Guano & Thousand-Virgin Sub-basins Watershed Assessment

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December, 2010

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Introduction

Harney County Watershed Council

The Harney County Watershed Council (HCWC) addresses issues and concerns about watershed health in seven sub-basins in Southeast Oregon. HCWC provides a framework for education, coordination, and cooperation among interested parties for the development and implementation of watershed plans and activities beneficial to the people and the environment.

The HCWC's area of responsibility (only area in Oregon) covers approximately 6.1 million acres. The area is comprised of four complete sub-basins and two partial sub-basins within the "Oregon Closed Basins - HUC171200", and one partial sub-basin within the "Black Rock Desert - HUC160402." The names of the seven sub-basins are: Silver, Silvies, Harney-Malheur Lakes, Donner und Blitzen, Guano, Thousand-Virgin and Alvord Lake. Some of these sub-basins overlap into Grant, Lake, Crook and Malheur Counties in Oregon, and Humboldt and Washoe Counties in Nevada (Figure 1-1).

Figure 1-1. HCWC's sub-basins.

Mission

The Council recognizes that local economic and ecological prosperity is dependent upon the current, future availability, and quality of water. Therefore, the HCWC is committed to this three-part goal:

- Determine the health of individual watersheds or watershed segments.
- Retain the health of high quality watersheds.
- Restore and enhance those watersheds, or portions thereof, that may show improvement.

HCWC Assessments

The purpose of a watershed assessment is to provide HCWC the baseline information needed for development of watershed management plans. An assessment serves as a planning tool used by HCWC and its partners to develop, prioritize, and coordinate watershed enhancement projects and associated monitoring activities. HCWC watershed assessments are grant funded and developed under contract with the Oregon Watershed Enhancement Board (OWEB) following guidelines outlined in the Oregon Watershed Assessment Manual.

The HCWC was created in 1998 with the primary goals of assessing watershed function of each sub-basin and educating themselves and the community about watershed health issues. Toward this end, five sub-basin assessments have been completed. With the completion of this report, HCWC will begin a process to comprehensively review the findings of the completed assessments and produce a Basin-wide Action Plan that identifies and prioritizes specific projects to improve watershed health for the entire region. Community engagement will be needed for the successful development and achievement of a Basin-wide Action Plan. The Council continues to expand private landowner and citizen involvement through outreach and education programs and opportunities to participate in planning, implementing, and overseeing watershed enhancement projects.

HCWC benefits from the active involvement of the following entities: private landowners, Oregon Water Resources Department (OWRD), Oregon Department of Fish and Wildlife (ODFW), Harney County, Malheur County, Bureau of Land Management (BLM), Burns Paiute Tribe, OWEB, United States Forest Service (USFS), Izaak Walton League, Malheur National Wildlife Refuge, Oregon Department of Environmental Quality (ODEQ), U.S. Fish and Wildlife Service (USFWS), Agriculture Research Service (ARS), Oregon State University (OSU), The Nature Conservancy (TNC), Natural Resources Conservation Service (NRCS), and Oregon Department of Agriculture (ODA).

Scope of the Assessment

The Guano and Thousand-Virgin Sub-basins occupy over 1.8 million acres in Harney and Lake Counties in Oregon (Figure 1-2). The portions of the sub-basins in Nevada are not assessed in this document.

The funds available for watershed assessments are limited and, consequently, the HCWC must choose the types and amounts of work that can be included. HCWC's ability to produce a more comprehensive assessment of the Guano and Thousand-Virgin Sub-basins was greatly enhanced by in-kind support provided by the Burns and Lakeview BLM Districts, the Hart Mountain National Antelope Refuge (HMNAR), ODFW, and Harney County.

In general, HCWC watershed assessments focus on summarizing data from existing research, resource inventories, and management plans. In past watershed assessments, the HCWC filled data gaps by conducting field evaluations with the cooperation of public and private landholders. That type of activity was limited for this project. Instead, this assessment emphasizes the geologic history of the Guano and Thousand-Virgin Sub-basins to give report users the benefit of understanding factors, that have shaped the land we now see.

The Lakeview and Burns BLM Districts manage 64% of the Guano sub-basin area and Burns BLM District manages 99% of the Thousand-Virgin sub-basin. Both Districts have extensive, on-going efforts to assess their lands. Similarly, the HMNAR comprises 13% of the combined areas (but with all lands being within the Guano Sub-basin). The Oregon Department of State Lands (ODSL), Land

Figure 1-2. Guano and Thousand-Virgin sub-basins (including portions located in Nevada)

Management Division, manages 1.7% of the land in the southwest corner of the Guano sub-basin. Other federal, state and county agencies have on-going regulatory jurisdiction in the two sub-basins, but do not have lands they specifically manage. (See Land Ownership , Map 1-1)

Private lands constitute 19.6% of the Guano sub-basin and 1.2% of the Thousand-Virgin sub-basin project area. In the past HCWC has engaged willing private landowners in monitoring and assessment activities on their land. An opportunity for this level of landowner engagement did not present itself in this assessment. However, we do report on some of the land management practices recently implemented by private landholders to improve watershed health on their lands.

OWEB's Oregon Watershed Assessment Manual focuses on assessing function of fish-bearing and/or perennial streams. The BLM, HMNAR, and ODFW have past, on going, and future plans for studies on fish and fish habitat on the major streams in the project area. Therefore, in order to avoid a needless duplication of efforts HCWC did not specifically complete any fish habitat evaluation for this project However, ODFW has conducted field observations on perennial streams and collected information to assess the possibility of fish occurring in tributary streams, where their presence is currently not documented

Readers should understand that assessments of this type are at best a snap-shot-in-time. Some of the data and information in this report is very current; other materials may appear dated but still provide an indication of watershed condition. It is also important to note that there is often significant lag time between the implementation of new management and the documentation of its effects, particularly in the arid environment characteristic of the project area.

It is a goal of HCWC to use the information in this report to guide its future involvement in sub-basin watershed management opportunities. That involvement could range from facilitating specific watershed enhancement projects to reassessing the overall sub-basin watershed health again in the future. HCWC goals are that this document helps readers understand the important factors influencing watershed health in the Guano and Thousand-Virgin Sub-basins. We also invite the public to become involved with the HCWC efforts to understand and improve watershed health in the sub-basins.

Project History

HCWC announced and issued a Request for Proposal (RFP) for this project in early summer, 2007. The contract was awarded to Dr. Peter Mehringer later that summer.

Dr. Mehringer left the project in the spring of 2009 and HCWC then hired Scott Miles to finish writing and producing this report. Mr. Miles had similarly finished the last HCWC watershed assessment in 2006 on the Alvord Sub-basin when the previous main author left the project for other employment.

Unfortunately, health issues forced Mr. Miles to withdraw from the project in the fall of 2010. At that time, the HCWC elected to complete the assessment using the diverse skills of the Council Members.

Information Sources and Formatting

The format of the Guano and Thousand Virgin Sub-basins Watershed Assessment is based on the Alvord Lake Sub-basin Watershed Assessment, the Oregon Watershed Assessment Manual, as well as, the project proposal. The assessment includes the following elements:

- Description of the watershed including its natural and cultural features
- Description of importance of environmental processes
- Description of the mechanisms by which environmental changes have occurred
- Description of specific land use activities generating change
- Description of the watershed's present condition (e.g., aquatic–riparian systems and fish populations)
- Description of likely future environmental conditions in the watershed, including a discussion of trends and potential effects of past activities
- Identification of missing or unavailable information and issues that may require additional assessment or data-gathering
- Interpretations, restoration needs, and management recommendations
- Maps of critical areas

The text of the Guano and Thousand Virgin Sub-basins Watershed Assessment in places borrows from the following three government documents: 1) the Andrews Management Unit/Steens Mountain Cooperative Management and Protection Area Proposed Resource Management Plan and Final Environmental Impact Statement, Burns District BLM, 2004 (abbreviated throughout the document as Andrews FEIS); 2) Lakeview Resource Management Plan and Record of Decision, Lakeview District BLM, 2003 (Lakeview RMP); and 3) The Hart Mountain Comprehensive Conservation Plan (Hart CCP)

Chapter Contents

There are four chapters in the report. Below are their titles and brief descriptions.

- Introduction. This short introduction to the HCWC and the Guano and Thousand-Virgin Sub-basins.
- Watershed Assessment. Discussions of various topics with emphasis on their connection to watershed health in the sub-basins.
- Basin Characteristics. General information about the sub-basins, physical features and the plants and animals, which reside there.
- Land and Resources: Use and Management. General information on various land management topics.

Report Review Process and Final Production

There have been reviews of the document by scientists and technical staff of the BLM, Eastern Oregon Agriculture Research Center (EOARC), and ODFW. Most of the individuals involved were already connected to HCWC in various capacities. HCWC feels that these review activities are part of the normal production of the final document and consequently these activities are also not documented within this report.

The intended audiences for the Guano and Thousand Virgin Sub-basins Watershed Assessment are primarily landowners. However, it is hoped that interested agencies, special interest groups, and research institutions may also benefit from the compilation and synthesis of information on these sub-basins.

Anyone with questions about this report and its production should contact the HCWC, 450 N. Buena Vista #4, Burns, Oregon, 97720, 541-573-8199.

Map 1-1. Land Ownership and 5th Field Watersheds Map.

Guano and Thousand-Virgin Sub-Basins Description

The Guano and Thousand-Virgin Sub-basins are two of seven sub-basins in the Oregon Closed Basins and Black Rock Desert Basin in southeastern Oregon (Figure 1-1 and Figure 1-2). There are ten watersheds within the Guano sub-basin and three watersheds within the Thousand-Virgin sub-basin. (See Appendix D for a description of the watershed boundary system.) These watersheds are shown together in Map 1-1

- Guano - 17120008
  - Clover Swale - 1712000807
  - Walls Lake Reservoir - 1712000808
  - Rock Creek - 1712000805
  - Lower Guano Slough - 1712000806
  - Upper Guano Slough - 1712000804
  - Shallow Lake - Slickey Lake - 1712000811
  - Guano Creek - Guano Lake - 1712000803
  - Sage Hen Creek - 1712000802
  - Home Creek - Garrison Lake - 1712000809
  - Skull Creek - 1712000810
- Thousand-Virgin - 16040205
  - Rincon Creek - 1604020504
  - Long Draw - 1604020503
  - Thousand Creek - 1604020506

The Guano sub-basin contains approximately 1,637,700 acres and the Thousand-Virgin contains 172,900 acres. The sub-basins in the assessment area are bordered on the east by portions of the Steens and Pueblo Mountains, on the west by Hart Mountain and Poker Jim Ridge, on the north by a subtle rise at the north end of Catlow Valley and on the south by the Nevada State border. The sub-basins extend south into Nevada, but since HCWC's area of responsibility ends at the State border, the Nevada portion is not included in this watershed assessment.

The terrain in the sub-basins varies from rugged, steep mountains at over 8000 feet to playa lakes at approximately 4530 feet. Interestingly, the highest point in the study area is the top of Warner Peak at 8017 feet in the Guano sub-basin. The lowest place in the project area is a point in Rincon Creek at 4388 feet in the Thousand-Virgin the sub-basin.

The sub-basins are closed[1] or are part of a closed system. In addition, many of the fifth-field watersheds are isolated from the others, with only internal drainage. Furthermore, most perennial streams (year around surface flow) are isolated from each other and do not flow into other perennial streams. Most perennial streams, flow through relatively short, steep, and rocky canyons. Water not lost to the coarse alluvium of the fans flows into ranch irrigation systems or out into the common playa lakes at the base of the mountains. Water reaching the playa lakes is usually absorbed or lost to evaporation in a relatively short time—usually within each year.

1 Closed systems do not have a surface water connection to the Pacific Ocean,

The playa lakes rarely contain water for more than a year; therefore, they generally do not support fish populations. However, during wet cycles, populations of fish may temporarily live in the playa lakes, which are fed by fish-bearing streams.

Great Basin redband trout (*Oncorhynchus mykiss newberrii)* and Tui Chub (*Gila bicolor*), both special status species, are present in some streams in the sub-basins.

Approximately 78% of the sub-basins are comprised of shrub dominated uplands. The project area also contains juniper dominated uplands, cottonwood, aspen, shrub dominated riparian zones, and some small upland and riparian areas dominated by herbaceous vegetation. The dominant land use is agriculture. Managed livestock grazing occurs on most rangelands, while hay production is the dominant use on a small portion of land in the valley bottoms.

The Guano and Thousand-Virgin Sub-basins are semiarid, with most locations receiving 8 to 14 inches annual precipitation primarily in winter and spring. The tops of the mountains forming the sub-basin boundaries receive more moisture, much as snow. The lowest sub-basin elevations generally do not have a winter-long snow pack. The area is characterized by abundant sunshine throughout the year and extreme day and night temperature differences. Summer day temperatures in the lower elevations can surpass 100 degrees Fahrenheit and frost may occur during any month of the year. Thunderstorms are common between April and September, and the prevailing winds are west-southwest.

The Guano and Thousand-Virgin Sub-basins lie in the northwest portion of the Great Basin in the Basin and Range Physiographic Province. The oldest rocks in the area are metamorphosed volcanic rocks approximately 150 to 200 million years old. Most surface rocks are basalt and welded tuffs extruded in the past 16 million years.

Surface soils in the sub-basins are generally young and poorly developed. Soil-building processes are slow in the dry climate and erosion is common. Most locations do not have distinct, deep soil horizons. Naturally, bare soil between plants is common in much of the sub-basins.

Watershed Assessment

General Hydrology

Guano sub-basin is an internally drained basin. It is part of the Oregon Closed Basins sub-region and the Pacific Northwest Region. Thousand-Virgin sub-basin is part of the Black Rock Desert, which is a closed system and part of the larger Great Basin Region.

Surface Water

Surface water is defined as "precipitation that does not soak into the ground or return to the atmosphere by evaporation or transpiration. It is stored in streams, lakes, rivers, ponds, wetlands, oceans, and reservoirs." Table 2-1 lists all flowlines (streams, canals, or artificial paths) and Table 2-2 lists waterbodies identified by the United States Geological Survey (USGS) National Hydrography Dataset (NHD) within the Guano and Thousand-Virgin sub-basins (Map 2-1).

In the Guano and Thousand Virgin sub-basins, snowmelt runoff stored in reservoirs provides water through the hot summer season. If enough snow falls in the mountains during the winter months, most agricultural areas in the sub-basins can get through the summer with little or no additional monthly precipitation.

Table 2-1. Flowline Classifications, Segments, and Lengths. (NHD)

Classification	Guano		Thousand-Virgin	
	Segments	Miles	Segments	Miles
Canal/Ditch	98	64.40	4	1.25
Stream/River Intermittent	3492	3052.76	770	598.96
Stream/River Perennial	399	150.64	115	25.77
Stream/River Ephemeral	119	157.15	0	0.00
Artificial Path	660	79.61	33	1.16

Table 2-2. Waterbody Classifications, Count, and Acres. (NHD)

Classification	Guano		Thousand-Virgin	
	Count	Acres	Count	Acres
Playa	398	8108.84	2	9.21
Lake/Pond Not Categorized	53	249.87	0	0.00
Lake/Pond Intermittent	492	9237.80	32	28.10
Lake/Pond Perennial	204	1270.38	7	1.22
Swamp/Marsh Perennial	8	382.29	0	0.00

Map 2-1. Surface Water Map. (USGS NHD 2010)

Ground Water

Ground water is defined as "water that infiltrates the Earth and is stored in usable amounts in the soil and rock below the Earth's surface; water within the zone of saturation."

Ground water is commonly available to shallow wells completed in unconsolidated valley fill or fragmented rock layers in the underlying volcanic deposits. These aquifers consist primarily of sand and gravel containing variable mixtures of clay and silt. Many small volume irrigation, stock and domestic wells access these types of aquifers. Larger and deeper wells may capture water from these aquifers and underlying basalt.

Ground water supports pasture, cropland, livestock, wildlife, and domestic uses. Stock water wells and pipelines improve distribution of both wildlife and livestock.

There are no detailed groundwater studies available for the Guano or Thousand-Virgin sub-basins. The USGS does provide a generalized aquifer map. (Map 2-2) The aquifer map does not provide enough data for a meaningful assessment of groundwater resources.

Issues, concerns, and action items

- Educating the public on the connection of precipitation, surface water and ground water, and the role of ground water in surface water augmentation and temperature amelioration.

Map 2-2. Regional Aquifer Map. (USGS)

Water Use and Water Rights

Water Use

Beneficial uses of water occurring in the Guano and Thousand-Virgin sub-basins are the same as for the region overall. Common beneficial uses are irrigated agriculture, fish and fish habitat, livestock, domestic and recreation. Salmonid fish (trout) spawning, salmonid rearing and resident fish and aquatic life are the three uses deemed the most temperature sensitive within the Guano Sub-basin.

Water Rights

Under Oregon law, all water is publicly owned. With some exceptions, cities, farmers, factory owners, and other water users must obtain a permit or water right from OWRD to use water from any source— whether it is underground, or from lakes or streams. Generally speaking, landowners with water flowing past, through, or under their property do not automatically have the right to use that water without a permit from the Department.

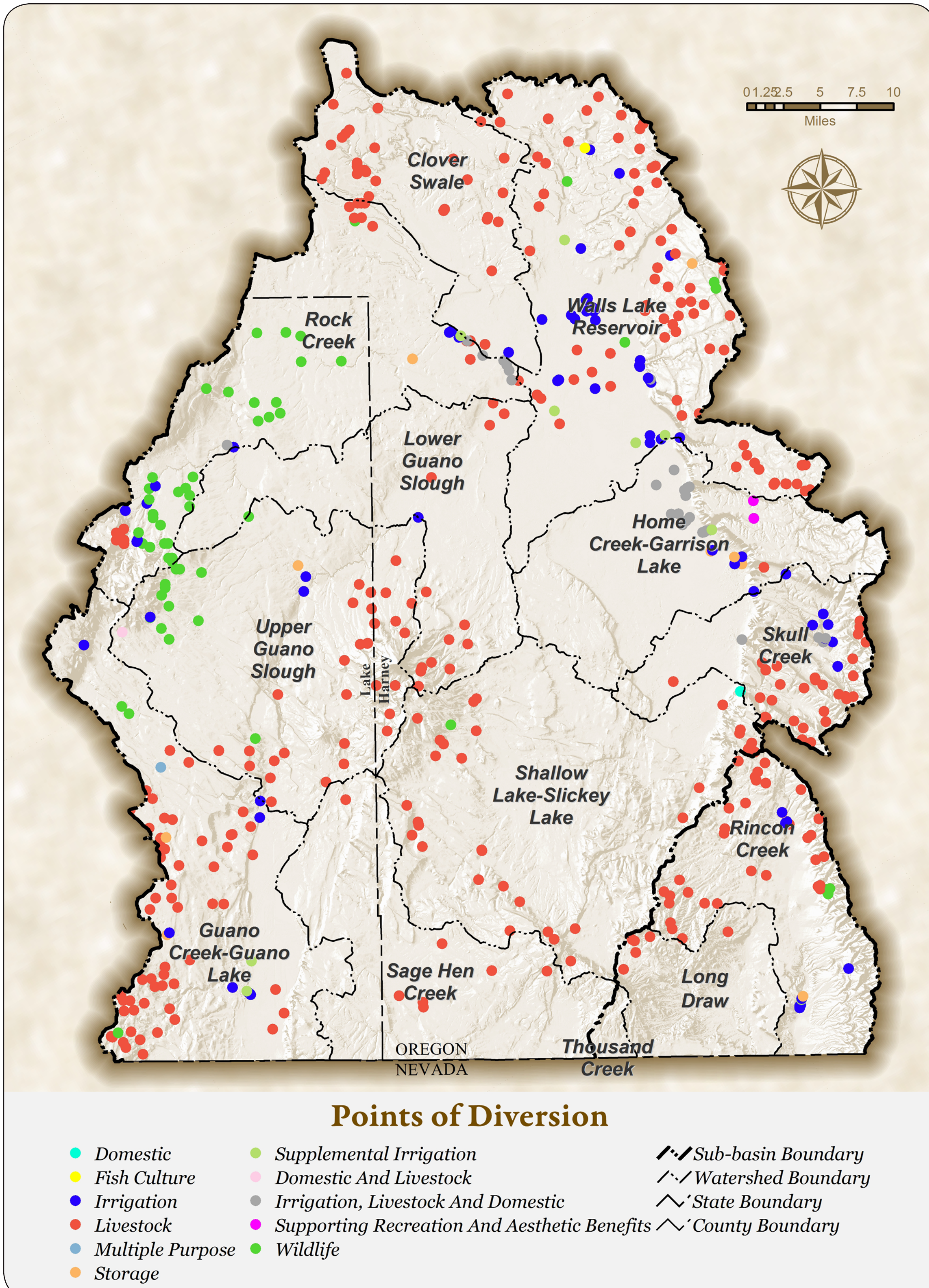
Prior Appropriation

Oregon's water laws are based on the principle of prior appropriation. This means the first person to obtain a water right on a stream is the last to be shut off in times of limited supply. In water-short times, the water right holder with the oldest date of priority can demand the water specified in their water right regardless of the needs of junior users. If there is a surplus beyond the needs of the senior right holder, the water right holder with the next oldest priority date can take as much as necessary to satisfy their right and so on down the line until there is no surplus or until all rights are satisfied. The date of application for a permit to use water usually becomes the priority date of the right.

Some uses of water are exempt from the requirement to obtain a permit. These are called "exempt uses."

Exempt uses of surface water include:

- Natural springs: use of a spring that, under natural conditions, does not form a natural channel and flow off the property where it originates at any time of the year.
- Stock watering: where stock drink directly from a surface water source and there is no diversion or other modification to the source. Also, use of water for stock watering from a permitted reservoir to a tank or trough, and, under certain conditions, use of water piped from a surface source to an off-stream livestock watering tank or trough.
- Salmon: egg incubation projects under the Salmon and Trout Enhancement Program (STEP) are exempt. Also, water used for fish screens, fishways, and bypass structures.
- Fire control: the withdrawal of water for emergency fire fighting or certain non-emergency fire fighting training.
- Forest management: certain activities such as slash burning and mixing pesticides. To be eligible, a user must notify the Department and the ODFW and must comply with any restrictions imposed by the Department relating to the source of water that may be used.
- Certain land management practices: where water use is not the primary intended activity.



Map 2-3. Points of water diversion and use. (OWRD)

- Rainwater: collection and use of rainwater from an artificial impervious surface (like a parking lot or a building's roof).

Exempt uses of groundwater include:

- Stock watering.
- Lawn or noncommercial garden: watering of not more than one-half acre in area.
- Single or group domestic purposes: not exceeding 15,000 gallons per day.
- Single industrial or commercial purposes: not exceeding 5,000 gallons per day. Does not include irrigation or watering to promote plant growth.
- Down-hole heat exchange uses.
- Watering school grounds: ten acres or less, of schools located within a critical ground water area.

Note: While these water uses do not require a permit, the use is only allowed if the water is used for a "beneficial purpose without waste" and may be subject to regulation in times of water shortage.

Current Water Rights.

Map 2-3 displays all current permitted "Points of Diversion" listed by OWRD, Table 2-3 is a summary of the listed uses. A complete water rights summary of all streams in the Guano and Thousand-Virgin sub-basins is located in Appendix E.

Table 2-3. Summary of Points of Diversion Uses.

	Guano	Thousand Virgin
Domestic	1	
Domestic And Livestock	1	
Fish Culture	3	
Irrigation	70	9
Livestock	326	42
Multiple Purpose	1	
Storage	12	4
Supplemental Irrigation	15	2
Supporting Recreation And Aesthetic Benefits	21	
Wildlife	185	26

Issues, concerns, and action items

- Conduct study regarding connectivity of surface and groundwater.
- Raise the level of awareness toward water conservation.

Wetlands

National Wetland Inventory

In 1986, the Emergency Wetlands Resources Act mandated that the USFWS complete the mapping and digitizing of the Nation's wetlands.

The Army Corps of Engineers (USACE), Environmental Protection Agency (EPA), USFWS, and NRCS worked together to develop common language and criteria for the identification and delineation of wetlands in the United States. They defined wetlands as possessing three essential characteristics that are the driving force creating all wetlands. Those characteristics are:

- Hydrophytic vegetation
  plant life growing in water, soil, or substrate that is at least periodically deficient in oxygen because of high water content
- Hydric soils
  soils that are saturated, or flooded long enough during the growing season to develop anaerobic (without oxygen) conditions in the upper part of the soil profile (See Hydric Soil Map on page 2-10)
- Wetland hydrology
  the movement of water in and out of the wetland ecosystem

The result of these efforts is the National Wetland Inventory (NWI). The NWI has further evolved into the Wetlands Geospatial Data Layer. This data layer houses all of the USFWS digital geospatial wetlands data, and forms the Wetlands Spatial Data Layer of the National Spatial Data Infrastructure (NSDI). This geospatial information is used for management, research, policy development, education and planning activities. See NWI map on page 2-12 and Table 2-4 for a complete listing of classified wetlands in the Guano and Thousand-Virgin sub-basins.

Table 2-4. NWI Classified Wetlands

Classification	Guano	Thousand Virgin
Emergent Wetland	30,502 acres	170 acres
Forested/Shrub Wetland	13,209 acres	6 acres
Lake	4,503 acres	26 acres
Pond	1,925 acres	33 acres
Riverine	1,241 acres	338 acres
Other	10 acres	0 acres

Wetlands Habitat

Wetlands are the link between land and water and are some of the most productive ecosystems in the world. Some common names for different types of wetlands are swamp, marsh and bog. Depending on the type of wetland, it may be filled mostly with trees, grasses, shrubs or moss. A wetland classification requires an area filled or soaked with water at least part of the year. Some wetlands are actually dry at certain times of the year. Many species of waterfowl and shorebirds use these areas during spring

Map 2-4. Hydric Soils (NRCS).

and fall migrations, but in summer, wildlife use is restricted to resident species. Springs and seeps also support unusual invertebrates, such as snails or other species that may be endemic to local areas. These systems tend to provide constant water flows and consistent temperatures that are distinctly different from adjoining riparian habitats.

Wetlands have many important functions that benefit people and wildlife

- Provide habitat for a wide variety and number of wildlife and plants
- Filter, clean and store water, and act like kidneys for other ecosystems
- Collect and hold flood waters
- Absorb wind and tidal forces
- Provide places of beauty and many recreational activities

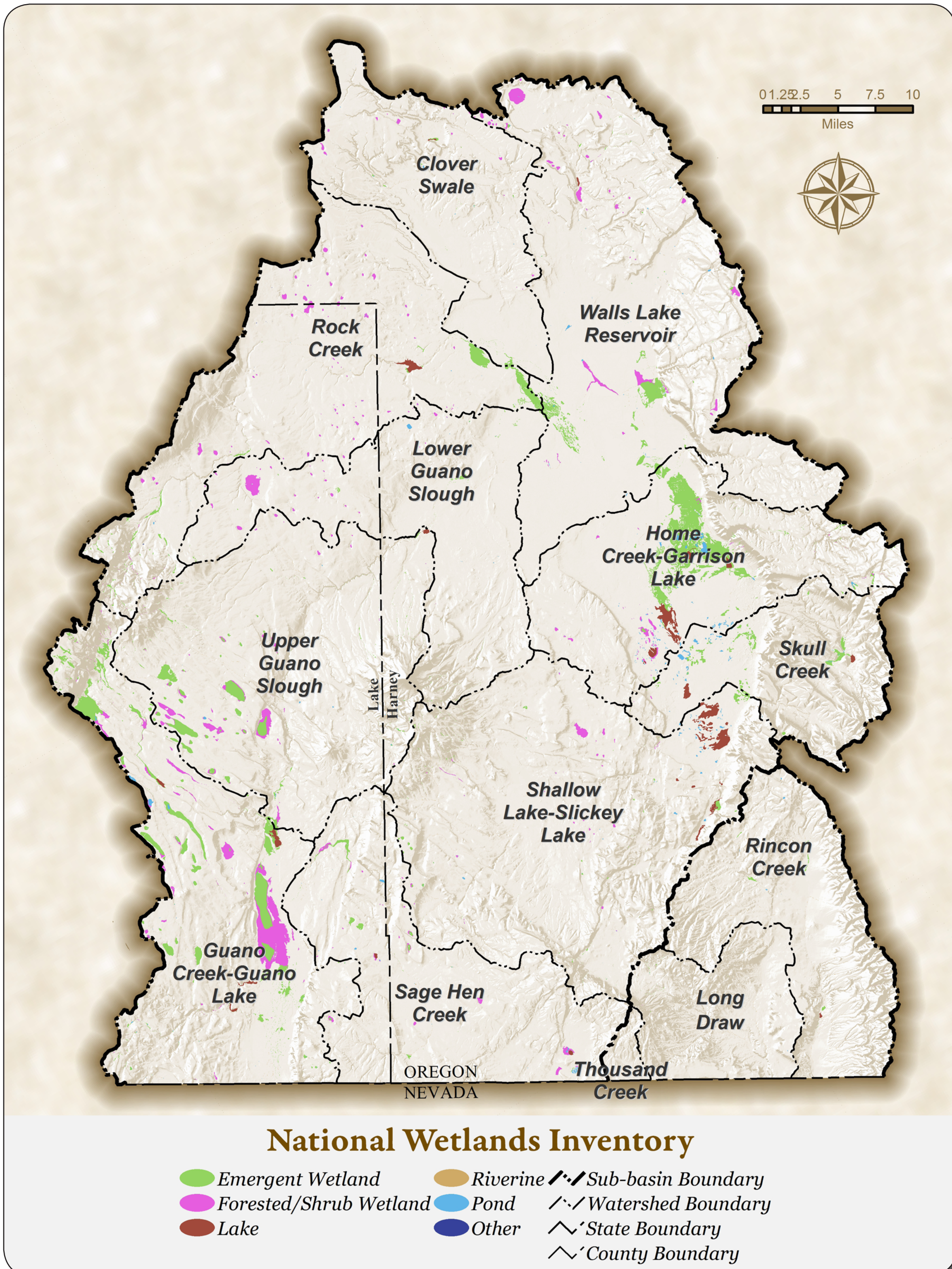
Protection and restoration of wetlands require management of activities that could affect the vegetation and the soils, which in turn affect the overland and subsurface flow and storage of water. In most settings, wetland habitats are vulnerable to surface-disturbing activities, which can affect soil stability, water-holding capacity, and plant composition.

Wetlands Assessment

Due to the landscape scale of this assessment, HCWC lacked the resources to conduct wetlands fieldwork.

Issues, concerns, and action items

- Identify errors in the NWI and submit corrected data for incorporation into the NWI.
- Raise the level of awareness of the functioning and importance of wetlands in the general public and land managers.
- Engage stakeholders into a collaborative and coordinated effort to maintain and/or restore wetlands.



Map 2-5. National Wetland Inventory. (USFWS)

Channel Habitat Types

Most streams in the Guano and Thousand Virgin sub-basin flow from deeply incised canyons with bedrock control at higher elevations to alluvial channels at lower elevations, and end their journey in terminal marshes on the basin floor. Their headwater stream segments are characterized by steep gradients, V-shaped fluvial canyons, and vegetation types dominated by aspen, willow, and alder. Alluvial fans may occur along mountain footslopes below the mouths of the V-shaped canyons. Potential vegetation of alluvial fans ranges from woody-riparian associated with steep stream gradients (>4%) and coarse soils to meadow associated with gentle gradients (<4%) and fine-textured soils. In alluvial valleys, stream gradients are gentle, soils are fine-textured, and vegetation is predominantly grasses and forbs.

Another dryland peculiarity is that of waterholes, or deepened and widened reaches of channel with more or less permanent water. Most waterholes are located at points of flow convergence.

Channel Classification System

Drawing on existing stream classification systems, a basic number of channel types for Oregon streams called Channel Habitat Types (CHTs) have been identified. The commonly utilized attributes of stream gradient and confinement are the prime identifying features of any CHT. Additionally, valley shape and stream size may guide assignment of CHTs to a stream system. The purpose is to provide users with sufficient information to understand the characteristics of each CHT, and enable users to make inferences about how land use impacts can alter physical channel form and process and, therefore, fish habitat. The information included is intentionally brief, but provides a picture of channel type characteristics.

Classified Streams

Only five streams within the project area were examined for CHTs. All streams were located in the Guano sub-basin, no streams were examined in the Thousand-Virgin sub-basin. See Table 2-5 for those CHTs identified and Appendix H for complete descriptions of the CHTs.

Issues, concerns, and action items

- Study effective methods of channel control to reduce under cutting and wash outs.

Table 2-5. Channel Habitat Types identified within the Guano sub-basin

Code	CHT Name	Gradient	Channel Confinement	Size
Guano Creek				
LM	Low Gradient Moderately Confined	<2%	Moderately confined	Variable
LC	Low Gradient Confined	<2%	Confined	Variable
MM	Moderate Gradient Moderately Confined	2-4%	Moderately confined	Variable
MH	Moderate Gradient Headwater	1-6%	Confined	Small
Rock Creek				
LM	Low Gradient Moderately Confined	<2%	Moderately confined	Variable
LC	Low Gradient Confined	<2%	Confined	Variable
MM	Moderate Gradient Moderately Confined	2-4%	Moderately confined	Variable
MH	Moderate Gradient Headwater	1-6%	Confined	Small
Home Creek				
LM	Low Gradient Moderately Confined	<2%	Moderately confined	Variable
LC	Low Gradient Confined	<2%	Confined	Variable
MM	Moderate Gradient Moderately Confined	2-4%	Moderately confined	Variable
MH	Moderate Gradient Headwater	1-6%	Confined	Small
Threemile Creek				
LM	Low Gradient Moderately Confined	<2%	Moderately confined	Variable
LC	Low Gradient Confined	<2%	Confined	Variable
MM	Moderate Gradient Moderately Confined	2-4%	Moderately confined	Variable
MH	Moderate Gradient Headwater	1-6%	Confined	Small
Skull Creek				
LM	Low Gradient Moderately Confined	<2%	Moderately confined	Variable
LC	Low Gradient Confined	<2%	Confined	Variable
MM	Moderate Gradient Moderately Confined	2-4%	Moderately confined	Variable
MH	Moderate Gradient Headwater	1-6%	Confined	Small
Note: Stream size refers to the Oregon Department of Forestry (ODF) designations based on average annual streamflow. Small streams possess flows less than or equal to 2 cubic feet per second (cfs). Medium streams possess flows greater than 2 but less than 10 cfs. Large streams possess flows of 10 cfs or greater.				

Streams

Streams and their associated riparian zones are important components of watersheds. Likewise, the condition of streams and their riparian zones are very important components of watershed health. In the following sections we: 1) present the amount (length in miles) of perennial streams in the Guano Sub-basin, 2) provide information on the determination of the riparian condition throughout the sub-basin and present the results of those determinations, and 3) discuss three situations about sub-basin streams that are informative about stream functioning and that have implications for stream and riparian management.

Perennial Streams

Perennial streams or perennial stream reaches have year-around flowing surface water. In contrast, intermittent stream reaches have water, which commonly flows on the surface for only parts of the year, in a predictable period and for a minimum length of time (usually 30 days). In the inland northwest of the United States, that time is usually during the so-called spring runoff period. The other surface flow category in this three-part classification is ephemeral, reaches only having flowing water in direct response to storm events. That flow is not predictable – it can occur anytime throughout the year, generally associated with either rain or melting snow.

Most classifications show only five perennial streams within the Guano and Thousand-Virgin Sub-basins: three from the south end of the Steens Mountain (Home, Threemile and Skull creeks) which flow directly into Catlow Valley, and two from Hart Mountain (Rock and Guano creeks) which also flow into Catlow Valley, but which take longer and more circuitous routes to get there. However, these five streams only have the largest flows and the longest reaches, which are perennial in the project area. There are other streams, which have smaller flows and shorter perennial reaches.

Perennial vs. Intermittent Hydrologic Features

In this era of increasing public scrutiny of public land management, potential problems may arise with data discrepancies and the associated risk of misinterpretation. In the case of streams, expectations are made for reaches that are perennial and those that are not. Policy and use decisions by both managing agencies and by the public can be poor when data errors exist. The BLM National Headquarters recently directed their offices to begin updating their maps to more correctly show perennial vs. intermittent stream flow reaches. BLM uses Geographic Information Systems (GIS) with USGS NHD data to make maps for public use and for their own project work maps. The obvious goal of the BLM was to provide maps that are more accurate for the public and for the agency itself.

Interestingly, without knowledge of the BLM's decision. HCWC decided to inventory the smaller perennial marked streams in the project area to try to determine the extent of perennial flow in those streams. For HCWC the ultimate goal was to move the topic beyond just noting and periodically documenting data discrepancies. This was an opportunity to assess the perennial vs. intermittent nature of essentially an entire group of USGS marked streams in a relatively large area.

Streams

The project

Determining the perennial[1] vs. intermittent[2]/ephemeral[3] nature of stream flow on a one-time visit to a site is not possible unless there is no surface flow, an observation of these conditions by strict definition defines a intermittent stream reach. If there is surface flow at the time of a visit, there can be other indicators, which allow one to infer that the flow is intermittent. The first and usually most obvious of the intermittent indicators is the composition of streamside vegetation. Certain suites of vegetation along a channel will indicate likely perennial flow or at least significant amounts of soil moisture throughout much/most of the growing season. Other vegetation suites indicate significant amounts of flow or soil moisture for parts of the growing season, but likely not the entire growing season or any amount of time approaching the entire growing season.

Pre-field activities

Using BLM maps all reaches of perennial streams on public land in the project area were recorded. Stream reaches under 0.3 miles long were taken off the list due to their short length. Most of the reaches are in two general geographic areas, the west slopes of the Pueblo Mountains and the east slope of Hart Mountain. In addition, there were three marked reaches clumped in the middle of the project area at the north end of Beatys Butte and one near the Nevada border southeast of Beatys Butte. Those three general groups were located east-to-west on Burns BLM, Lakeview BLM and HMNAR lands.

Field activities

Most reaches were walked once or twice. A few reaches which were obviously intermittent and whose entire length could be seen were not walked. The intermittent nature of distant parts of those reaches was confirmed with binoculars. Short, steep tributaries most commonly matched this description of streams not walked. Frequently, reaches were grouped in single drainages, including supposedly perennial tributaries and forks clustered around main channels.

Results

Table 2-6 thru Table 2-8 are summaries of the results. Note that in all three geographic areas the results are very similar. The overall average of field-determined miles vs. GIS data was 33 percent, and the three geographic region percents were 35, 31 and 28 percent. The mileages have been rounded to the nearest 0.05 miles.

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1 A stream in which water is present during all seasons of the year

2 A stream, or reach of a stream, that flows for prolonged periods only when it receives groundwater discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

3 A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no continuous supply from melting snow or other source, and its channel is above the water table at all times.

Table 2-6. Pueblo Mountain perennial/intermittent creek comparison.

Creek/Stream name	USGS Miles	HCWC Miles
Southern un-named creek	0.35	0.00
Deep Creek & tributaries	2.90	0.95
Pass Creek & tributaries	2.10	0.40
East Creek & tributaries	4.65	1.95
Stonehouse Creek & tributaries	3.95	2.10
Little Stonehouse Creek & tributaries	3.90	1.30
Modesto Creek & tributaries	3.75	0.90
Northern un-named creek	1.70	0.00
Five Draws Creek	0.75	0.70
Totals	24.05	8.30

Table 2-7. Hart Mountain perennial/intermittent creek comparison.

Creek/Stream Name	USGS Miles	HCWC Miles
Box Creek	0.75	0.60
Un-named creek - 1	0.95	0.95
Un-named creek - 2	0.80	0.00
Un-named creek - 3	1.75	0.00
Un-named creek - 4	0.30	0.00
Camp Creek	0.75	0.75
Cold Creek	1.60	0.00
Bond Creek	1.45	1.05
Corral Creek	0.75	0.00
Deer Creek	1.75	0.00
Totals	10.85	3.35

Table 2-8. Beatys Butte perennial/intermittent creek comparison.

Creek/Stream Name	USGS Miles	HCWC Miles
DL Spring Creek	0.80	0.80
North Spring Creek	0.65	0.00
Willow Spring Creek	0.80	0.00
Sagehen Creek	2.50	0.55
Totals	4.75	1.35

Lakes and Ponds

While not included in the fieldwork, issues exist with the classification of perennial/intermittent lakes and ponds too.

Conclusions

The data does not support a single conclusion regarding the apparent discrepancies in classification of perennial streams in the project area; rather several possible explanations exist, including but not limited to the following:

- Classification errors in the original USGS paper maps and subsequent inclusion of those errors in the digital conversion.
- Climate change has altered snowpack's and/or the duration of the snowpack's contribution to former perennial reaches.
- Vegetation change has altered the hydrology of the project area.
- Groundwater levels (water table) are lowering, allowing more infiltration of surface waters.

Issues, concerns, and action items

- Land managers and the public should be educated about situations where the perennial/non-perennial status of streams is incorrectly marked on USGS topographic maps.
- Various stakeholders should consider an organized effort to more clearly determine the perennial vs. non-perennial extent of the sub-basin's streams.

Riparian Zones

Introduction

Webster's Ninth Collegiate defines riparian as relating to or living or located on the bank of a natural watercourse (as a river) or sometimes of a lake or a tidewater.

The first Bush Administration stated in October 1988, "[our] position on wetlands is straightforward: All existing wetlands, no matter how small, shall be preserved." As a result, BLM established an initiative with the goal of inventorying, assessing the condition of, and restoring three quarters of BLM's 23.7 million acres of riparian areas and wetlands (D.O.I 1991).

The success rate of restoration efforts depends on understanding how riparian systems function, not just in a geomorphic or hydrologic sense, but ecologically as well. Riparian ecology is the active exchange between riparian species and their environment that directs the progression of both. Much of the research intended to broaden the knowledge base of riparian ecology has focused on understanding riparian plant distributional patterns as related to biological and physical influences. This body of literature centers largely on the role of flood dynamics and/or fluvial geomorphology in shaping plant communities. Flooding is the force that links riparian plant distribution with surrounding landforms, subjecting both plant and land to constant change. Flow duration and flooding frequency data can generally be correlated with species-landform association data.

Proper Functioning Condition

Proper Functioning Condition (PFC) is a methodology for assessing the physical functioning of riparian and wetland areas. The term PFC describes both the assessment process, and a defined, on-the-ground condition of a riparian-wetland area.

The PFC assessment provides a consistent approach for assessing the physical functioning of riparian-wetland areas through consideration of hydrology, vegetation, and soil/landform attributes. The PFC assessment synthesizes information that is foundational to determining the overall health of a riparian-wetland area.

The on-the ground condition refers to how well the physical processes are functioning. PFC is a state of resiliency that will allow a riparian-wetland system to hold together during a 25 to 30 year flow event, sustaining that system's ability to produce values related to both physical and biological attributes.

On-the-ground condition definitions

- PFC: Riparian-wetland areas are properly functioning when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high water flows. Thereby, reducing erosion and improving water quality by filtering sediment, capturing bed load, and aiding in floodplain development. A riparian-wetland area that is at PFC has improved floodwater retention and groundwater recharge, developed root masses that stabilize stream banks against cutting action, and developed diverse ponding and channel characteristics. Having these attributes provides the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, other uses, and supports greater biodiversity.

- Functional - At Risk (FAR): Riparian-wetland areas that are in functional condition, but an existing soil, water, or vegetation attribute makes them susceptible to degradation. Stream reaches determined to be Functional At Risk are further assessed for Trend (upward, not apparent, or downward).
- Non-Functioning (NF): Riparian-wetland areas that clearly do not provide adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows, and thus are not reducing erosion, improving water quality, etc.

Hart Mountain National Antelope Refuge Riparian Assessment

To evaluate in detail riparian condition and change over time, HMNAR established 35 permanent riparian monitoring plots between 1993 and 1995. These plots were to be monitored every 5 years. The desired future condition of Hart Mountain's riparian areas is outlined in the CMP (1994 Vol. 1, pp. 13-14). The Refuge plans to perform a synthesis of monitoring data collected since 2000 in the near future (M. Bennett, Refuge Biologist, pers. comm.).

Additionally, the management plan of 1994, excluded livestock grazing from HMNAR for 15 years (until 2009). HMNAR was scheduled to assess the impacts of the exclusion in 2010.

HCWC will update this assessment with the HMNAR data once available.

Rock Creek and Guano Creek

Riparian habitats increasingly act as barometers for management of fish and wildlife resources in western North America. At HMNAR, riparian areas comprise <1% of the refuge but collectively harbor more wildlife species than other habitats. Rock, Deer, and Guano creeks occur on the east side of Hart Mountain, drain into the Catlow Valley, and comprise the bulk of perennial stream and riparian habitat on the Refuge (Table 2-9).

Table 2-9. Riparian areas and complexes of the three streams on the HMNAR.

Stream	Watershed (acres)	Valley riparian (acres)	Valley riparian (miles)	Valley riparian complexes (no.)
Rock Creek	79,254	1,641	60	65
Guano Creek	21,887	1,848	23	47
Deer Creek	13,717	35	3	6

Guano Basin

The historic Shirk Ranch homestead, located on Guano Creek south of HMNAR, contains an emergent marsh and meadow complex that provides significant habitat for water birds, especially, migrating and breeding waterfowl.

Guano Slough

Guano Slough drains part of the eastern flank of Hart Mountain and the north and western flanks of Beatys Butte, a 7,918-foot volcano 19 km to the south. The slough cuts steeply into the fine-grained rock of the lower slopes and continues north along the western margin of the semi-arid Catlow Valley through semi-consolidated sandstone and siltstone, ashy diatomite, pumice and tuff breccias. As it approaches base level, past Black Canyon, the slough divides and braids into multiple channels, alternately dissecting and re-depositing material before seeping out into the valley (Walker and Repenning 1965). Most springs, and shallow ephemeral ponds fill hollows in the uneven braided surface. During the summer months, these shallow ponds evaporate, but pools harboring tui chub may remain in clay-lined depressions of the deepest channels. By fall, the water table drops three feet or more in sand. Upstream in the sandy floor of Black Canyon seepage sustains some pools.

Home and Threemile creeks

Perennial creeks on Roaring Springs Ranch (Table 2-10) are monitored and subject to research projects as well. They show clear improvements in habitat through the application of adaptive management practices.

Table 2-10. Physical characteristics of Threemile and Home (Kunkel 1976).

Stream (section)	Length (m)	Ave. Width (m)	Ave. Max. depth (cm)	Pool Surf. Area (m^2)	Riffle Surf. Area (m^2)	Total Surf. Area (m^2)
Threemile (upper)	183	2.4	36	206	233	439
Threemile (middle)	183	2.1	38	188	196	384
Threemile (lower)	183	2.5	32	169	288	457
Home	100	100	57	205	370	494

Home Creek

From its headwaters near 7,000 feet elevation, Home Creek flows down the west side of the Low Steens Catlow Valley. It passes through Home Creek Canyon to an approximate elevation of 4,600 feet where it flows under Catlow Valley Road (Hwy 205). Home Creek, the highest drainage on the 7,700-feet-high South (Low) Steens, used to flow to the northern portion of the marsh north of Westfield Lake. The majority of Home Creek, 17.35 miles, is now under private ownership. BLM manages about 5 miles of Home Creek east of Catlow Valley Road. Once the stream flows west under the road it is diverted for agricultural uses.

Home Creek has been subjected to past channel modification including channel straightening in the lower portion of the stream. However, the lower portion of Home Creek (above Hwy 205) has well developed stabilizing vegetation along the channel margins.

The BLM portion of Home Creek can be separated into three reaches based on elevation and landform. Reach One, the lower canyon at 5,000 feet elevation downstream until the stream enters private land at approximately 4,600 feet, is dominated by cottonwood (*Populus* spp.) and whiplash willow (*Salix lucida* Muhl. ssp. *lasiandra* (Benth.) E. Murray), yellow willow (*Salix lutea* Nutt.), and coyote willow (*Salix exigua* Nutt.) in the lower section and the upper section of reach one is dominated by aspen (*Populus tremuloides*), western juniper (*Juniperus occidentalis* var. *occidentalis* Hook.), whiplash willow, yellow willow, and coyote willow. Vegetation and large boulders line the stream bank. This reach was rated as being in PFC in 1998. Values for shade measurements in reach one taken in summer 2005 varied from 2% to 91% with an average of 54% shade. Temperatures in Reach One exceed the State's standard at some point every year.

Reach Two, canyon section, is a steeper and narrower middle portion of the canyon from 5,000 feet elevation up to the head of the canyon at 5,600 feet. This reach is dominated by red Osier dogwood (*Cornus sericea* L), arroyo willow (*Salix lasiolepis* Benth.) and yellow willow, wild rose (*Rosa woodsii*), western juniper, and chokecherry (*Prunus virginiana* L.). Vegetation along the banks is well established and nearly continuous with large boulders stabilizing the banks. This reach was rated as being in PFC in 1998. No temperature data has been collected within this reach; however, the data collected in Reach Three and in Reach One show that the stream cools approximately 10 degrees while flowing through Reach Two.. The stream is well shaded in this reach, but flow from springs may actually be the primary factor causing the temperature decrease.

Figure 2-1. View down the willow-shaded Home Creek below Reach 2 (BLM 2007)

Reach Two is difficult to access. Shade estimates from 2003 varied between 20% and 50%. Herbaceous cover is more common in the upper third of this reach as it leaves the canyon. Woody species identified above appear to be increasing. There was limited evidence of large ungulate (livestock, wild horses, deer, and elk) use in the uppermost portion of this section.

Reach Three(Upper Home Creek), from the top of the canyon at 5,600 feet elevation upstream until the stream enters private land at 5,700 feet, is dominated by Nebraska sedge (*Carex nebrascensis* Dewey), Baltic rush (*Juncus balticus* Willd.), and Kentucky bluegrass (*Poa pratensis* L). This reach was rated as functioning at risk (Functional - At Risk) with an upward trend. The stream is wider, lower gradient, and more open than the other reaches. The high width to depth ratio and the lack of shade expose this reach of Home Creek to direct sunlight.

Upper Home Creek has undergone erosion in the past as evidenced by photo monitoring points. The photo from 1979 shows raw banks and the high potential for erosion. The channel has changed drastically since 1979 as illustrated in the 1995, 2000, and 2003 photos of the same site. Some willows are establishing in this reach. Establishment of riparian woody vegetation would contribute to thermal buffering of water temperatures.

Temperature data have been collected near the boundary of Reach Two and Reach Three for several years. High water temperatures in this portion of Home Creek are likely the result of a high width to depth ratio and lack of shade providing cover.

Figure 2-2. Home Creek flows through the narrow steep rocky section of Reach 2 and flows out of this canyon segment about 10 degrees colder than when it entered the canyon (BLM 2007).

Threemile Creek

Of the 9.6 miles of Threemile Creek, 3.55 are public land and 5.5 miles of the stream are private. Threemile Creek originates from springs in a steep-walled canyon and flows westward, traversing 2.8 miles of the valley floor to feed Westfield Lake, and before channelization, the large marsh near the center of the valley. The length of the Threemile Creek from source to reservoir is 2 miles. Threemile Reservoir is impounded by an earthen dam and is controlled for irrigation. Surface area and depth of the reservoir vary considerably over the course of a year. In 1974 most of the reservoir averaged only 164-feet-deep, but a narrow 3 – 6.9-foot-deep-trough, formed by the removal of material for the dike, existed along the north and west reservoir perimeter. Threemile Creek meets the ODEQ temperature standard for Redband trout based on nine years of data.

PFC analysis of Threemile and Home creeks

More recently, stream channel stability and floodplain function for Home Creek and Threemile Creek have been evaluated by analyzing PFC (Table 2-11). BLM (1998) applies PFC to determine the minimum stream channel/riparian area functional threshold for managing associated values such as water quality, fish and wildlife habitat, aesthetics and livestock forage. Table 2-11 illustrates the lengths of streams assessed by BLM in the Guano sub-basin and the PFC rating of each reach.

Table 2-11. PFC assessment for public land reaches of two streams in the Guano sub-basin.

Stream	PFC (miles)	FAR / Trend (miles)	NF	Date
Home Creek	2.5	3.25/U	0	1998
Threemile Creek	3.25	0	0	1998 & 2003
Distance figures are estimated to 0.25 miles.				

Skull Creek

Seven and one-half miles south of Threemile Creek, Skull Creek is the southernmost of the three perennial streams draining southern Steens Mountain and emptying into Catlow Valley. Skull Creek flows westerly from Steens Mountain. After crossing the breached Pleistocene bar at the mouth of Skull Creek Canyon, it turns sharply northward for about 0.6 miles flowing along the eastern fringe of Skull Creek dunes before turning west and entering the central Catlow Valley. The low relief of pluvial lake sediments filling Catlow Valley stands in sharp contrast to the Catlow Rim, a 1,000-foot scarp.

Before its diversion, Skull Creek, with the largest drainage basin of the streams draining southern Steens Mountain, flowed from the canyon mouth northwest toward Catlow Marsh (Garrison Lakes) 5 miles northwest of Skull Creek dunes. According to Cressman (1942), the drought of 1934 left the Catlow Valley lakes completely dry.

Skull Creek watershed is mostly private property. BLM manages only about three miles of intermittent/ ephemeral headwater tributaries of Skull Creek located within the Steens Mountain Wilderness

Unlike Home and Threemile creeks, Skull Creek lacks a narrow canyon. Moderately sloping hillsides surrounded the headwaters of Skull Creek, and its lower portion has a gentle gradient within an open valley. Below its headwaters, Skull Creek diverts into a ditch, around a broad meadow, and then flows into a reservoir. From there it flows back into its natural stream channel below the meadow. Several springs feed into the headwaters of Skull Creek.

Two major valley types comprise this watershed at varying elevations. Gilbert (2006) describes a Type I valley dominating the middle to upper elevations of the watershed with Type II valleys extending both above and below it. Rosgen (1996) describes Type I valleys as V-shaped and confined, supporting predominantly A type stream channels. Type II valleys exhibit more gradual side slopes and valley floor slopes than Type I valleys and most commonly support B type stream channels. Gilbert (2006) classified most of the reaches he studied as a B4a stream type. The "B" indicates moderate entrenchment (entrenchment ratio = 1.4 – 2.2), a moderate width-to-depth ratio (>12), and moderate sinuosity (>1.2), while the "4" means that gravel was the dominant channel material, and the "a" represents steep stream slopes ranging from 4% to 9.9%. In parts of the Type I valley the reaches switched to an A4 stream type indicating overall lower entrenchment ratio, and width-to-depth ratio values.

Meadows and marshes

Some of the most important wetland habitats receive formal protection by federal or state agencies. About 12,300 acres of meadows and marshes are within the bounds of HMNAR. Most meadows and marshes have been extensively modified by human activities and particularly by irrigation diversions for hay production and livestock grazing. Flood irrigation is widely used and provides extensive seasonal wildlife habitat on private lands, as do the associated storage impoundments and distribution systems.

Smaller meadows and marshes provide substantial habitat during wet weather regimes. Even playas contain standing water in wet years. Playas are a unique component of the semi-arid ecosystems, providing a connecting link to larger marshes and meadows through many small islands of habitat scattered throughout the landscape. The highly seasonal playas are widely distributed across the area, with concentrations in the Guano sub-basin. Depending on water conditions, playas can provide high quality migration habitat for water birds, and in some cases, summer-long water on playa lakebeds. In many cases, bulldozed waterholes and resultant livestock grazing concentrations have changed the hydrology and vegetation of small playas. With some exceptions, the amount and quality of the habitats available at these smaller sites may be more a function of annual precipitation than any human factor. The sub-basins also include a number of other marsh and meadow complexes, which historically provided important habitat for native fish and wildlife. These areas are predominantly in private ownership and have been significantly altered by diversions of water for irrigation and draining of wetlands for agricultural use. Meadow and marsh habitats are primarily seasonal and vary dramatically depending on climate and water levels.

Flood Irrigation

Historically, much of the meadow hay in the project area was and is produced using a primitive system of wild flooding. During periods of naturally high runoff, water is diverted from streams with dams and spread over the land by means of ditches and dikes. Meadows comprised primarily of perennial grasses, sedges, rushes, and legumes remain flooded through the irrigation season which may extend from early March to mid-July. Flooding of hay meadows in the spring actually mimics natural hydrologic processes that have occurred annually for thousands of years within the region and can benefit the environment through groundwater recharge, cooling of subsurface return flows, forage production, and the creation of wildlife habitat.

Implications of channel types and monitoring of riparian habitat

With HMNAR and Guano Area of Critical Environmental Concern (ACEC)/Resource Natural Area (RNA) in the west and Roaring Springs Ranch and the Steens Mountain Cooperative Management and Protection Area (CMPA) in the east, at least 15 years of research and monitoring data are available for the Guano sub-basin watershed. Upward trends in ecological conditions in each of the major perennial drainages (Guano Creek, Rock Creek, Home Creek, Skull Creek, and Threemile Creek) are obvious and persistent. The issues for these streams are therefore not the lack of monitoring or availability of data, nor the degradation of riparian habitats, but instead the adequate synthesis and interpretation of that data. Research in arid environments increasingly emphasizes the hydrologic determination of vegetation patterns and dynamics as traced back through interactions of surface and subsurface hydrology responding to local and immediate perturbations, but conditioned by geologic history and long-term climatic variation. For example, riparian wet meadows are the focal point of livestock impact and restoration actions in many drainage systems. However, the mesic vegetation of these meadows is linked to high ground water levels, which often occur upstream of side-valley alluvial fans. Channel incision through these meadow systems results in declining ground water levels and vegetation shifts toward more xeric species. The incision process itself involves positive feedback through mechanisms of lowered ground water levels favoring species providing less bank stability that promote more incision. Factors contributing to incision often include fire, floods, heavy grazing, and runoff enhanced by clearing. Throughout the Desert West alluvial deposits display the dynamic history of associated drainages and the Guano and Thousand Virgin sub-basins are no exception. One may assign CHTs and apply PFC criteria to desert basins. However, a geo-historical perspective shows that in many cases this amounts to fitting square pegs into round holes.

Management strategies should recognize that fluvial systems of the northern Great Basin are not static, but adjust to rather modest changes in climate. In fact, Holocene paleoclimatic and stratigraphic reconstructions indicate that some northern Great Basin streams are currently in non-equilibrium states.

The first step in a stream-restoration program should be to develop a solid understanding of what the targeted rivers were actually like before the changes that restoration seeks to undo or mitigate (Montgomery 2008;Walter and Merritts 2008). Trajectories of change in arid and semi-arid ecosystems, controlling geological and hydrological variables, and impact sensitivities provide a model of "what you should know about the system you are trying to fix."

Issues, concerns, and action items

- Educate the public and land managers as to the relationship between land management activities and riparian conditions.
- Improve streams classified as Functional – At Risk, Nonfunctioning, and/or having a downward trend.
- Assess unclassified streams for functioning condition or riparian trend.
- Periodically re-assess streams to document possible changes in condition.

Water Quality

Section 303(d) of the Federal Clean Water Act of 1972 requires that the ODEQ identify streams and water bodies that are "water quality limited." ODEQ must (1) designate the beneficial uses of each water body, (2) select parameters that define and contribute to water quality and are related to beneficial uses; (3) establish standards for each parameter, and (4) then review available data and information for each water body to determine if it is meeting the standard. If the water body is not meeting the standard, then it goes on the 303(d) list. ODEQ then has to work with the local landowners and water users to (5) develop the Total Maximum Daily Loads (TMDLs) and a (6) Load Allocation for that water body. The resulting (7) Water Quality Management Plan is monitored by the Designated Management Agency (such as the ODA, or BLM). ODEQ to date has completed steps 1, 2, 3 and 4. At publication time, TMDLs have not been established for any features in the project area.

The Guano sub-basin is the only sub-basin that contains any 303d listed streams or water bodies. The sub-basin contains three streams (Map 2-6). Table 2-12 lists the features and cause for the listing.

Table 2-12. 303d listed streams (ODEQ)

Name	Segment (miles)	Cause of Listing	Season
Skull Creek	0 to 13.3	Temperature	Summer Rearing 17.8°C
Home Creek	0 to 21.3	Temperature	Year Around (Non-spawning) 20°C
Rock Creek	0 to 52.5	Temperature	Year Around (Non-spawning) 20°C

Summary and Conclusions

The three listed stream reaches exceed the 20 C or 17.8 C seven-day moving average of daily maximum temperatures. The temperature standard says that if streams are naturally warmer than the 20 or 17.8 C criteria, then that natural temperature becomes the new standard. However, human activities are not allowed to increase stream temperatures beyond their naturally warmer temperatures.

Issues, concerns, and action items

- HCWC and others should strive to educate the public on the connection of water quality as it relates to watershed health.
- HCWC and others should strive to educate the public and land managers on the connection of land management activities and water quality.

Map 2-6. 303d Streams (ODEQ)