CANDIDATE CONSERVATION AGREEMENT WITH ASSURANCES FOR FLUVIAL ARCTIC GRAYLING IN THE UPPER BIG HOLE RIVER

2020 Annual Report

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Montana Fish, Wildlife & Parks

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I. Introduction

A Candidate Conservation Agreement with Assurances (CCAA) is an agreement between the U.S. Fish and Wildlife Service (USFWS) and any non-Federal entity whereby non-Federal property owners who voluntarily agree to manage their lands or waters to remove threats to species at risk of becoming threatened or endangered receive assurances against additional regulatory requirements should that species be subsequently listed under the Endangered Species Act (ESA). According to the USFWS, since 2000 there have been 50 CCAA's approved in 24 different states that have more than 25.2 million acres enrolled by 717 landowners that cover 84 species. The project areas associated with these CCAA's range from a one-acre area aiming to protect the Greater and Lesser Adam Cave Beetles in Kentucky to 7,214,287-acre area to protect Lesser Prairie Chicken in Colorado, Kansas, Oklahoma, New Mexico, and Texas (USFWS 2018). The Fluvial Arctic Grayling in the Upper Big Hole River CCAA Program (Big Hole Arctic Grayling CCAA) began in July 2006.

The conservation goal of the Big Hole Arctic Grayling CCAA is to secure and enhance a population of fluvial (river-dwelling) Arctic Grayling (*Thymallus arcticus*) within the upper reaches of their historic range in the Big Hole River drainage. Under the Big Hole Arctic Grayling CCAA, Montana Fish, Wildlife & Parks (FWP) holds an ESA section 10(a)(1)(A) Enhancement of Survival Permit issued to it by USFWS on August 1, 2006 and will issue Certificates of Inclusion to non-Federal property owners within the Project Area who agree to comply with all stipulations of the Program and develop an approved site-specific conservation plan (Figure 1). Site-specific conservation plans will be developed with each landowner by an interdisciplinary technical team made up of individuals representing FWP, USFWS, USDA Natural Resources Conservation Service (NRCS), and Montana Department of Natural Resources and Conservation (DNRC; collectively known as the Agencies). The conservation guidelines of the Big Hole Arctic Grayling CCAA will be met by implementing conservation measures that:

1) Improve streamflows

2) Improve and protect the function of riparian habitats

3) Identify and reduce or eliminate entrainment threats for Arctic Grayling

4) Remove barriers to Arctic Grayling migration

This planning effort will help alleviate private property concerns, as well as generate support from private landowners to improve habitat conditions for Arctic Grayling throughout the Project Area. The goal for the Arctic Grayling population inhabiting the Project Area is to increase the abundance and distribution of Arctic Grayling within the Project Area (FWP and USFWS 2006).

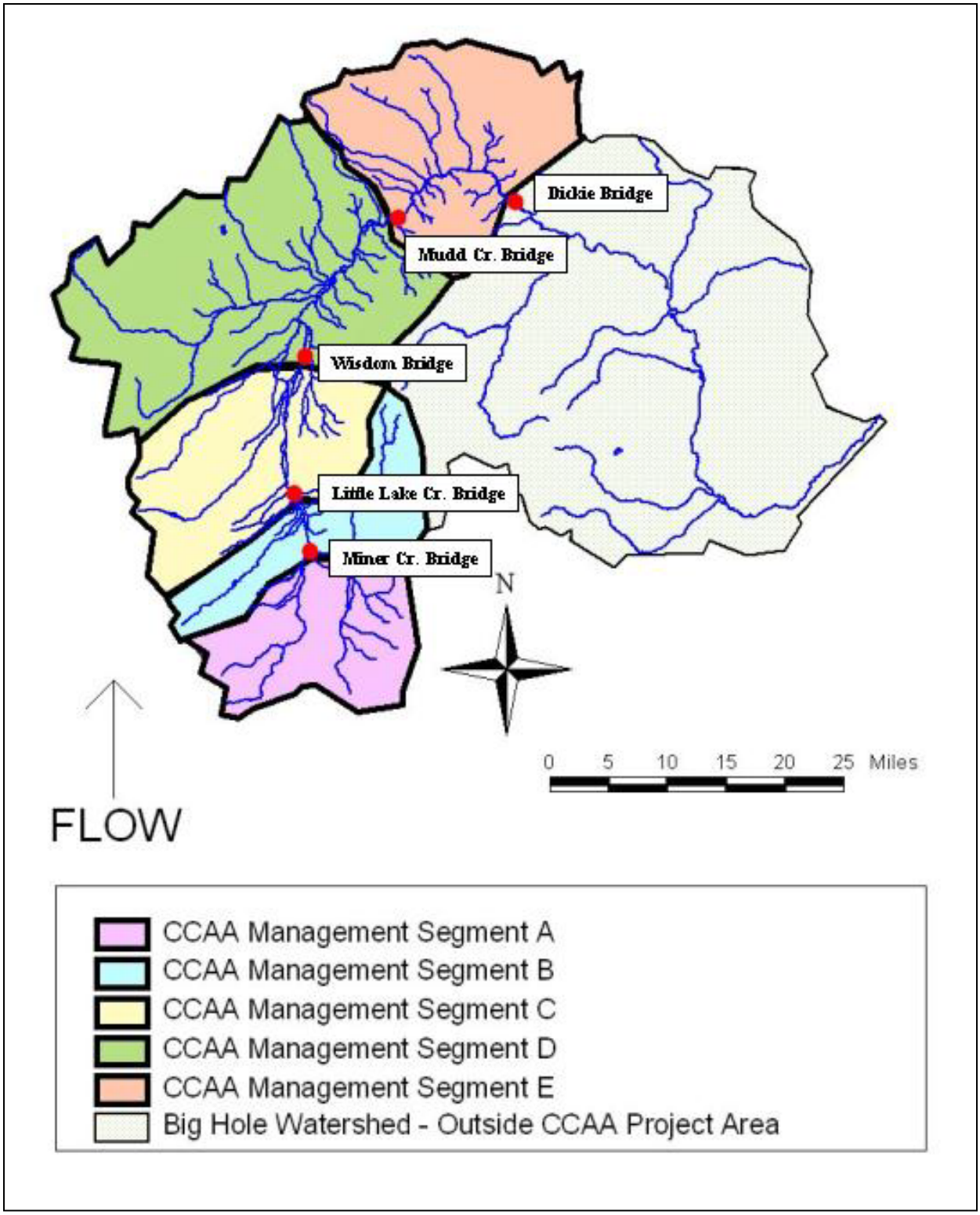

Figure 1. The Big Hole Arctic Grayling CCAA Project Area & Management Segments.

The Big Hole Arctic Grayling CCAA is a collaborative effort among private landowners, state and federal agencies, and non-government organizations. These stakeholders have agreed to work together for the common goals of conserving Arctic Grayling, improving the Big Hole watershed fish populations, addressing private property concerns, and enhancing the overall health of the upper Big Hole watershed.

The 2020 report includes a summary listing of current enrollment, signed site-specific plans, conservation actions implemented, and FWP project funding as part of the Big Hole Arctic Grayling CCAA.

II. Legal Status of Montana Arctic Grayling

On July 23rd, 2020, the USFWS announced that the Upper Missouri River Distinct Population Segment (DPS) of the Arctic Grayling did not warrant protection under the Endangered Species Act (ESA). This decision was determined from the best available science, advances in the Big Hole Arctic Grayling CCAA, and critical conservation work completed by private landowners (Federal Register 2020). For complete legal review prior to 2020 please review the USFWS 2020 listing determination (Federal Register 2020).

III. Landowner Enrollment

On August 1, 2006, the USFWS issued FWP an ESA section 10(a) (1) (A) Enhancement of Survival Permit # TE-104415, authorizing the Big Hole Arctic Grayling CCAA. The issuance of this permit allowed for the official enrollment of any non-federal landowner within the Big Hole Arctic Grayling CCAA Project Area. Enrolled non-federal landowners are provided incidental take coverage and regulatory assurances once the non-federal landowner, FWP, and the USFWS counter-sign the Certificate of Inclusion and the approved site-specific conservation plan for the enrolled property, if Arctic grayling become listed under the ESA. Currently, there are 32 landowners (Participating Landowners) that have enrolled 148,320 acres of private and 6,230 acres of DNRC leased land into the Big Hole Arctic Grayling CCAA (Figure 2). Enrollment for the Big Hole Arctic Grayling CCAA will remain open until 90 days prior to any final listing rule published by the USFWS in the Federal Register.

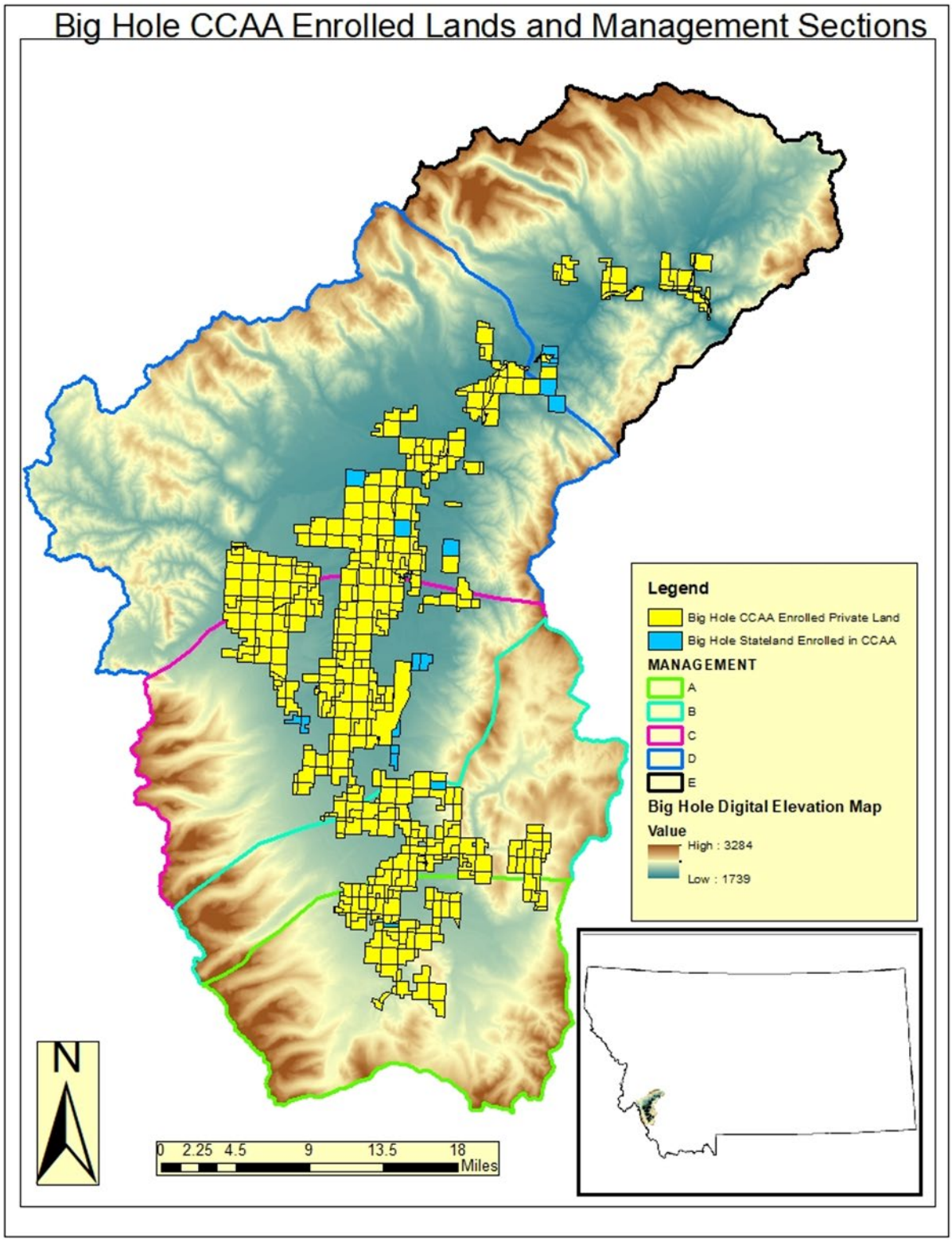

Figure 2. December 31st, 2020 Big Hole Arctic Grayling CCAA Program of private and state land enrolled. Enrolled land includes 32 private landowners and 148,320 private acres and 6,230 acres of DNRC leased lands.

IV. Big Hole Arctic Grayling CCAA Rapid Assessments and Compliance Monitoring

The Participating Landowners in the Big Hole Arctic Grayling CCAA allow the Agencies to complete a "rapid assessment" of the enrolled property within 90 days of enrolling. The rapid assessment focuses on identifying immediate threats to Arctic Grayling and validating water rights compliance. Immediate threats to Arctic Grayling may include structures, mechanical devices or pollutants that pose a threat of immediate mortality. Examples include unscreened pumping from or toxic effluent entering a stream. Additional information may be gathered during rapid assessments that assist with the development of the site-specific conservation plan with the Participating Landowner (Petersen and Lamothe 2006).

A. Surveys for Immediate Threats to Arctic Grayling

All surveys for immediate threats to Arctic Grayling have been conducted on enrolled properties. No immediate threats to Arctic Grayling were identified during the surveys. Monitoring of enrolled properties for immediate threats continues as site-specific conservation plans are being developed by the Agencies.

B. Water Rights Compliance Evaluation

Water right and irrigation compliance monitoring was completed on the following properties: 1–8, 10–21, and 23–31. These efforts, completed by DNRC and FWP, included site visits on each property to assess compliance of flow rate and period of use with the landowner's water right. Some of the required monitoring for enrolled properties was provided by the District Court–appointed water commissioner. Also, continuous stage recorders installed in the Spokane, Strowbridge, Ferris, Miller, Huntley, and Montgomery ditches provided flow information for water rights compliance, instream flow conservation projects, and ongoing development of the site-specific plans. During 2020, all enrolled landowner compliance monitoring and all flow plans were completed and adhered to (Table 1).

C. Streamflow Monitoring required by CCAA

In concert with the two USGS real-time streamflow gages located at Management Segments C and D (Figure 1), DNRC continued to operate and maintain four real-time streamflow gages located at Management Segments A, B, and E as well as a basin inflow gage. In addition, DNRC continuously monitored flow in at least one tributary within each Management Segment and six key irrigation ditches.

Table 1. 2017–2020 Irrigation Meeting and Compliance Monitoring.

Property #	2017		2018		2019		2020	
	Compliance Checks Completed	Irrigation Meeting	Compliance Checks Completed	Irrigation Meeting	Compliance Check Completed	Irrigation Meeting	Compliance Checks Completed	Irrigation Meeting
1	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
3	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
6	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
7	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
8	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	No*
9	Yes	Yes	Yes	Yes	No*	Yes	Yes	Yes
10	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
11	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
12	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
13	Yes	Yes	Yes	Yes	Yes†	Yes	No*	No*
14	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
15	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
16	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	No
17	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
18	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
19	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
20	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
21	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
22	Yes	Yes	Yes	Yes	No*	Yes	No*	No*
23	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
24	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
25	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
26	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
27	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
28	Yes	Yes	Yes	Yes	Yes†	Yes	No*	No*
29	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
30	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
31	Yes	Yes	Yes	Yes	Yes†	Yes	Yes	Yes
32	Yes	Yes	Yes	Yes	No*	N/A	No*	No*
Yes† -Landowner irrigation compliance completed in Spring and Summer, but precluded in Fall due to other priority conservation efforts								
No* - Landowner irrigation compliance/irrigation meeting precluded due to other priority conservation efforts or Covid-19								

V. Site-Specific Conservation Plans

Site-specific conservation plans are developed for each Participating Landowner by the Agencies and the landowner. The site-specific conservation plans identify conservation actions that will lead to improved streamflow, enhanced riparian and stream channel condition, improved fish passage and reduced levels of entrainment.

A. Completed and Approved

Currently 31 site-specific conservation plans have been implemented in the Big Hole CCAA program (Table 2). One site-specific conservation plan is currently in draft form due to landownership transfer; however, conservation efforts are being implemented with the current landowners. Six site-specific plans will undergo the 10-year or new ownership updates in 2021. In 2020, two site-specific plans were updated and implemented for another 10 years. All site-specific plans are 10-year agreements between the Participating Landowners, FWP, and the USFWS. Updates on the implementation of these site-specific plans, including compliance monitoring results, will be included annually in future reports. No new enrollment and site-specific plans have been developed in 2020.

B. Extension Requests Approved by the USFWS

FWP did not submit approval for extensions to complete site-specific plans in 2020. Extensions provided additional time to complete the SSP and document past and ongoing conservation actions for Arctic Grayling on the property receiving the extension.

Table 2. Property numbers of enrolled landowners and their associated CCAA management segment, enrolled acres, and enrollment status.

Property Number*	Management Segment(s)	Private Land Enrolled (Acres)	State Land Enrolled (Acres)	Enrollment Status	10 Year SSP Update
1	C & D	15,424.0	0	SSP Completed	2024
2	A	6,327.0	640	SSP Completed	2029
3	A & B	2,930.6	0	SSP Completed	2026
4	D and C	2,284.7	0	SSP Completed	2025
5	D	2,514.4	640	SSP Completed	2025
6	B and C	2,492.6	0	SSP Completed	2030
7	B	6,976.8	0	SSP Completed	2030
8	E	2,729.0	0	10-Year Update	2021
9	E	901.0	70	SSP Completed	2023
10	A	887.0	0	SSP Completed	2026
11	C	3,023.2	0	10-Year Update	2021
12	C & D	23,510.0	560	SSP Completed	2022
13	C & D	2,683.7	2,240	SSP Completed	2023
14	E	667.4	0	SSP Completed	2022
15	D	1,117.8	0	SSP Completed	2024
16	C	163.0	0	SSP Completed	2022
17	B & C	3,751.1	0	SSP Completed	2023
18	C	3,448.0	0	SSP Completed	2026
19	D	8,771.5	640	SSP Completed	2024
20	A and B	1,336.7	0	SSP Completed	2025
21	C	1,555.1	0	SSP Completed	2024
22	E	812.0	0	SSP Completed	2025
23	A, B, C & D	24,343.4	0	SSP Completed	2023
24	C & D	5,010.1	0	SSP Completed	2023
25	D & E	6,512.1	1,280	SSP Completed	2025
26	D	1,472.9	0	New Owner	N/A
27	A and B	4,136.7	160	SSP in Draft	N/A
28	E	333.3	0	SSP Completed	2027
29	A and B	6,277.2	0	SSP Completed	2025
30	A and B	880.0	0	SSP Completed	2024
31	E	1,629.0	0	SSP Completed	2024
32	B	3,418.8	0	New Owner	N/A

VI. Conservation Measures

Through the process of developing site-specific conservation plans for Participating Landowners, the Agencies identify projects that reduce or eliminate entrainment of Arctic Grayling, eliminate barriers to fish passage, maintain adequate streamflow and protect and/or improve riparian and stream habitat quality. Projects and related conservation efforts completed in 2020 are reported below.

A. Entrainment Surveys

In 2020, FWP completed 18 entrainment surveys on 8.92 miles of irrigation ditches managed by six enrolled landowners (Table 3). No grayling were collected during these surveys. Fish species present during entrainment surveys included: Brook Trout (*Salvelinus fontinalis*), Brown Trout (*Salmo trutta*), Rainbow trout (*Oncorhynchus mykiss)*, Mountain Whitefish (*Prosopium williamsoni*), Burbot (*Lota lota*), Longnose Dace (*Rhinichthys cataractae*), Rocky Mountain Sculpin (*Cottus bondi*), Longnose Suckers (*Catostomus commersoni*), and White Suckers (*Catostomus catostomus*).

Table 3. FWP electrofishing entrainment surveys completed in 2020 in the upper Big Hole watershed as part of the Big Hole Grayling CCAA requirements.

Date	Source	Miles	Number of Grayling Rescued
7/21/2020	Warm Springs Creek	0.44	0
7/21/2020	Warm Springs Creek	0.37	0
7/21/2020	Big Hole River	0.52	0
7/21/2020	Warm Springs Creek	0.52	0
7/21/2020	Governor Creek	0.68	0
7/21/2020	Warm Springs Creek	0.49	0
7/22/2020	LaMarche Creek	0.42	0
7/22/2020	Big Hole River	0.54	0
7/22/2020	Rock Creek	0.89	0
7/22/2020	Deep Creek	0.16	0
7/22/2020	Big Hole River	0.67	0
7/23/2020	North Fork Big Hole	0.29	0
7/23/2020	North Fork Big Hole	0.80	0
7/23/2020	Big Swamp Creek	0.61	0
7/23/2020	NF Big Swamp	0.24	0
7/23/2020	Little Lake Creek	0.13	0
7/23/2020	Little Lake Creek	0.61	0
9/24/2020	Big Hole River	0.54	0
	Total	**8.92**	**0**

B. Projects to Minimize or Eliminate Entrainment of Arctic Grayling

Low channel gradients preclude using fish screens to reduce entrainment in parts of the Study Area; however, fish screens installed on La Marche and Rock creeks have successfully prevented grayling entrainment. The Agencies are developing a new fish screening system for a large ditch downstream of Wisdom that has repeatedly entrained grayling YOY. However, in 2020 no grayling YOY were observed during rescue operations. This project is anticipated to be completed in the Fall of 2021. Rescue operations will continue in the ditch downstream of Wisdom until the fish screening system is installed.

C. Projects to Enhance Fish Passage

During 2020 the Agencies completed three fish passage improvement projects (Table 4).

Table 4. Upper Big Hole Watershed fish passage projects completed in 2020 as part of the Big Hole Arctic Grayling CCAA. Projects include improving or modifying irrigation diversions to provide fish passage, installing fish ladders or installing bridges.

2020		
Associated Waterbody	**Enrolled Landowner**	**Project Component**
Fishtrap Creek	22	One Fish Ladder
Swamp Creek	1	Two Fish Ladders

D. Projects to Enhance Riparian and Stream Channel Habitat

During 2020 the Agencies and Participating Landowners implemented 8 riparian habitat projects to enhance stream function and riparian habitat on 10 properties (Table 5).

Table 5. Upper Big Hole Watershed riparian and stream channel improvement projects completed in 2020 as part of the Big Hole Arctic Grayling CCAA. Projects include improving riparian habitat through stock water development, stream restoration, channel activation, riparian pasture fence, etc.

2020		
Associated Waterbody	**Enrolled Landowner**	**Project Component**
Big Hole River	20	Stream Restoration

Big Hole River	25	Stream Restoration
Big Hole River	Non-enrolled	Stream Restoration
Rock Creek	11	Riparian Fence
North Fork of Miner Creek	6	Riparian Fence
Swamp Creek	4	Riparian Fence Removal
Big Hole River	27 and 20	River Fence Crossing

E. Projects to Improve Streamflow and Irrigation Water Management

During 2020 the Agencies partnered with participating landowners to implement 10 projects on eight enrolled properties to enhance the ability to control and measure irrigation withdrawals and reduce the need to divert water for livestock watering purposes (Table 6).

Table 6. Upper Big Hole Watershed streamflow and irrigation management projects completed in 2020 as part of the Big Hole Arctic Grayling CCAA. Projects include installing headgates, PODs, ditch maintenance, and stock tank and spring development and maintenance.

2020		
Associated Waterbody	**Enrolled Landowner**	**Project Component**
Moose Creek	1	Stockwater System
Fishtrap Creek	22	Headgate
Swamp Creek	1	Two Headgates
Big Hole River	20	Headgate
Spring Creek	27	Headgate

Big Hole River	17	Headgate
Deep Creek	9	Stockwater Well Maintenance
Big Hole River	27	Solar Panel for Stockwater System
Steel Creek	13	Headgate and Ditch Repair
Big Hole River	18	Headgate

In addition to improvements to irrigation infrastructure, the Big Hole Arctic Grayling CCAA requires reductions to irrigation diversions in response to streamflows dropping below established seasonal flow targets at each of the five gaging stations (Miner Lakes Road, the mouth of Miner Creek, the Wisdom Bridge, Mudd Creek Bridge, and Dickie Bridge). A total of 163 ft^3/s in 2020 were returned to the Big Hole or its tributaries in accordance with site plans and flow targets. The majority of these flows returned to the Big Hole River and tributaries were implemented in the summer months (July, August and September) as base flow conditions persisted as well as below average precipitation throughout the basin.

F. Projects to Expand Arctic Grayling Distribution into Historically Occupied Waters

One of the CCAA Arctic Grayling population goals is for Arctic Grayling to reoccupy or utilize habitats in historically occupied waters within the Big Hole Arctic Grayling CCAA Project Area (FWP and USFWS 2006). RSI's were deployed in Trail Creek and Wise River from 2014-2018 and over 300,000 grayling eggs were incubated in each of the streams. Subsequent monitoring in 2015 and again in 2019 failed to find any juvenile grayling in either stream. A single adult grayling was captured in the Wise River in 2015 but this fish did not originate from the eggs incubated in RSI's.

Arctic grayling were introduced into Van Houten Lake and Twin Lakes. Eggs were collected from Mussigbrod and Miner lakes and eyed at the Big Timber hatchery. They were subsequently introduced into both lakes through the use of flow through container incubators. Eggs were incubated in 3 consecutive years in both lakes. Adult grayling from Mussigbrod and Miner lakes were also introduced to Van Houten Lake. Subsequent monitoring showed that the adult grayling introduced into Van Houten Lake were thriving, but there was no evidence that eggs introduced recruited to the fishery. Age-1 grayling from the Axolotl Lake brood pond were stocked into Van Houten Lake in 2019. No subsequent monitoring has occurred at Twin Lakes, but no angler reports have been received of grayling being caught in the lakes.

Age-1 Arctic grayling were introduced into McVey Creek in 2018 and 2020. A fish barrier was constructed on McVey Creek in 2011 to block upstream fish passage of non-native fish so that restoration of westslope cutthroat trout could occur upstream. The fish barrier created a small

pond upstream. Grayling were introduced to this pond. Netting in the spring of 2019 indicated the fish introduced in 2018 were thriving. Subsequent electrofishing later that summer revealed that the age-grayling had successfully reproduced in the stream upstream of the pond. More than 100 young of the year grayling were counted in the stream. In 2019 a population estimate was done on age-0 grayling upstream of the pond and there were 128 fish/mile in the reach immediately upstream of the pond. Age-1 grayling ranged upstream of the pond more than 1.5 miles.

Long Branch Creek also received introductions in 2018, 2019 and 2020. Long Branch Creek was also a stream where westslope cutthroat trout restoration has occurred. The non-native rainbow and Yellowstone cutthroat trout that were present in the stream were removed with rotenone. The lower mile of the stream upstream of the natural fish barrier is low gradient and contains a shallow lake (Long Branch Lake). Arctic grayling from the Axolotl brood were introduced into this lower reach of the stream. No subsequent monitoring has occurred yet in Long Branch Creek.

In 2020 grayling were introduced into lower reaches of Bender Creek which is a tributary to Johnson Creek which flows into the North Fork of the Big Hole River. Brook trout were removed from Bender Creek upstream of a fish constructed fish barrier. Similar to Long Branch Creek, the habitat immediately upstream of the fish barrier is low gradient. There are multiple beaver dams and age-1 grayling were introduced to the stream immediately upstream of the low gradient section of stream. Subsequent introductions are planned in Bender Creek with the hopes of establishing a self-sustaining population of grayling.

VII. Monitoring

The Big Hole Arctic Grayling CCAA requires specific monitoring of the grayling population response to conservation measures implemented under this agreement. In 2016, FWP began using genetic monitoring to document population trends in Big Hole grayling under the guidance of geneticists and with the approval of USFWS (Kovach et al. 2020; Table 8). Genetic monitoring was justified for two reasons, 1) Determining trends in population abundance of rare or highly migratory fish species can be difficult, and 2) Genetic analysis is an effective alternative or supplemental method to determine the health and long-term persistence of fish populations (Schwartz et al. 2007). Genetics are used to analyze the structure of an Arctic Grayling population and determine its long-term viability by estimating genetic diversity in a population (A_r), effective number of breeding individuals that produced a given cohort (N_b), and ultimately the overall genetic effective population size (N_e). These estimates provide important population information on potential rate of loss of genetic variability and inbreeding depression, population dynamics, and the efficacy of management actions. Moreover, genetic data ensure that conservation efforts maintain the historic diversity found within and among Arctic Grayling populations, and thus, the continued evolutionary legacy of the species [Upper Missouri River Arctic Grayling Conservation Strategy, in preparation]. Additionally, stream

temperature and discharge are monitored on each of the 10 reaches (FWP and USFWS 2006). Mainstem reaches are located near the lower boundary of each management segment (A through E) and tributary reaches include Governor Creek, Miner Creek, Rock Creek, Steel Creek and Deep Creek. Additional monitoring is conducted to evaluate restoration projects.

A. Fish Population Monitoring

In fall 2020, FWP completed electrofishing surveys to determine N_b in the Big Hole River drainage. Surveys were conducted on 11 reaches over a total of 14.07 miles. A total of 180 young of year (YOY) and 20 Age 1+ grayling were captured during these surveys (Table 7). One hundred-twenty YOY grayling genetic samples were used to calculate N_b. N_b for the 2020 grayling cohort was 208 (95% CI: 167-271; Figure 3). Although point estimates for N_b were lower than the estimate from last year (332.8), they are consistent with the ongoing positive trend in N_b for the Big Hole grayling population. Other species sampled included brook trout, brown trout, rainbow trout, burbot, sculpin, longnose dace, white suckers, and longnose suckers.

Table 7. Grayling captured during 2020 Fall one-pass electrofishing surveys in the Big Hole River watershed.

Reach Name	Reach Length (mi.)	Number of Grayling YOY Samples Collected
Deep Creek	2.06	0
Howell Creek	0.59	0
Howell Side Channel	0.65	43
Upper Howell Side Channel	0.55	7
Pintler Creek	0.51	13
Plimpton Creek	2.74	5
Upper Plimpton Creek	0.39	1
Squaw Creek	0.8	40
Lower Squaw Creek	0.05	54
Steel Creek	2.7	1
Swamp Creek	3.03	16
TOTALS	**14.07**	**180**

Table 8. Estimates of family summary statistics and N_b for Arctic Grayling from the Big Hole River. N is number of individuals genotyped. N_b shows estimates of the effective number of breeders, based on 12 microsatellites. LCI and UCI are the lower and upper (respectively) 95% confidence intervals for the N_b estimate from each year

Year	N	N_b	LCI	UCI
2007	50	107.1	76.2	171.7
2008	30	77.2	47.6	175.7
2009	128	77.6	66.7	91.4
2010	46	92.4	66.1	146.0
2011	66	81.9	64.5	108.9
2012	56	289.0	142.8	5050.9
2013	49	432.7	171.7	∞
2014	88	268.4	166.8	614.1
2015	56	181.9	109.2	465.5
2016	51	96.1	68.0	155.3
2017	63	155.4	103.3	289.7
2018	128	145.2	115.1	191.3
2019	145	332.8	203.7	510.1
2020	119	208.0	166.6	271.3

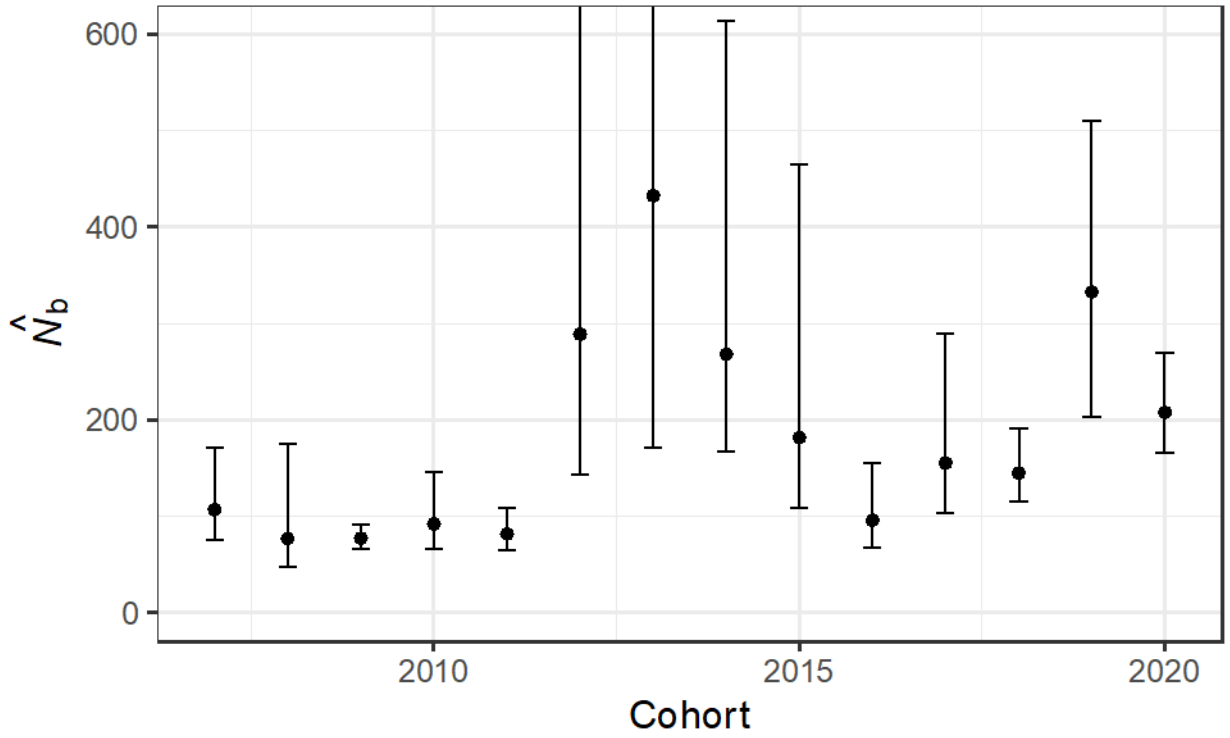

Figure 3. Estimates of the number of effective breeders (N_b) in Arctic grayling from the Big Hole River over time. Error bars indicate 95% confidence intervals.

B. Stream Temperature Monitoring

In 2020, stream temperature data were collected in the Big Hole River at Saginaw Bridge, Miner Lakes Road, the confluence with Miner Creek, Wisdom Bridge, and Dickie Bridge. A thermograph was lost on the Big Hole River at Mudd Creek Bridge due to bridge construction. The 2020 Big Hole River tributary sites included Deep Creek, Governor Creek, Howell Creek, Miner Creek, the Confluence of Plimpton and Howell Creeks, Plimpton Creek, Rock Creek, Smith Spring, and Steel Creek. A thermograph was lost on Governor Creek due to high flows, but data was used from a TruTrack 100 ft upstream. Stream temperature data were recorded at 60-minute intervals from May 1st through October 1st. The 2020 data were summarized as maximum and mean temperature for the monitoring period and hours and days exceeding 21.1º C (70º F) and 25º C (77º F; Table 9). The thermal stress threshold for salmonid species is considered 21.1º C (70 º F; Behkne 1992), and 25º C (77º F) represents the upper incipient lethal temperature for Arctic Grayling (Lohr et al. 1996).

Table 9. Stream temperature monitoring results for 2020.

Monitoring Site (Big Hole Arctic Grayling CCAA Management Section	Mean Seasonal Temperature °C (°F)	Maximal Seasonal Temperature °C (°F)	Cumulative Hours Exceeding 21.1° C (70° F)	Cumulative Hours Exceeding 25° C (77° F)
Big Hole River Dickie Bridge	15.3 (59.6)	24.1 (75.4)	127	1
Big Hole River Miner Creek Confluence	12.6 (54.7)	23.4 (74.1)	70	0
Big Hole River Miner Lakes Road	11.5 (52.6)	21.9 (71.4)	8	0
Big Hole River Saginaw Bridge	9.7 (49.5)	19.6 (67.3)	0	0
Big Hole River Wisdom Bridge	13.8 (56.9)	23.0 (73.4)	70	0
Deep Creek	11.7 (53.0)	22.1 (71.7)	13	0
Governor Creek	12.7 (54.9)	23.4 (74.1)	93	0
Howell Creek	11.5 (52.6)	21.7 (71.0)	6	0
Miner Creek	12.6 (54.7)	23.4 (74.1)	70	0
Plimpton – Howell Confluence	14.0 (57.3)	25.4 (77.6)	256	2
Plimpton Creek	14.6 (58.4)	25.1 (77.2)	253	1
Rock Creek	13.5 (56.4)	23.5 (74.3)	121	0
Smith Spring	13.6 (56.4)	25.0 (77.0)	201	1
Steel Creek (1)	13.8 (57.0)	24.8 (76.6)	197	0
Steel Creek (2)	13.0 (55.3)	22.7 (72.8)	35	0
Steel Creek (3)	11.2 (52.1)	20.9 (69.6)	0	0
Steel Creek (4)	10.3 (50.5)	18.2 (64.8)	0	0

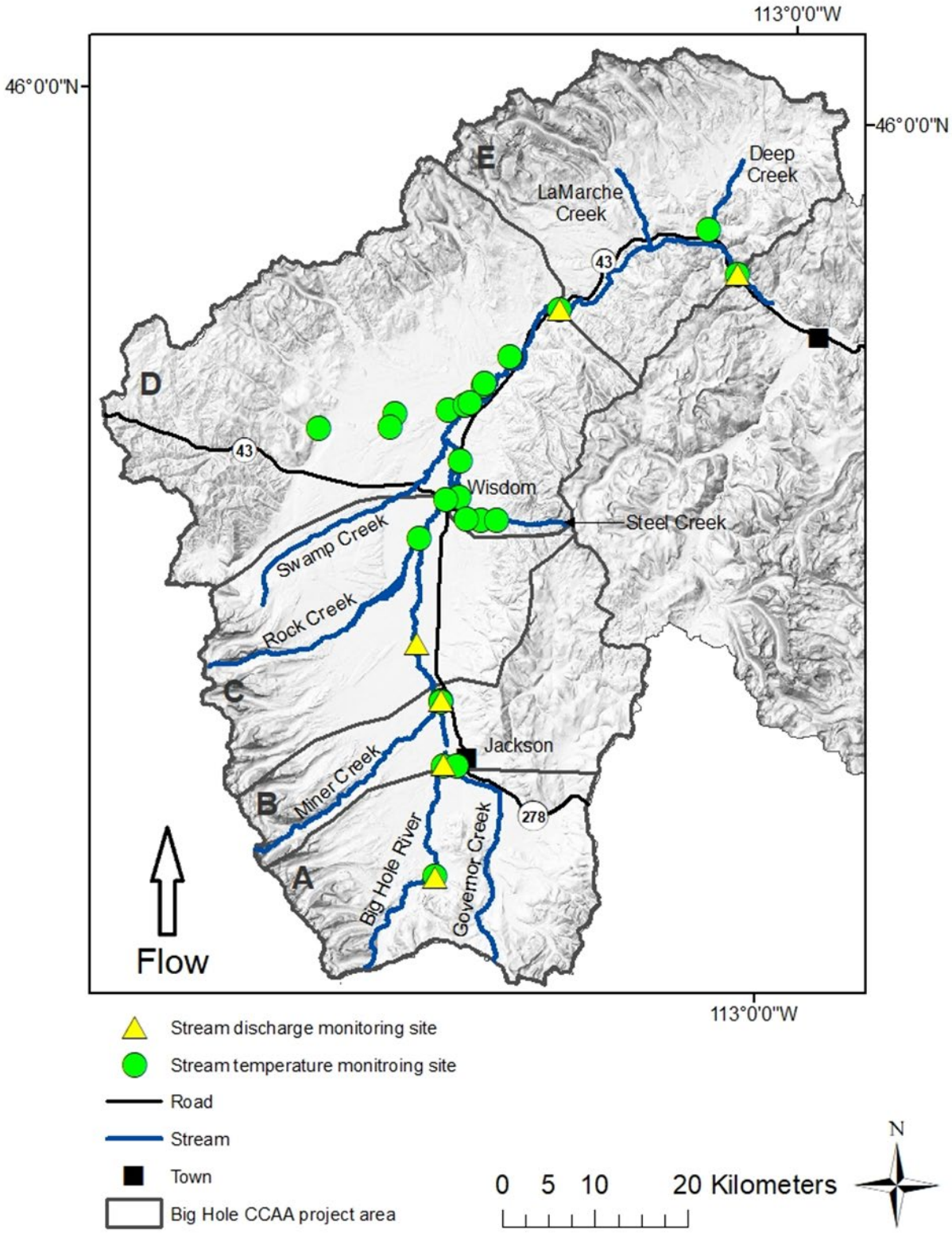

Figure 4. Stream temperature (green circle) and stream discharge (yellow triangle) monitoring sites in the Big Hole Arctic Grayling CCAA Project Area.

C. Streamflow Monitoring

Along with two USGS real-time streamflow gages located at management segments C and D, DNRC continued to operate and maintain four real-time streamflow gages located at the upper project boundary and at management segments A, B, and E (Figure 3) as part of a Furnished Record Policy with the USGS. In addition, DNRC continuously monitored flow in at least one tributary within each management segment and six key irrigation ditches.

Snowpack and precipitation data were monitored by NRCS (available at www.nrcs.gov), and results are based on the period-of-record (1981–2010).

In 2020, the Big Hole basin snowpack peaked above median values, however snowpack receded faster than normal resulting in overall below average snowpack. Total precipitation in the Big Hole basin was 99% of average. A large June precipitation event extended runoff by a couple of weeks and provided a much-needed boost in streamflows. Below average snowpack conditions and average total precipitation resulted in Big Hole Arctic Grayling CCAA stream discharge targets being met 78% of the time (Figures 5-10), which is consistent with the general flow target goal stated in the CCAA of meeting or exceeding flow target values at least 75 % of the days during the spring period and during the summer and fall period in years with an average snowpack.

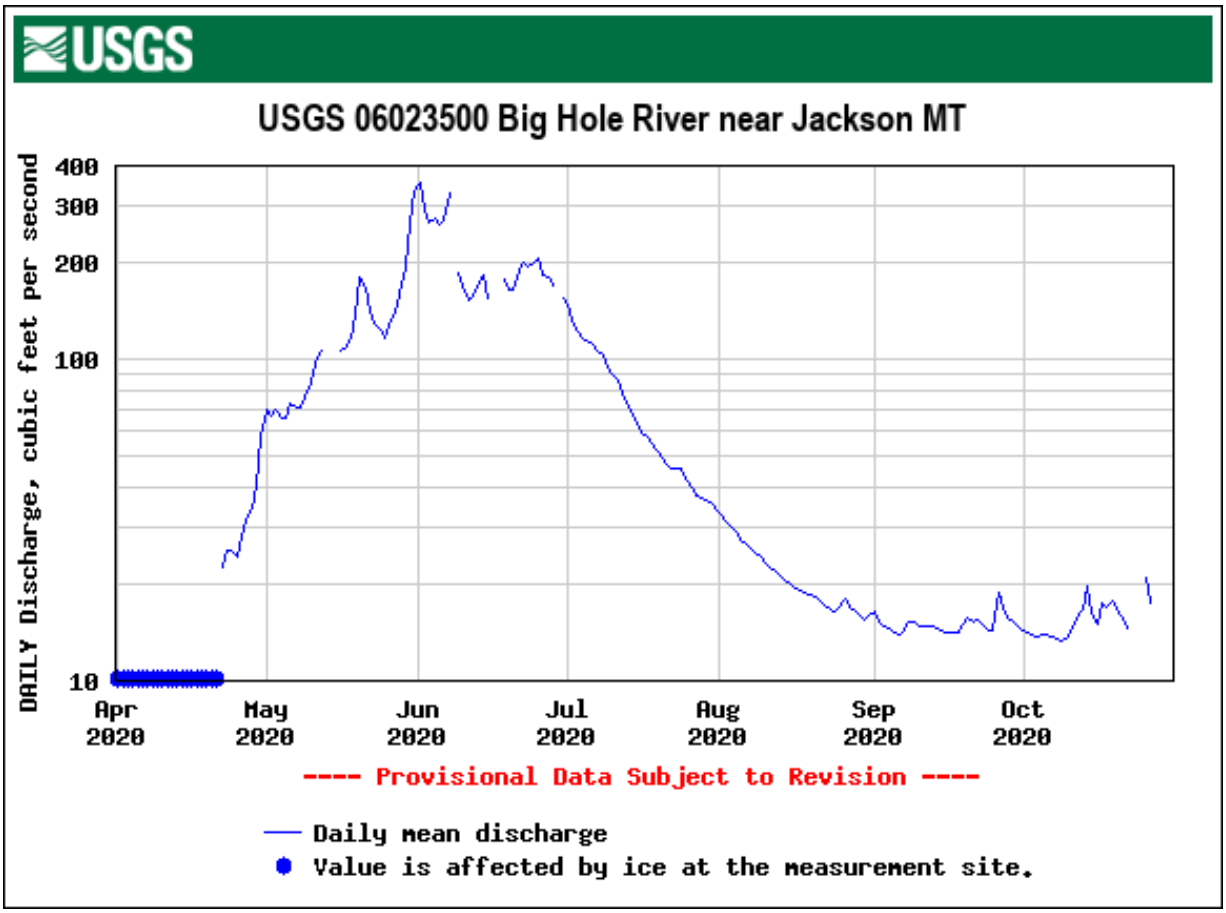

Figure 5. 2020 stream discharge data collected from the Big Hole River at the real-time gaging station located at the upper Big Hole Arctic Grayling CCAA project area boundary (Saginaw Bridge).

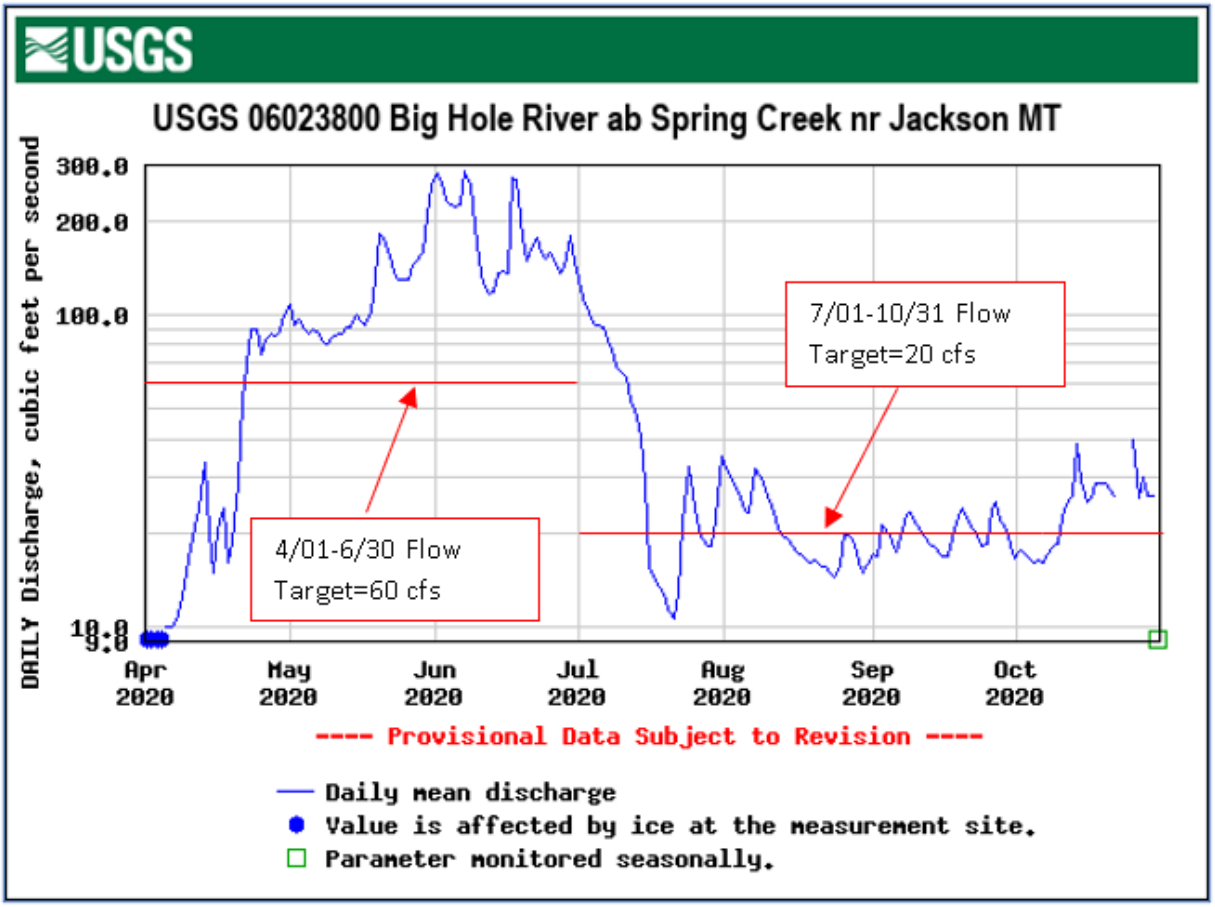

Figure 6. 2020 stream discharge data collected from the Big Hole River at the real-time gaging station located at the lower Big Hole Arctic Grayling CCAA Reach A boundary (Miner Lakes Road).

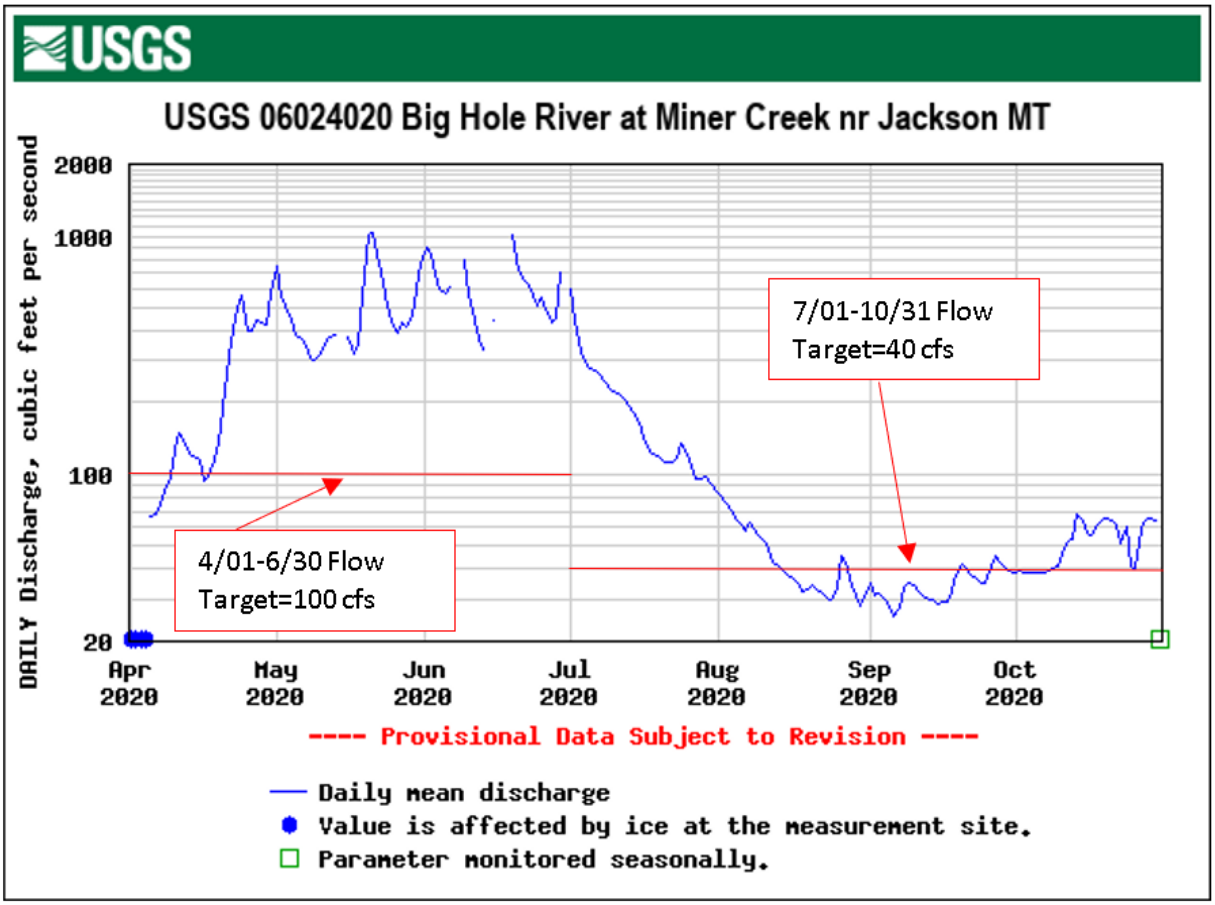

Figure 7. 2020 stream discharge data collected from the Big Hole River at the real-time gaging station located at the lower Big Hole Arctic Grayling CCAA Reach B boundary (confluence with Miner Creek).

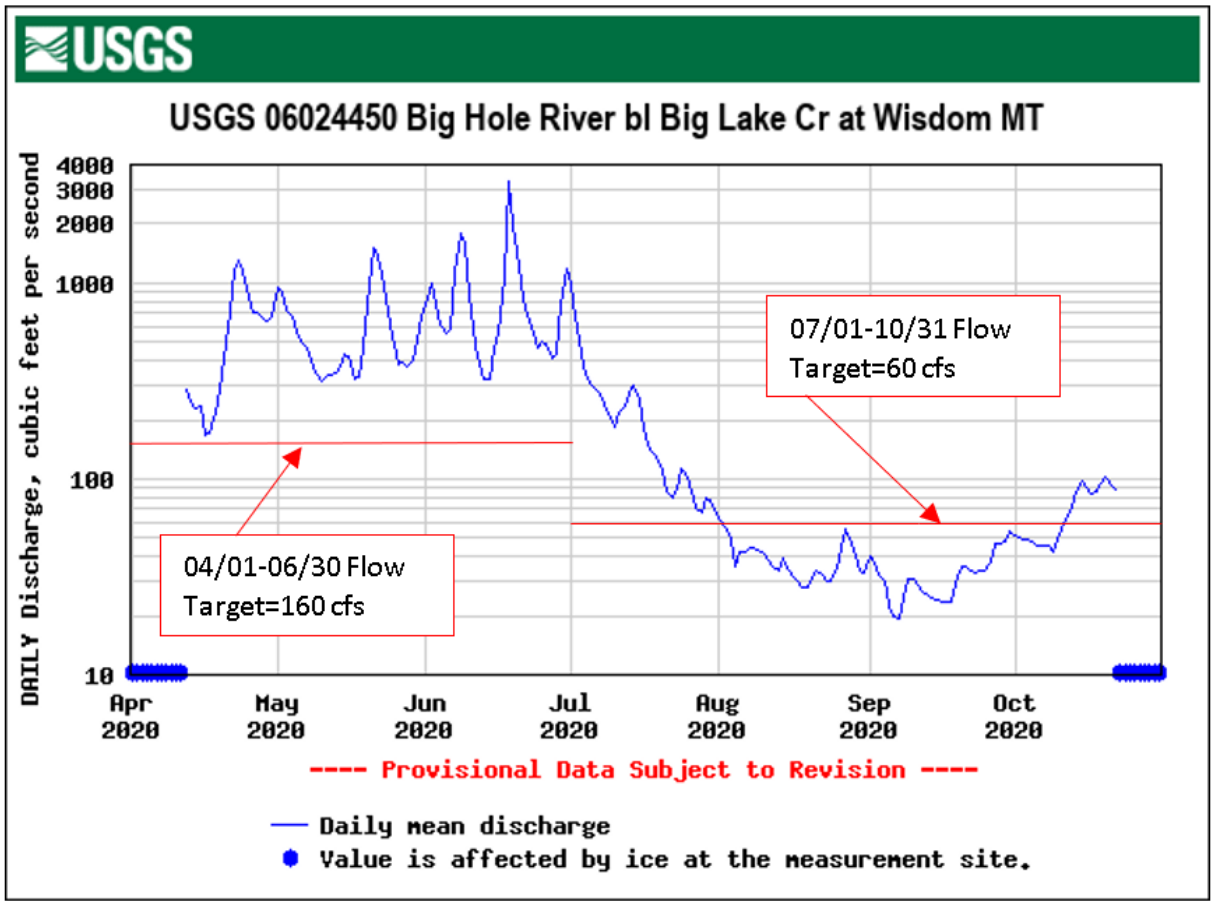

Figure 8. 2020 stream discharge data collected from the Big Hole River at the real-time gaging station located at the lower Big Hole Arctic Grayling CCAA Reach C boundary (Wisdom Bridge).

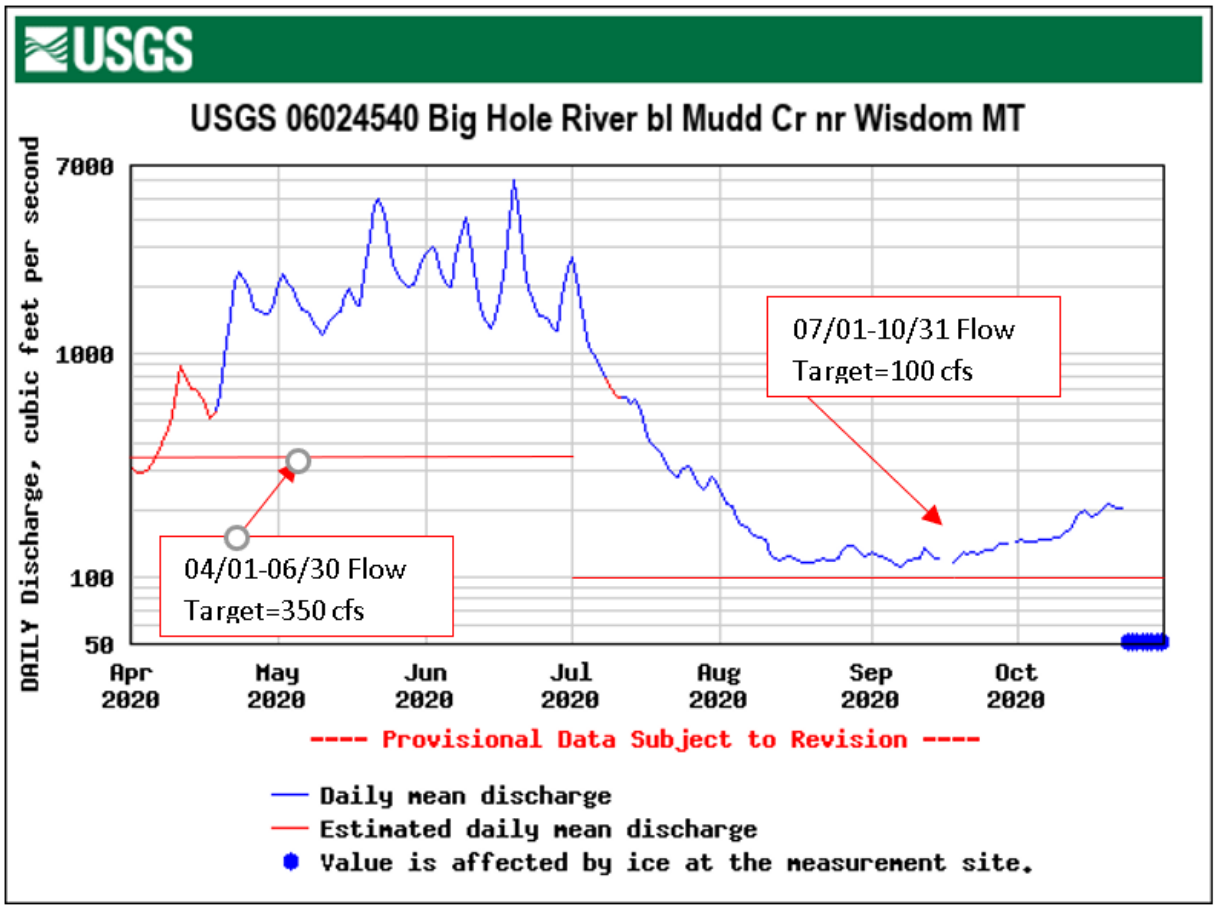

Figure 9. 2020 stream discharge data collected from the Big Hole River at the real-time gaging station located at the lower Big Hole Arctic Grayling CCAA Reach D boundary (Mudd Cr Bridge).

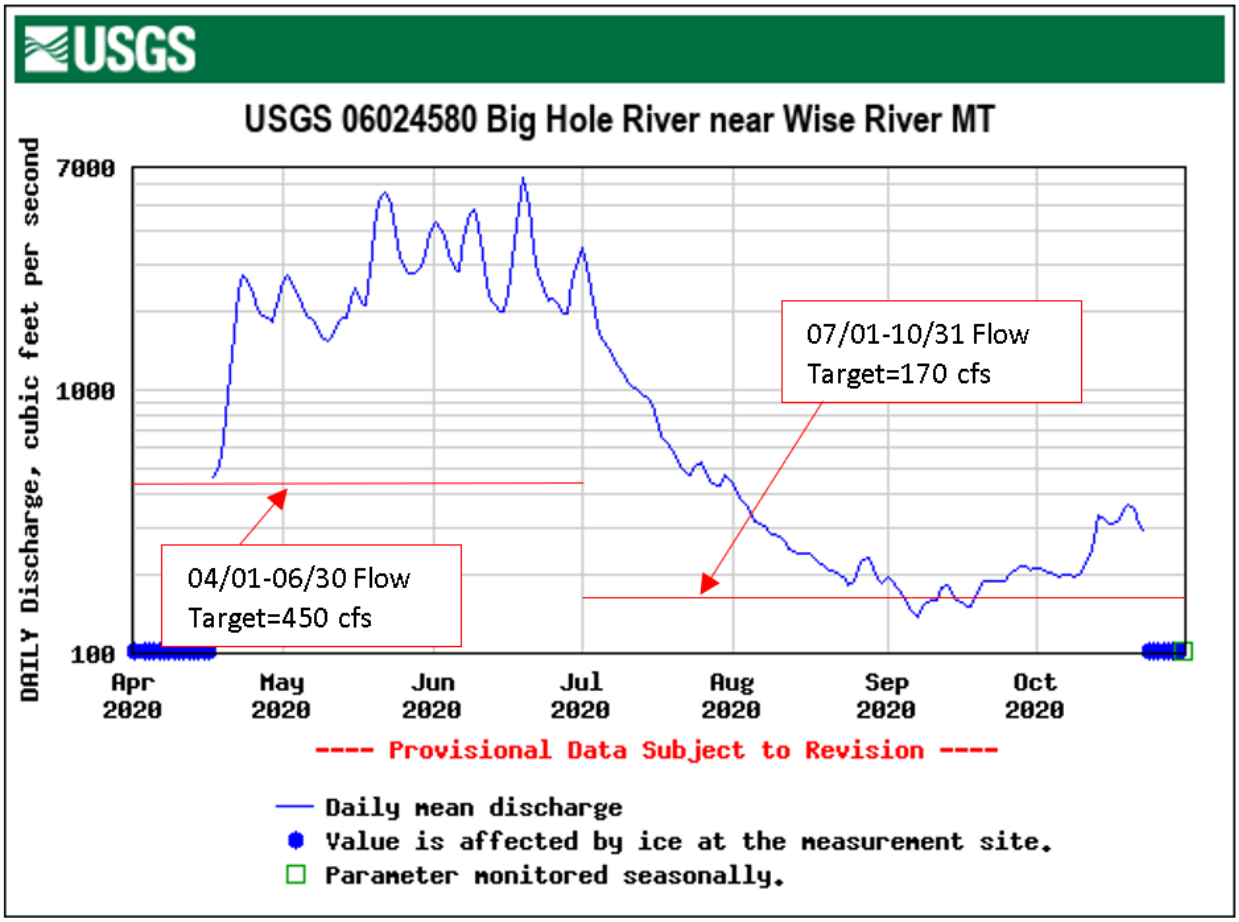

Figure 10. 2020 stream discharge data collected from the Big Hole River at the real-time gaging station located at the lower Big Hole Arctic Grayling CCAA Reach E boundary (Dickie Bridge).

D. FWP Monitoring of Compliance with Approved Site-Specific Plans

The monitoring of compliance with approved site-specific plans has occurred annually on the following Properties: 1–32. All landowners with approved site-specific plans followed their plan in 2020. FWP field personnel checked the amount of water being diverted by the landowners, the trend of riparian areas under a grazing or riparian management plan, the ability of fish to access fish passage structures and for any evidence of immediate threats of harm or mortality to on the enrolled properties. The initial compliance meetings focus on expectations for monitoring the riparian management and irrigation diversion agreements in the approved site-specific plan. The necessary field forms for documenting actions are provided to the landowners at that time.

VIII. Summary of Estimated Take Associated with the Big Hole Arctic Grayling CCAA

In 2020, the USFWS determined that listing the upper Missouri River Basin Distinct Population Segment of Arctic Grayling, as threatened or endangered under the Endangered Species Act

was not warranted. Due to the current legal status of Arctic Grayling, ESA-defined take (harm, harass or kill) did not apply to the implementation or monitoring of the Big Hole Arctic Grayling in 2020.

IX. NRCS Special Funding

In 2018, the NRCS secured funding for a 4-year, permanent technician position in cooperation with FWP and DNRC. The position is managed by FWP to assist with CCAA irrigation compliance and riparian monitoring. This position was hired in the spring of 2018–2019 through FWP and DNRC, and again filled in March of 2020. The technician position will remain filled through the duration of the grant. The NRCS will continue to pursue and meet the obligations of existing EQIP contracts with enrolled landowners in 2021, develop TIP proposals during the Winter of 2021, and secure funding for the permanent technician position in 2022.

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