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ENVIRONMENTAL QUALITY TECHNICAL NOTE

ECOLOGICAL CONSIDERATIONS IN SPRING DEVELOPMENT

By

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Introduction

This Technical Note describes the ecology of spring ecosystems in arid portions of the Western United States and provides guidance on related NRCS environmental policy and a protocol for evaluating the site-specific effects of spring development on the ecological functions of springs. NRCS often assists clients to develop springs and seeps to provide water for livestock and wildlife. Spring development may cause adverse impacts to fish and wildlife habitat, riparian areas, and wetlands. A site evaluation can help determine effects on existing ecological functions of the spring and potential losses from the development, including effects of the impoundment and/or diversion of spring water on local wildlife and wildlife habitat, and the effects of consumptive use on riparian health and function, stream flow, water temperature, local aquifer recharge and wetland function and values. This Technical Note was written for the use of NRCS technical specialists and conservation planners working directly with land users in the arid West.

Spring Ecology

Springs are places where groundwater emerges from soil or rock onto the land or into a water body. Springs vary widely in their landscape position, quantity and quality of water, and support of downslope or downstream ecosystems. Springs are among the most complex, diverse, and productive ecosystems in the West. Springer and Stevens (2009) developed a classification system to describe various types of springs based on their emergence setting and hydrogeology. The spring types most likely to be developed as water sources for livestock and wildlife include the following:

- Helocrene - Emerges from low gradient wetlands; often indistinct or multiple sources seeping from shallow, unconfined aquifers
- Hillslope - Emerges from confined or unconfined aquifers on a hillslope (30–60^{o} slope); often indistinct or multiple sources
- Hypocrene - A buried spring where flow does not reach the surface, typically due to very low discharge and high evaporation or transpiration
- Limnocrene - Emergence of confined or unconfined aquifers in pool(s)
- Rheocrene - Flowing spring, emerges into one or more stream channels

In arid environments like those dominating NRCS' West Region, springs may provide the only source of water and mesic habitat across large areas of the landscape. Spring habitats support a diverse array of aquatic and wetland plant and animal species, including many that are rare or endemic (Springer and Stevens 2009.) They have been termed "keystone ecosystems" because their ecological importance is greatly disproportionate relative to their small extent (Stevens and Meretsky 2008a.) An example of this is found in Nevada, where 165 of 173 endemic species are spring-habitat obligates (Abele 2011.)

Springsnails (*Pyrgulopsis spp.*) are representative of diversity in spring ecosystems; 137 species have been described (Hershler et al. 2013.) They are tiny gastropods with shells measuring between 1 and 8 millimeters in length (Hershler 1994.) As their common name suggests, springsnails live in springs and seeps, including thermal springs, and are often concentrated at the point of discharge (Hershler 1998.) They are widely distributed in the Western United States and Mexico with the Great Basin and Colorado River Basin containing the largest number of species (Hershler et al. 2014.) Dependent upon groundwater and with limited mobility, springsnails display a high degree of endemism. Often a single spring or spring complex supports the entire known distribution of a *Pyrgulopsis* species (Hershler 1998.) At least five species are documented to have gone extinct (Hershler 1994, 1998) and 80% of extant species are considered endangered by the American Fisheries Society (Johnson et al. 2013.)

Due to the scarcity of water in the arid West, available fish habitat is mostly limited to streams, springs, and cienegas (spring fed wetland/marsh habitat, Minckley and Meff 1987.) Desert streams fluctuate greatly from low or intermittent flow to scouring flash floods, whereas springs and cienegas offer a more stable environment for fish to inhabit. Desert springs and streams function as aquatic habitat "islands" in an "ocean" of arid land that effectively prevents interhabitat movement of biota. As a consequence of this isolation, in situ genetic and morphological differentiation has led to a localized and highly endemic fauna, particularly in springs (Meffe 1989). The arid West historically sustained approximately one-third of the native fish fauna of North America, many of which were found nowhere else in the world (Desert Fish Habitat Partnership 2015.) The desert southwest is home to 81 fish species endemic to the area. Of those, 24 are restricted to springs and cienegas. Thus, approximately 30% of the fish taxa are

restricted to springs and cienegas and presumably would not exist if these habitats were lost (Meffe, 1989) making these habitats and associated species vulnerable to disturbance.

Throughout the arid and semiarid deserts of the southwest, natural springs and seeps and their associated mesic habitats can provide critical refuge and food resources for amphibians. However, most amphibians are not spring habitat obligates (Stewart 1994) due, in part, to the small size, low yields and lack of adequate breeding sites in most springs. The majority of frog and toad species occurring in arid deserts of the southwest spend the winter and dry months underground. Others (*Lithobates* and *Pseudacris*) are entirely aquatic, living in permanent water habitats. Most species of salamanders in the region are terrestrial and lay their eggs on land in moist locations.

A few amphibians occur predominately around permanent, flowing springs and seeps and their associated streams, marshes and riparian habitats. These species are dependent on spring-fed, mesic habitats and include the Black Toad (*Anaxyrus exsul*), Vegas Valley Leopard Frog (*Lithobates fisheri*), and Tarahumara Frog (*L. tarahumarae*). The Relict Leopard Frog (*L. onca*) was predominately a spring inhabitant in parts of Nevada, Utah and Arizona, but populations of this species have been extirpated throughout most of its range due to alteration of spring habitats, water development and agriculture. An additional nine species of frogs of the genera *Anaxyrus*, *Lithobates*, *Pseudacris*, and *Spea*, have been identified as occurring in more diverse aquatic habitats, utilizing both spring sites and other waters sources (i.e. intermittent streams, catchment basins, temporary pools) in the southwestern deserts.

Springs are also of great importance to humans. Many cultures consider them sacred, and humans have always used springs as sources of drinking and bathing water as well as gathering and hunting areas. Springs are important in creation and other stories of many Western Indian Tribes (Rea 2008.) Emigrants to the West during European settlement were also dependent on springs as water sources (USDOI 2001.)

Given the importance of water to humans and other animals, especially in arid environments, it is not surprising that the majority of springs in the West have been impacted by anthropogenic uses. Springs are among the most threatened ecosystems in the West, with at least 90% estimated to be ecologically impaired (Stevens and Meretsky 2008b, Springer and Stevens 2009.)

Threats to spring ecosystems include (Stevens and Meretsky 2008b, Springer and Stevens 2009, Hershler 1998, Hershler et al. 2014):

- Groundwater pumping
- Impoundment of flow
- Diversion of flow
- Channelization of springbrooks

- Unmanaged grazing/trampling by livestock, wild horses and burros, and other large ungulates
- Recreational use
- Invasive species

In addition, spring ecosystems are likely vulnerable to the effects of climate change.

Because adverse impacts to springs are so widespread, many times NRCS-assisted spring developments provide opportunities to restore or improve their ecological functions over existing conditions. The Site Evaluation in Appendix A can be used to document evaluation of benchmark and planned spring ecological functions. A wetland functional assessment and the Stream Visual Assessment Protocol or similar tool may be needed in addition to the Site Evaluation.

NRCS Environmental Policy Related to Spring Development

A number of NRCS environmental policies are potentially applicable to spring development. Springs are unique ecosystems that provide habitat for wildlife, including threatened and endangered species and species of concern. Springs often support wetlands and riparian areas. Invasive species may be present in springs and disturbance in and around springs can result in colonization of the area by invasive plants. A spring may be considered a Traditional Cultural Property (TCP) by Indian Tribes and the surrounding area may contain prehistoric or historic artifacts or other cultural resources. Each of these policies is briefly summarized below, and the corresponding reference is provided for further reading.

National Biology Manual Policy [190-V-NBM, Part 510.1]

NRCS policy (130–GM, part 406) is to provide ecosystem-based assistance to our customers for the integrated management needed to sustain natural resources. Ecosystem-based assistance policy requires NRCS to use biological sciences to:

- Develop and improve soil, water, animals, plants, air, and related human resources that maintain biological resources as integral components of all ecosystems, such as forest, range, cropland, and aquatic ecosystems,
- Protect the habitat of threatened and endangered species of plants and animals,
- Restore and safeguard unique ecosystems, and
- Develop and maintain an esthetically pleasing, high quality environment.

NRCS policy has the following specific objectives concerning biological resources and their habitats:

• To restore, create, maintain, or enhance terrestrial and aquatic habitat that can attract, support, or produce wildlife and aquatic organisms.

• To conserve the habitats of wildlife and aquatic organisms and to minimize or avoid damage to habitat from changes in land use or from installation of soil, water, animals, plants, air, and related human resource conservation measures.

Endangered and Threatened Species and Species of Concern [GM 190, Part 410.22]
When NRCS concludes that a spring development may affect federally listed species or designated critical habitat, NRCS will recommend alternative conservation treatments that will avoid adverse effects and, to the extent practicable, provide long-term benefit to species. When NRCS concludes that a spring development may adversely affect Federal proposed or candidate species, proposed critical habitat, or State or Tribal designated Species of Concern, NRCS will recommend only alternative conservation treatments that will avoid or minimize adverse effects, and to the extent practicable, provide long-term benefit to the species.

Protection of Wetlands [GM 190, Part 410.26]
Wetlands will be identified in the area affected by a proposed spring development and an Environmental Evaluation will be conducted. If wetlands could be adversely affected, NRCS will use mitigation sequencing to avoid, minimize, or compensate for lost wetland functions, in that order. Spring developments designed to restore or enhance specific wetland functions, and which result in a net gain of wetland functions, may not require additional compensation.

Riparian Area Recognition and Management [GM 190, Part 411]
NRCS will assist the land user to recognize the values and functions of riparian areas. If the land user's objectives are in conflict with conservation of the riparian area resources, alternatives must be presented that identify ways to resolve conflicts.

Plans that include riparian areas will meet planning criteria for the soil, water, air, plant, and animal resources within the riparian areas. Riparian area management shall be integrated into plans and management alternatives developed for the conservation treatment unit (CTU). Management alternatives will be based on those resource concerns and conservation treatments necessary to solve all the resource concerns in the CTU and meet the land user's objectives. Because of a riparian area's unique position near watercourses or water bodies, the planner should always consider the water quality and quantity benefits, and fish and wildlife benefits provided. The plans must maintain or improve those benefits.

Invasive Species [GM 190, Part 414]
Recognizing and addressing invasive species presence and associated resource concerns is an integral part of the conservation planning process. Invasive species resource concerns described in a conservation plan will be addressed in accordance with planning procedures in the National Planning Handbook and National Environmental Compliance Handbook, and in compliance with

any existing county, State, or Federal regulations concerning noxious and/or invasive species. The plan will include:

1. An inventory of invasive species within the conservation management unit being planned

2. A map/aerial photograph outlining the affected areas of the land being planned

3. Identification of appropriate control and restoration techniques/strategies and their operation and maintenance requirements

4. Environmental Evaluation CPA-52 identifying and assessing the impact and issues pertaining to invasive species.

All risks to other resources from invasive species control/eradication and restoration techniques shall be considered when developing the conservation plan.

Cultural Resources Policy [GM 420, Part 401]

Spring Development is considered an undertaking with the potential to affect historic properties; therefore NRCS shall identify cultural resources and historic properties early in the planning and environmental review processes. It is the policy of NRCS to protect cultural resources in their original location to the fullest extent possible. If adverse effects to an historic property cannot be avoided, and treatment alternatives cannot be implemented, NRCS will consider withdrawing all assistance from the specific undertaking or proceeding with the adverse effects and take steps to minimize or mitigate these effects in consultation with State and Tribal Historic Preservation Officers, Tribes, and the Advisory Council on Historic Preservation (AHCP.) NRCS will follow ACHP regulations (36 C.F.R. 800.7 and 800.11) and NRCS' steps in the National Cultural Resources Procedures Handbook (Part 601, Section 601.26, Failure to Resolve Adverse Effects).

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Appendix A. - Site Evaluation

Proposed spring developments can be evaluated using the Spring Site Evaluation form. States should modify this evaluation to incorporate their standard resource inventory procedures.

To ensure compliance with NRCS policy on biological resources, wetlands, riparian areas, and invasive species, the Planned Score should be higher than the Benchmark score and ≥ 5.

This site evaluation can also be used to monitor the effects of spring developments over time.

In general, one Site Evaluation form should be used for each spring being considered for development; however groups of similar springs may be evaluated on a single form.

Before going to the field to conduct the assessment, read through the Summary Sheet. Review topographic maps, aerial photos, National Wetland Inventory Maps, State Natural Heritage Program data, Invasive Species Maps and other sources of information that will help you complete the Summary Sheet. Precipitation data can be obtained from the National Water and Climate Center WETS Tables.

Equipment List

_____Clipboard

_____100’ tape

_____Digital camera

_____1 liter water collection bottle or other vessel of known volume

_____Watch with second hand or stopwatch

_____Shovel or soil auger

_____Water quality test kit (highly recommended)

_____Plant and animal field guides

_____Extra copies of site evaluation form

_____Maps of planning area

Spring Site Evaluation Summary Sheet

Owner's name _____ **Date of assessment**_____

Evaluator's name(s)_____

Weather conditions today_____(Precip amounts/average temps)

Basin weather conditions: Current water year_____

Last water year _____ (% average precip/temperature anomalies)

Spring name (if any) _____ **Tributary to** _____

Ecoregion or MLRA_____ **HUC** _____

Groundwater withdrawals depleting local aquifer? Yes _____ No _____ Unknown _____ Describe any aquifer impacts: _____

_____

Spring Location/Discharge: _____/_____ft^3/s

Spring Brook Width/Length (ft) : _____/_____ **Wetland area** (acres or ft^2): _____

Riparian area (acres or ft^2): _____ **Disturbance Level:** undisturbed slight moderate high

Disturbance Sources: diversion impoundment elk livestock wild equids

recreation other_____

Spring Type: Helocrene Hillslope Hypocrene Limnocrene Rheocrene

Other _____

Spring hydrology: _____intermittent; months of year wetted: _____

_____perennial; months of year at baseflow: _____

Photo Point Locations and Descriptions:

Photo Pt. #	GPS Coordinates/Waypoints	Description
1		
2		
3		

Water quality:

DO (mg/l)	Temp (°F)	Salinity (ppt)	Conductivity	pH

Vegetation:

Submergent	Floating	Emergent	Herbaceous	Woody

Wildlife:

Springsnails	Other Mollusks	Other Invertebrates	Fish	Amphibians

Invasive Species:

Plants	Mollusks	Crayfish/Other Invertebrates	Fish	Amphibians

Notes: _____

_____

_____

_____

_____

Spring Functional Assessment

Element 1 – Geomorphology

Description	Score	Benchmark	Planned
Natural topography unaltered; or past alterations small, affecting < 20% of historic wetland/riparian area	10 - 8		
Minor alterations to natural topography noticeable throughout wetland area, or 20 - 50% of wetland/riparian area eliminated	7 - 5		
Substantial alterations to natural topography throughout wetland area, or > 50% of wetland/riparian area eliminated	4 - 2		
Spring source obliterated by impoundment, excavation, grading, cultivation, excessive trampling, recreational use or other disturbance	1 - 0		

Element 2 – Springbrook channel condition

Description	Score	Benchmark	Planned
Natural, stable spring brook with vegetated banks; or minor alterations on < 20% of length	10 - 8		
Spring brook channelized or filled, incising, or aggrading for 20 - 50% of length	7 - 5		
Spring brook channelized or filled, incising, or aggrading for > 50 - 90% of length	4 - 2		
90 – 100% of spring brook channelized or filled	1 - 0		

Element 3 – Hydrologic alteration

Description	Score	Benchmark	Planned
Spring flow appears unaltered or only slightly altered by humans, no flow augmentation from agricultural or urban sources, very little or no impoundment of spring water	10 - 8		
20 - 50% of spring flow diverted or impounded; or spring flow somewhat augmented by agricultural runoff or storm water	7 - 5		
50 - 90% of spring flow diverted or impounded; or spring flow substantially augmented by agricultural runoff or storm water	4 - 2		
90 – 100% of spring flow diverted or impounded, or augmentation by agricultural runoff or storm water accounts for > 50% of flow	1 - 0		

Element 4 – Nutrient Enrichment and Pathogens

Description	Score	Benchmark	Planned
Spring is protected from excessive nutrient inputs by intact vegetated buffers and/or controlled access; water appears clear; little or no algal growth	10 - 8		
Grazing by livestock, wild equids, or wild ungulates occurs near the spring source during part of the year, manure/scat present; water clear to greenish; moderate algal growth	7 - 5		
Excessive or year-round grazing, fertilizer use, or septic leach fields upslope of spring source; abundant manure/scat or algal growth; greenish water	4 - 2		
Pipes or concentrated flow areas discharge above spring; green water or thick algal mats present	1 - 0		

Element 5 – Wetland/Riparian Vegetation

Description	Score	Benchmark	Planned
Wetland and riparian species composition and density are as expected for site; native species dominate and all vegetation layers expected for site are present	10 - 8		
Vegetation layer missing or excessively grazed/browsed; or invasive or upland species comprise > 20% of cover in wetland/riparian area	7 - 5		
Two or more vegetation layers missing or excessively grazed/browsed; or invasive or upland species comprise > 50% of cover in wetland/riparian area	4 - 2		
Few or no native species present, invasive or cultivated species dominate or large areas of bare ground are present	1 - 0		

Element 6 – Habitat Buffers

Description	Score	Benchmark	Planned
Spring source is buffered by at least 200’ of native or naturalized vegetation that is undisturbed or lightly or infrequently grazed/browsed	10 - 8		
Spring source is buffered by 100 - 200’ of native or naturalized vegetation that is undisturbed or lightly or infrequently grazed/browsed	7 - 5		
Spring source is buffered by 50 - 100’ of native or naturalized vegetation that is undisturbed or lightly or infrequently grazed/browsed	4 - 2		
Spring source is buffered by < 50’ of native or naturalized vegetation that is undisturbed or lightly or infrequently grazed/browsed	1 - 0		

Assessment Score

Element	Benchmark Score	Planned Score
Geomorphology		
Springbrook Channel Condition		
Hydrologic Alteration		
Nutrient Enrichment and Pathogens		
Wetland/Riparian Vegetation		
Habitat Buffers		
Total Score		
Total Score/Number of Elements Scored		

Suspected causes of element scores or average score less than 5:

_____

_____

_____

Recommendations for further assessment or actions:

_____

_____

_____

Continue planned spring development? Yes_____ No_____

Reason(s):_____

_____

Continue planned spring development with modifications:

_____

_____

_____