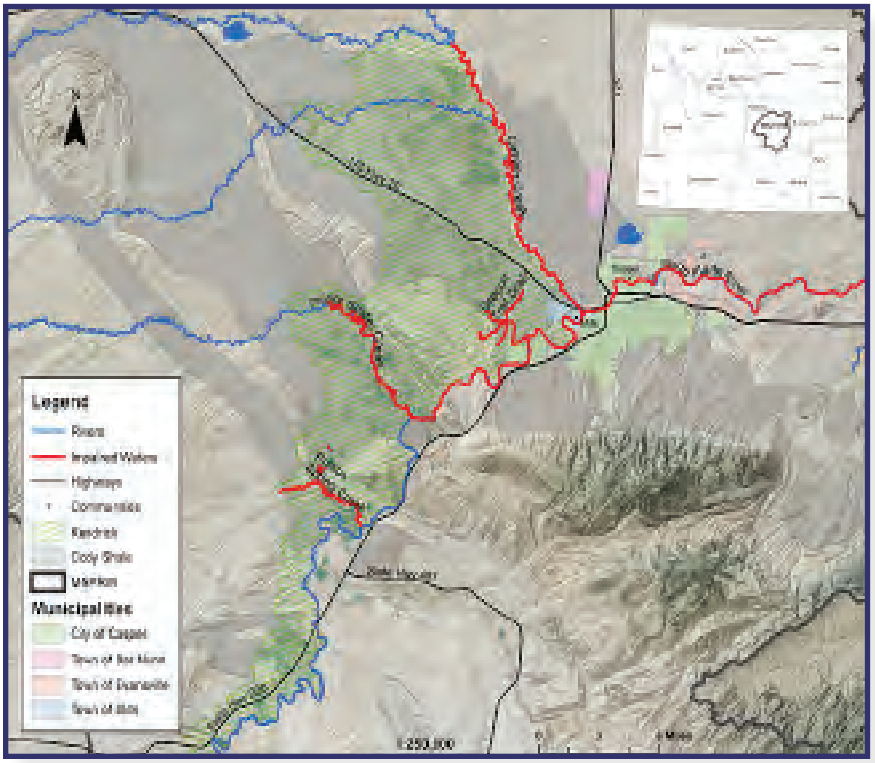


NCCD has credible data since 2001 that indicates a down-ward trend in the levels of selenium in local waterways. This trend is due in-part to the partnership between NCCD, NRCS, and landowners in the Kendrick Project to identify and adopt alternative, more efficient irrigation water delivery systems.

Selenium Management

Management and control of selenium migration is the responsibility of all landowners within the watershed, but irrigation practices within the Kendrick Project are primary areas of interest due to the documented relationship between selenium migration and irrigation practices. The Kendrick Project is 110,000 acres including 24,250 acres under irrigation; approximately 13,300 acres under sprinkler irrigation (55%) and 10,950 acres utilize conventional furrow irrigation (45%) water delivery methods. Below you can see where the Kendrick Project, as well as the municipalities, are in relation to the underlying Cody Shale.

Kendrick Project Area



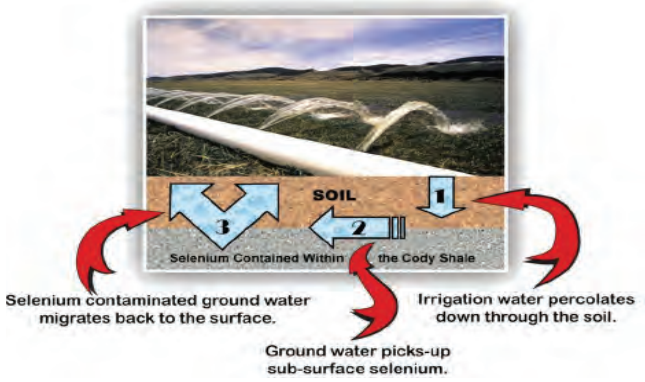
Selenium Management

Keeping Selenium Out of the River

Once selenium is present in the soil and water, it becomes complicated and costly to remove with conventional physical or chemical techniques. With removal not being a cost-effective option, the challenge is to manage and control the selenium in-place to minimize its migration to wetlands and waterways, and reduce the amount absorbed by plants and crops. Studies on the effects of irrigation water on selenium migration have been discussed and documented throughout the rural West where surface or shallow subsurface selenium has been identified.

Irrigation Delivery Systems

Selenium is highly concentrated in areas of pooling water, irrigation runoff and in wetlands on selenium rich soil.



1. Irrigation water percolates down through selenium-rich soil.

2. Ground water picks-up additional sub-surface selenium from Cody Shale bedrock.

3. Selenium contaminated ground water migrates back to the top soil and is absorbed by plants and crops. During

drought conditions or storm water runoff events, soil is eroded carrying selenium across the landscape to waterways and rivers.

Landowners in the Kendrick Project Area are managing selenium migration through the transition from conventional flood and furrow irrigation to more effective sprinkler delivery systems. While the conventional flood or furrow irrigation systems are relatively cost effective, studies indicate both are a relatively inefficient use of water as more than half of the water delivered is lost to deep percolation, runoff, or evaporation. Deep percolation and runoff can transport selenium via surface or ground water into adjacent drainages.

Scientific studies and field tests indicate the use of alternative irrigation practices such as center pivot and side roll systems can decrease the amount of selenium leached back into the soil and transported to irrigation drainages and groundwater.

Irrigation Management

Good irrigation management results in low runoff, minimal leaching below the plant roots, and no surface erosion. Whether irrigating a lawn, vegetable garden, field crop, or pasture, understanding the soil conditions and crop requirements are an important component of irrigation management to avoid selenium concentrations in pooling water and runoff.

Selenium Management

Apply Water At A Rate The Soil Can Absorb

Soil Type	Soil Uptake Rates (Inches/Hour)
Sand	2 to 4
Sandy Loam	1 to 3
Silt Loam, Loams	0.25 to 1.5
Silty Clay Loam, Clay	0.1 to 0.3

Water according to soil moisture in the root zone. Check soil moisture to determine when to irrigate. It's time to water when soils have lost more than 50% of the water available to plants in the root zones. Root zones of pasture, corn, and alfalfa are 2, 3, and 4 feet deep respectively. Use a soil probe, a tensiometer, gypsum block, or the feel method to test the soil. Annual crops will use a net application of 1-to-3 inches of available water (water available at the root zone) per week in the summer.

Water or irrigate before 9:00 am or after 5:00 pm, and whenever possible, avoid irrigating on windy or rainy days. Irrigate at a slower flow rate to reduce runoff and increase depth of penetration. Water or irrigate less frequently for longer periods of time at a slow flow rate to encourage healthier and deeper root system development and to allow the water to penetrate the soil down to the lower plant roots.

Selenium Management

Urban Landscape Irrigation

With common urban watering practices, a large portion of water applied to lawns and gardens is not absorbed by the plants. The water is lost through evaporation, runoff, pushed down below the root zone when applied too quickly, or in excess of plant needs and soil type. The goal of efficient irrigation is to reduce water loss by applying only as much water as is needed to keep plants healthy.

- Lawn turf is best watered with sprinklers.
- Flower beds can be watered with soaker hoses placed on top of the ground and covered with mulch.
- For trees and shrubs use drip irrigation emitters spaced around the dripline of the plant. Move the emitter outward every two or three years as trees and shrubs grow.

In much of Natrona County, selenium is present in the soils and underlying bed rock. Selenium migration can be naturally reduced through water conservation. Using less irrigation water to maintain landscaping and crops means less selenium is transported from yards and fields to our drainages and the North Platte River.

Riparian Areas

Looking out over the landscape of a watershed, it is easy to identify the viable creeks, streams, rivers and ponds by the presence of natural vegetated corridors that line the banks.

Known as riparian areas, this natural vegetation reduces erosion, holds sediment in place and moderates surface runoff from entering

creeks, drainages and ponds. Roots and surface mulch in a riparian area remove certain pollutants dissolved in surface and ground water before it reaches the creek or pond and leads to overall improved water quality.

Riparian areas function like a sponge by absorbing floodwaters from rain, melting snow and irrigation runoff. The water is then slowly released over a period of time, which can keep creeks flowing into the late summer months. Trees and shrubs in the riparian area and along creek banks help reduce erosion during high water and flood events, slowing or eliminating the transport of selenium into the waterway.

Urban creek-side property owners can reduce selenium, fertilizer and pesticide migration into adjacent creeks and streams by creating and maintaining a healthy functioning riparian area or buffer zone. A buffer zone can be created establishing plants with deep root systems that can resist erosion, stabilizing hillsides and shorelines.

Preserving and enhancing a riparian area can ensure the beneficial attributes of creek-side property ownership and support the desired land use as well encourage wildlife to frequent your property!

Selenium Management

Filter Strips

Filter strips are generally man-made areas of herbaceous vegetation established between cropland, grazing land, forest land or disturbed land and environmentally sensitive areas such as drainages, channels, wetlands, waterways and other areas susceptible to damage by water-borne pollutants.

Filter strips can reduce sediment containing selenium and other contaminates from migrating to adjacent land with different uses, irrigation water sources and local waterways.

Filter strips are generally established in areas where sediment, particulate organic matter and/or dissolved contaminants can naturally migrate, usually downgrade, to restricted land use areas or environmentally sensitive areas, such as drainages, creeks, lakes, ponds and the North Platte River.

Selenium Management

Seedling Tree Program

To help reduce the transport of selenium, NCCD encourages the planting of effective living windbreaks, erosion control barriers and snow fences in rural areas and on small acreages through its annual Seedling Tree Program. Natrona County residents can order trees through NCCD at a nominal cost, with delivery in early May just in time for spring planting.

Trees are sold in bundles of 10-or-25 depending on seedling size. Seedling size varies from 18 inches-to-6 feet tall and are naturalized to this region. Selected shrubs have edible berries for delicious jams and jellies or winter wildlife consumption. Popular species that grow well in local windbreaks and snow fences are Golden Currant, Sumac, Chokecherry, Bur Oak, Rocky Mountain Juniper and Ponderosa Pine.

Be sure to order early to ensure your desired species are available. Popular vegetative species and varieties do sell out! You can find the Seedling Tree Order Form at *www.nccdwyoming.com* from October through April.

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