COLORADO
Colorado Water Conservation Board
Department of Natural Resources

# Graves Creek
# Executive Summary

## CWCB STAFF INSTREAM FLOW RECOMMENDATION

| | |
|---|---|
| UPPER TERMINUS: | Colorado - Wyoming Stateline at<br>UTM North: 4538560.12 UTM East: 498477.70 |
| LOWER TERMINUS: | Confluence Unnamed Tributary at<br>UTM North: 4535421.23 UTM East: 500624.89 |
| WATER DIVISION: | 1 |
| WATER DISTRICT: | 1 |
| COUNTY: | Larimer |
| WATERSHED: | Lone Tree-Owl (HUC#: 10190008) |
| CWCB ID: | 13/1/A-001 |
| RECOMMENDER | Colorado Parks & Wildlife and City of Fort Collins |
| LENGTH: | 2.76 miles |
| FLOW RECOMMENDATION: | 0.17 cfs (1/1 – 12/31) |

# GRAVES CREEK

## Introduction

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights. Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

Colorado Parks and Wildlife (CPW) and the City of Fort Collins recommended that the CWCB appropriate an ISF water right on a reach of Graves Creek. This reach is located within Larimer County about 24 miles northeast of the city of Fort Collins (See Vicinity Map). Graves Creek originates in southern Wyoming and flows south joining with an unnamed tributary to form Spring Creek just north of Norfolk. One hundred percent of the land on the 2.76 mile proposed reach is publicly owned and managed by the City of Fort Collins. The upper end of the proposed reach is part of Soapstone Prairie Natural Area, and the lower end is part of Meadow Springs Ranch (See Land Ownership Map). CPW and Fort Collins recommended this reach of Graves Creek because it has a natural environment that can be preserved to a reasonable degree with an ISF water right.

The information contained in this report and the associated supporting data and analyses (located at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2015ProposedISFAppropriations.aspx) form the basis for staff's ISF recommendation to be considered by the Board. This report provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury.

## Natural Environment

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information is used to provide the Board with a basis for determining that a natural environment exists.

The Graves Creek drainage contains springs, perennial stream sections, and intermittent stream sections. Portions of the drainage are likely dry during much of the year and may only have flowing water during spring runoff or storm events. Downstream from the proposed ISF reach, the streambed appears to go dry and there is little indication of riparian vegetation. The headwaters of Graves Creek are within the boundary of the Ogallala or High Plains Aquifer as defined by the U.S. Geological Survey boundaries (USGS, 2009).

No fish species have been sampled in Graves Creek. However, the City of Fort Collins and CPW are evaluating the re-introduction of a number of native species to Graves Creek, including northern redbelly dace, *Phoxinus eos*, and common shiner, *Luxilus cornutus*. The northern redbelly dace is a State Endangered fish; only five specimens have been collected in Colorado (CPW, 2014). The common shiner is a state threatened species. Northern leopard frogs, which are a CPW Species of Special Concern and a BLM Sensitive Species, have been found at Graves Creek (See Table 1).

Riparian vegetation surrounding Graves Creek includes the Colorado butterfly plant, *Gaura neomexicana ssp. Coloradensis*. This species has been listed as threatened under the Endangered Species Act since 2000 by the U. S. Fish and Wildlife Service (USFWS). According to the USFWS, the Colorado butterfly plant is a rare short-lived perennial herbaceous plant found primarily in southeastern Wyoming, northcentral Colorado, and extreme western Nebraska. The Colorado butterfly plant is typically found in wetlands habitats along the meandering stream channels on the high plains.

Insect surveys were conducted on Meadow Springs Ranch and Soapstone Prairie Natural Area in 2009, 2010, and 2011. (Stoaks and Kondratieff, 2011; Stoaks and Kondratieff, 2012). One site was sampled on Graves Creek near the middle of the proposed ISF reach. Stoaks and Kondratieff (2011) note that flowing springs and streams are unique habitats on the high plans steppe, often with distinct aquatic communities. Further, they stress that these areas are important for conservation because "aquatic insect habitat and species have mostly disappeared on the Great Plains." Thirty-two uncommon insect species were found, with some only known to occur in Colorado on the Meadow Springs Ranch or Soapstone Prairie Natural Area (Stoaks and Kondratieff, 2012 has a full list of species). Aquatic macroinvertebrates were sampled at Graves Creek in 2011 (Stoaks and Kondratieff, 2012). This sampling effort found 58 insect taxa, many of which are common in spring environments.

**Table 1.** List of species identified in the vicinity of Graves Creek.

| Species Name | Scientific Name | Status |
|---|---|---|
| northern leopard frog | *Rana pipiens* | State Species of Special Concern<br>BLM Sensitive Species |
| Colorado butterfly plant | *Gaura neomexicana ssp. coloradensis* | Federally threatened |
| aquatic macroinvertebrates | *58 taxa (see Stoaks and Kondratieff, 2012)* | unknown |

## ISF Quantification

CWCB staff relies upon the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

## Methodology

CPW staff used the R2Cross methodology to develop the initial ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996). Riffles are most easily visualized as the stream habitat types that would dry up first should streamflow cease. The field data collected consists of streamflow measurements and surveys of channel geometry at a transect and of the longitudinal slope of the water surface.

The field data is used to model three hydraulic parameters: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic invertebrates (Nehring, 1979). CPW staff interprets the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on meeting 3 of 3 hydraulic criteria. The winter flow recommendation is based on meeting 2 of 3 hydraulic criteria. The model's suggested accuracy range is 40% to 250% of the streamflow measured in the field. Recommendations that fall outside of the accuracy range may not give an accurate estimate of the hydraulic parameters necessary to determine an ISF rate.

The R2Cross methodology provides the biological quantification of the amount of water needed for summer and winter periods based on empirical studies of fish species preferences. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree, or withdraws the recommendation.

## Data Analysis

R2Cross data was collected at one transect for this proposed ISF reach (Table 2). The R2Cross model results do not produce a summer flow which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model results in a winter flow of 0.17 cfs, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model.

**Table 2.** Summary of R2Cross transect measurements and results for Graves Creek.

| Entity | Date Measured | Streamflow (cfs) | Accuracy Range (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|---|---|---|---|---|---|
| CPW | 6/11/2014 | 0.1 | 0.04 – 0.25 | 0.17 | Out of range |
| | | | **Mean** | **0.17** | **NA** |

### ISF Recommendation

CPW recommends flows of 0.17 cfs (1/1 – 12/31) based on R2Cross modeling analyses, biological expertise and staff's water availability analysis. This flow amount meets the criteria for average wetted perimeter and average depth in the R2Cross model.

## Water Availability

CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

### Methodology

Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc). Although extensive and time-consuming investigations of all variables may be possible, staff takes a pragmatic and cost-effective approach to analyzing water availability. This approach focuses on streamflows and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data.

### Basin Characteristics

The proposed ISF on Graves Creek has a roughly 1.6 square mile drainage basin. The average elevation of the basin is 6,333 ft and the average precipitation is 15.99 inches. Graves Creek originates from a

series of spring complexes located within the basin. Only 3 conditional spring water rights were identified, all of which belong to the City of Fort Collins. Based on aerial photography, there does not appear to be any irrigated lands in the portion of the drainage basin located in Wyoming.

### Available Data

There is not a current streamflow gage on Graves Creek or anywhere in the vicinity of the proposed ISF. StreamStats relationships were not developed for the plains due to the lack of available gage data. The City of Fort Collins and/or their consultants installed and operated a flume near the middle of the proposed reach. This flume was equipped with a stage discharge recorder that measured stage every hour. The record starts 6/25/2010 with intermittent recordings through 1/12/2015. High flows from rain events disturbed the flume on multiple occasions resulting in the incomplete record.

Although winter flow records were not maintained on Graves Creek, staff was able to obtain anecdotal information on the year-round stability of streamflow. Daylan Figgs, the Fort Collins Natural Areas Senior Environmental Planner, has been responsible for managing the Soapstone Prairie Natural Area since April 2005. Mr Figgs observed that Graves Creek maintains a very consistent flow generally in the 0.2 – 0.3 cfs range, with larger flows occurring in response to large precipitation events. During drought periods, flows are observed to decrease slightly and the wetted stream segment tends to shorten slightly. However, flow remains in the 0.2 cfs range during these periods and Mr. Figgs has not seen Graves Creek without flow. In addition, Willie Altenburg, President of the Folsom Grazing Association, has been grazing cattle in the area since 1983. Mr. Altenburg stated that he cannot remember a time when Graves Creek was dry. The presence of numerous springs within the basin that contribute flow to Graves Creek likely explain the fairly constant base flows observed in Graves Creek.

### Data Analysis

Daily average streamflow was calculated from the flume record for each day with data. Due to the limited available data, median streamflow for each day of the year was not calculated. In addition, 95% confidence intervals for the median could not be calculated.

### Water Availability Summary

The hydrograph (Figure 1) shows all available data for the proposed ISF. There is very little data between January and May. However, measurements on either side of that time period are above 0.17 cfs. In fact, all available measurements except one are at or above the proposed ISF. This data is further confirmed by the observations made by Daylan Figgs since 2005 and Willie Altenburg since 1983. Staff concludes that water is available for appropriation on Graves Creek.

## Material Injury

Because the proposed ISF on Graves Creek is a new junior water right, the ISF can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S. (2014), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

## Citations

Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

CPW, Natural Diversity Information Source, accessed 1/5/2014, http://ndis.nrel.colostate.edu/wildlifespx.asp?SpCode=010036.

Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

Hansen, A.G., and K.T. Bentley, 2008, Inventory of fishes inhabiting Spottlewood, Graves, and Sand Creeks on Meadow Springs Ranch and Soapstone Prairie Natural Area, Lamar County, CO., Report prepared for the City of Fork Collins, and the Aquatic Research Section and Species Conservation Sections of the Colorado Division of Wildlife.

Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

Stoaks, R.D., and B.C. Kondratieff, 2011, Interim report on insect survey of Soapstone Prairie Natural Area, Larimer, Co. and Meadow Springs Ranch, Weld, Co., Colorado. Department of Bioagricultural Sciences and Pest Management, Colorado State University.

Stoaks, R.D., and B.C. Kondratieff, 2012, Final report on insect survey of Soapstone Prairie Natural Area, Larimer, Co., Colorado. Department of Bioagricultural Sciences and Pest Management, Colorado State University.

USFWS, Colorado Butterfly Plant, accessed 1/1/2015, http://www.fws.gov/mountain-prairie/species/plants/cobutterfly/.

USGS, 2009, Digital map of aquifer boundary for the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, accessed 12/31/2014 at http://water.usgs.gov/GIS/metadata/usgswrd/XML/ds543.xml

## Metadata Descriptions

The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

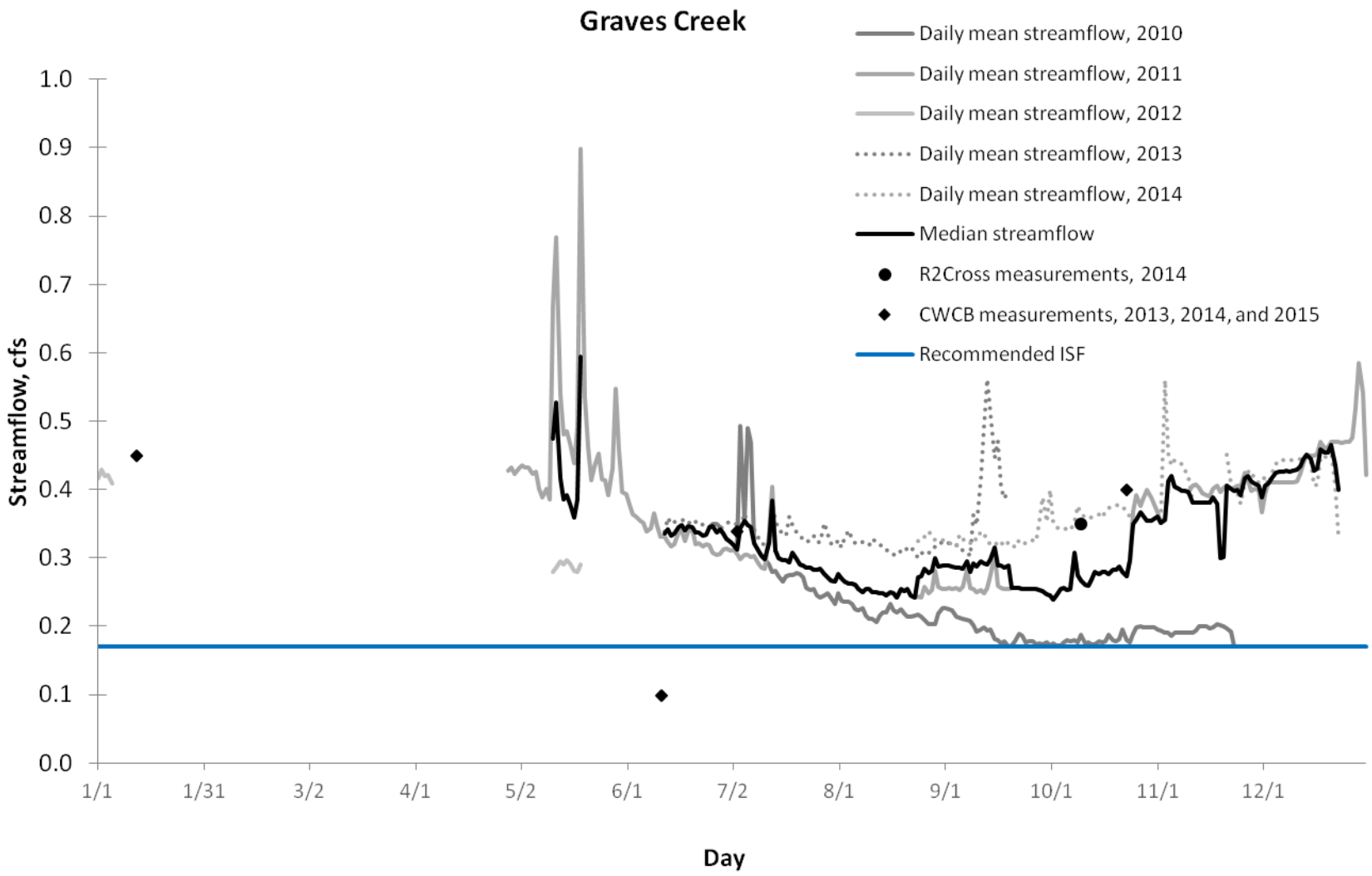
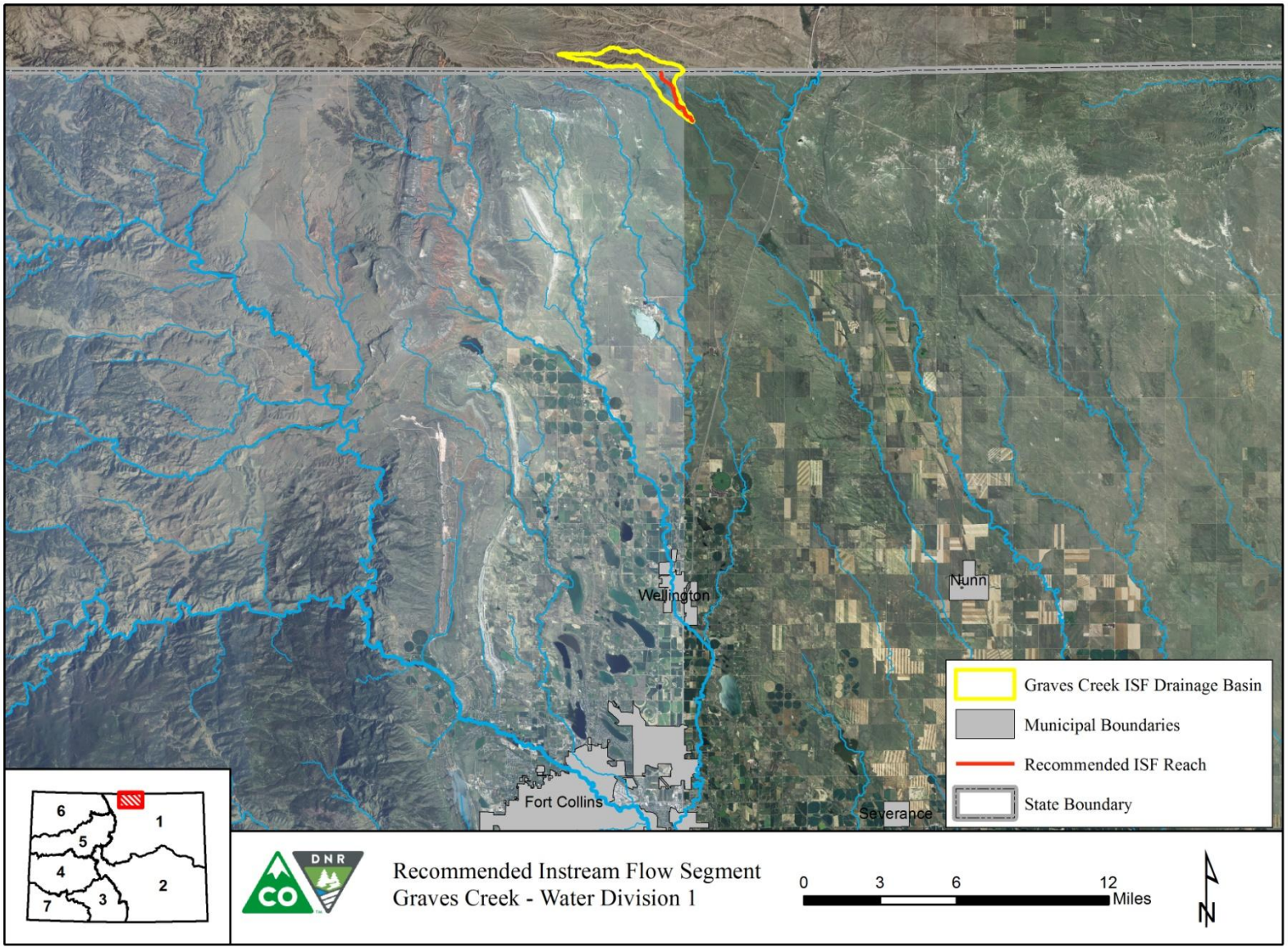
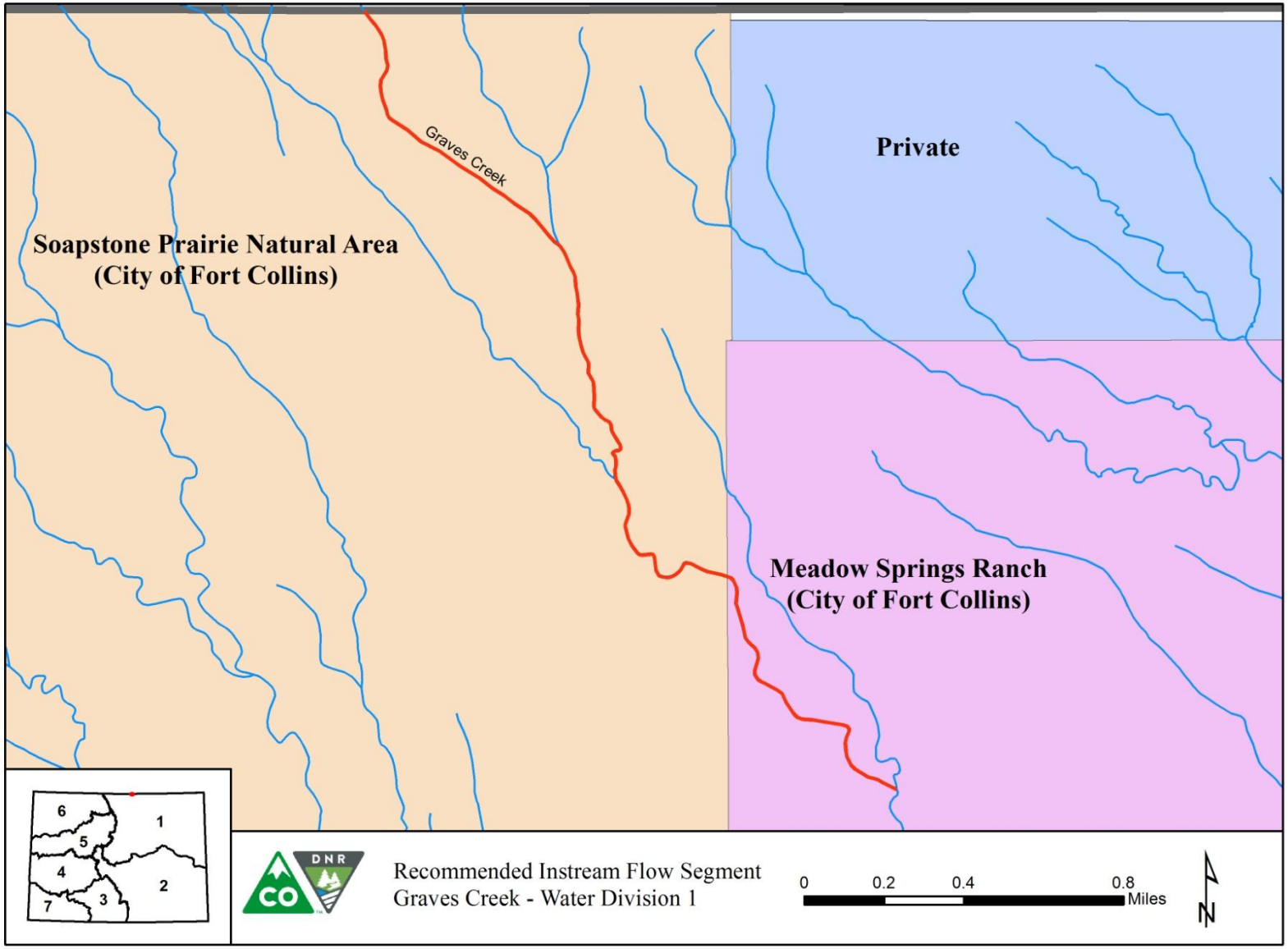



**Figure 1.** Complete hydrograph showing streamflow data and the proposed ISF rate on Graves Creek.

# Vicinity Map



# Land Use Map


Graves Creek
Private
Soapstone Prairie Natural Area
(City of Fort Collins)
Meadow Springs Ranch
(City of Fort Collins)
6
1
5
4
2
7
3
CO
DNR
Recommended Instream Flow Segment
Graves Creek - Water Division 1
0
0.2
0.4
0.8
Miles
N

# Water Rights Map