

Wood River Wetland Bullfrog Radio Telemetry Project

Bureau of Land Management – Lakeview District – Klamath Falls Resource Area

Fall 2008

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Introduction

Habitat loss and competition/predation from invasive species affects countless native species around the world. These occurrences are becoming more apparent in the results of numerous studies and monitoring efforts. The Oregon Spotted Frog (*Rana pretiosa*) is not different from the numerous species that are currently or have experienced drastic changes to their habitat. Once occurring over much of the Pacific Northwest, Oregon Spotted Frog (OSF) populations are believed to have been extirpated from up to 90% of their historic range (Hayes et. al 1997; McAllister and Leonard 1997). This habitat loss, along with many other factors, led the U.S Fish and Wildlife Service to designate the OSF as a candidate species for listing under the Endangered Species Act (USFWS 1993). This elevated status has highlighted the need for further research, surveys, and monitoring efforts for the species.

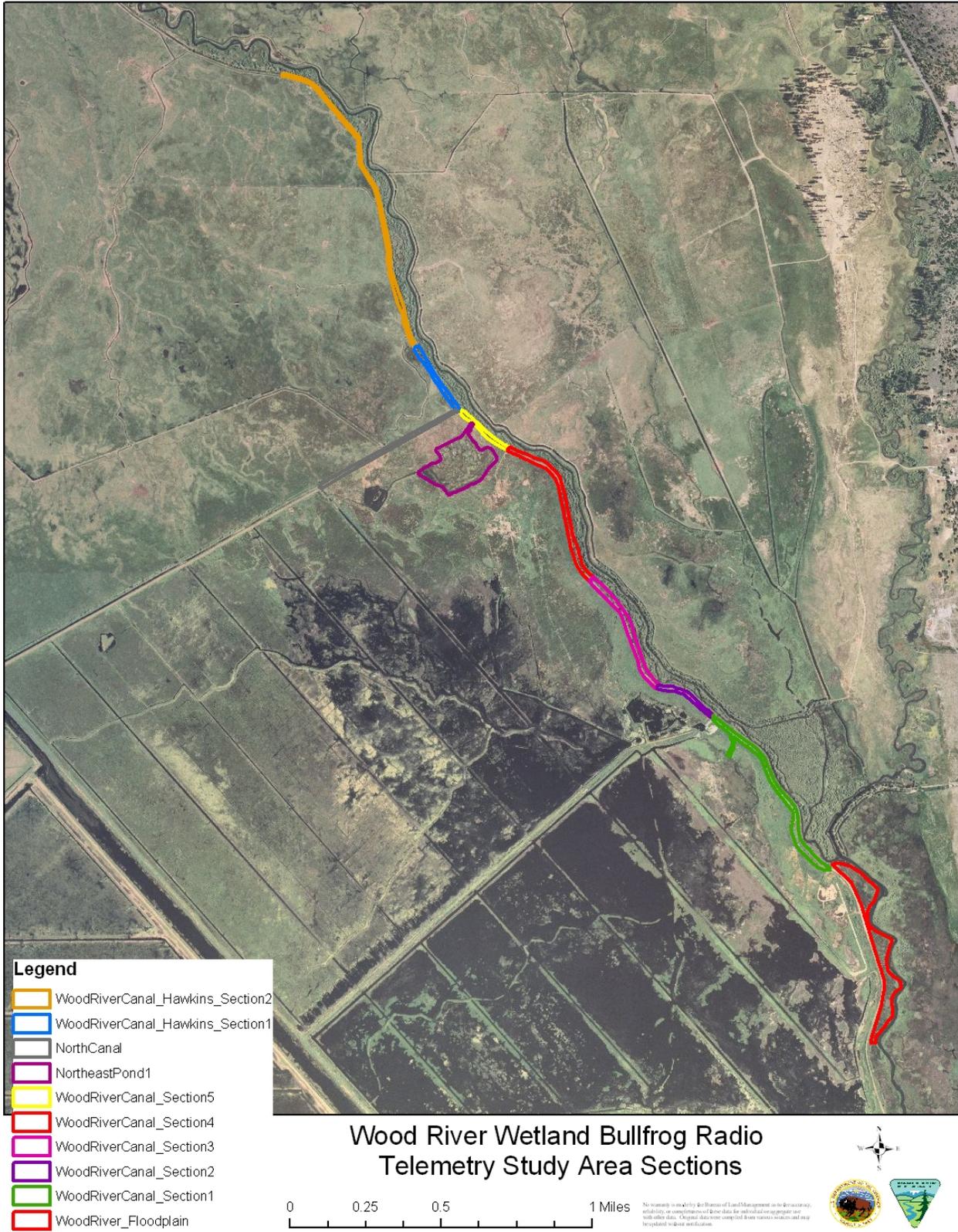
An understanding of specific habitat requirements during every life stage is critical for habitat management for ranids. The Wood River Wetland (WRW) OSF population has been well-studied during the spring and summer, documenting breeding and summer foraging habitat. Overwintering habitat/sites have not yet been documented for this population and this project was originally planned to gain further understanding of overall habitat needs for this endemic species. Documenting overwintering sites for the OSF was the main objective of this study. The initial approximately 4 weeks of effort in September 2008 to capture adult OSFs proved extremely difficult, and was largely unsuccessful. This difficulty was due to impenetrable stands of wocus (*Nuphar polysepalum*) within the site making navigation, and locating and capturing adult OSF's almost impossible. Also, it was theorized that the increasing presence of the invasive American bullfrog (*Rana catesbeiana*) made the OSF's extremely wary and therefore nearly impossible to approach during this time of year, even at night. The American Bullfrog is a widely introduced and invasive anuran that is frequently blamed for population declines of indigenous species (Bury and Whelan 1984). Some studies suggest that other factors associated with Bullfrog presence, like introduced fish or habitat alterations, may be more detrimental to indigenous species than the Bullfrogs themselves (Kiesecker and Blaustein 1998, Adams 1999, 2000). However, an increasing number of studies show direct and indirect negative effects of Bullfrogs on indigenous anurans via competition, predation, and habitat displacement (Boone et al. 2004, Pearl et al. 2004, others reviewed in Kiesecker 2003). Recent work raises the possibility that Bullfrogs may serve as a reservoir of a chytrid fungus, *Batrachochytrium dendrobatidis* (Longcore et al. 1999), pathogenic to some amphibians (Hanselmann et al. 2004, Pearl and Green 2005, Garner et al. 2006). Despite some conflicting reports and regional differences in effects, Bullfrogs are clearly a conservation concern (Adams and Pearl 2007).

The OSF's that were captured were undersized, and it was soon realized that capturing adult OSF's of appropriate size to fit with radio transmitters was not possible this year. In order to continue the study, utilize the radio transmitters and collect valuable movement and overwintering site data, transmitters were placed on American bullfrogs (bullfrogs) which we were able to capture at night. At this point, the focus of the study shifted from identifying OSF overwintering sites to studying bullfrog fall movements and overwintering sites. This data on local bullfrog habitat use is important for OSF habitat management because it has been hypothesized that potential competition for overwintering habitat between OSF's and bullfrogs may be a contributing factor to the recent decline/displacement of OSF's over the last decade within the WRW site.

Methods

This study was conducted within the Bureau of Land Management (Klamath Falls Resource Area) managed Wood River Wetland (WRW), which is located just north of Agency Lake in the Klamath Basin in southern Oregon (see Figure 1). The WRW OSF site is broken up into 10 segments along the east boundary of the wetland and adjacent to the Wood River itself (see Figure 2). The site is approximately 68 acres in size and 5441 meters in length. It was decided for logistical and navigational reasons to focus on the core of the site on BLM land, which includes 5 segments of the Wood River Canal (WRC) (see Figure 2). This area (WRC Sections 1-5) is approximately 3350 meters in length (see Figure 2).

Figure 2 – WRW OSF Site Segments



Capturing and radio fitting was conducted in early to mid September 2008. Bullfrogs were captured by hand and net from canoes in all five segments of the WRC by government personnel. Capturing was conducted at night with battery powered, hand-held spotlights to locate bullfrogs.

Once frogs were captured and determined to be of suitable size and health, they were put into temporary holding containers. A suite of habitat data were collected at the time of each frog's capture including: date, time, air temperature, water temperature, estimated water depth, estimated width of canal, adjacent vegetation types, UTM coordinates, canal segment number, and the frog's distance from shore when captured. Also, shortly after capture, the following data were collected for each frog: weight, snout to vent length, likely sex, and estimated age. Age estimates were based purely on size and sex was extremely difficult to determine on subadults (Table 1).

Suitable frogs were then belted using silk satin ribbon waist belts that the radio transmitters had been pre-sewn onto using nylon thread. Holohil Systems Ltd., model BD-2 transmitters were used. To accommodate frogs of varying sizes/weights, 1.5 and 1.9 gram transmitters were used. Fourteen frogs were fitted with 1.5 gram transmitters and 5 frogs with 1.9 gram transmitters. Battery life for both sizes of transmitters was approximately eight to ten weeks. This was ample duration to document frog locations as they moved into their overwintering habitat.

Radioed frogs were then released at their original capture site since they may be associated with microsite conditions. An attempt was made to put transmitters on frogs distributed throughout the 5 segments of the WRC in order to capture movement behaviors that may be associated with particular segments.

The second phase of the study was collecting location data for each radioed bullfrog. This work was performed by a contractor (South Wind Conservation, Inc.). The receiver/antenna used was a government-provided Lotek SRX 400. The telemetry was done from late September 2008 to early November 2008. Frogs were located every 2-5 days and several measurements were recorded upon each detection. Along with the UTM coordinates and canal segment number, segment locations of the belted frogs, date, time, estimated width of canal, estimated water depth, distance from shore, and distance from open water was also recorded for each frog located. Using a government provided YSI DO/Temp meter, the water temperature for the upper, middle and lower thirds of the water column was collected as well as the dissolved oxygen for the upper, middle and lower thirds of the water column. The vegetation types adjacent to the frog location were also recorded. Although no transmitters were successfully recovered, an attempt was made to remove all transmitters before the battery life expired.

Results

In just over one week, 19 bullfrogs were fitted with radio transmitters within the WRW OSF site (WRC segments 1-5). Six frogs were captured in WRC1 (BF9, BF10, BF11, BF12, BF15, BF16), 4 in WRC2 (BF5, BF6, BF7, BF8), 3 in WRC3 (BF13, BF14, BF17), 4 in WRC4 (BF1, BF2, BF3, BF4) and 2 in WRC5 (BF18, BF19). The weights of the radioed frogs ranged from 21.5 grams to 150.8 grams. The snout to vent lengths ranged from 59.8 millimeters (mm) to 106.6 mm with a mean of 66.5 mm (Table 1). The

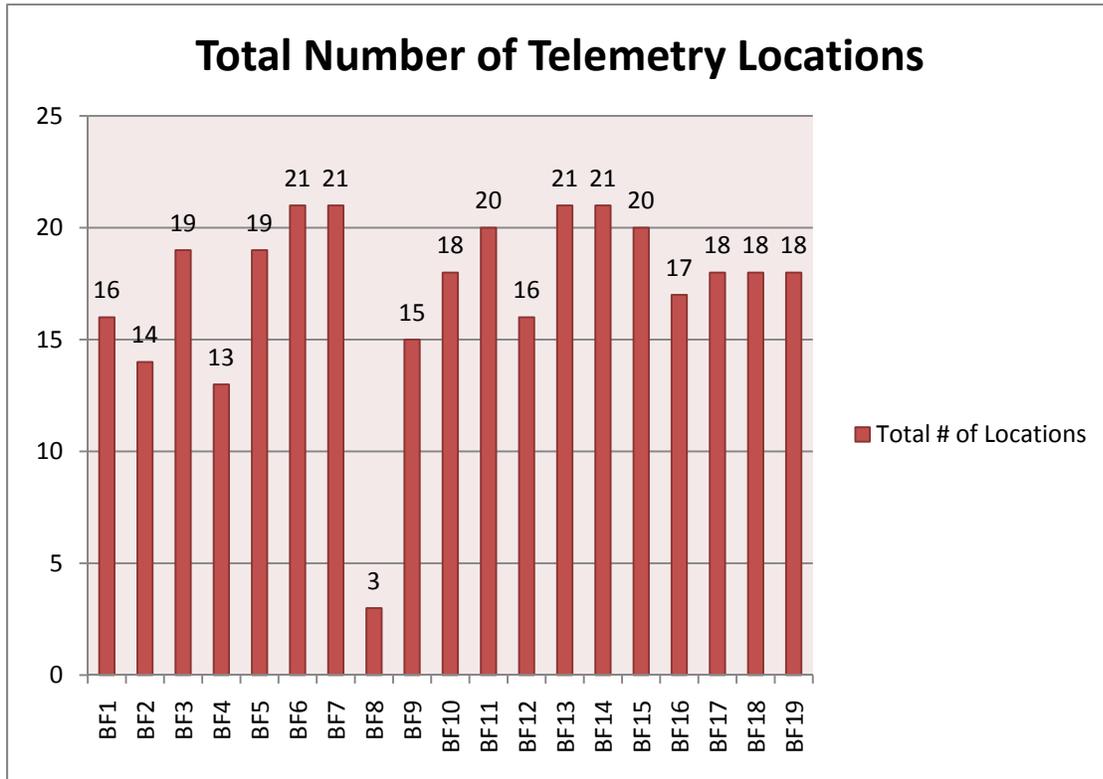
maximum values of both the weight and snout to vent length were set by one adult female (BF14) which was much larger than the rest of the frogs. Radioed frogs were located a total of 328 times (Figure 3) with a mean of 17 detections per frog over the course of the study. Figure 4 shows how frog capture/location points were distributed over the entire site. Maps that display individual frog capture, movement and last location data points are in Appendix A. Figure 5 shows the final telemetry location for each bullfrog, which is possibly each frog's overwintering site.

Table 1

Frog #	Weight (grams)	Snout-Vent Length (millimeters)	Age Estimate	Sex Estimate
BF1	33.5	70.8	adult	female
BF2	26.4	65.8	subadult	female
BF3	26.3	60.5	subadult	female
BF4	26.6	61	subadult	unk
BF5	21.5	59.8	subadult	female
BF6	25.1	62.3	subadult	unk
BF7	28.6	62.4	subadult	unk
BF8	23.6	60	subadult	unk
BF9	30.4	66.1	subadult	unk
BF10	32.4	66.5	subadult	unk
BF11	27	60.9	subadult	unk
BF12	30.2	64.6	subadult	unk
BF13	29.1	65.4	subadult	unk
BF14	150.8	106.6	adult	female
BF15	33.6	66.5	subadult	unk
BF16	37	69.6	adult	unk
BF17	38.7	69.3	adult	unk
BF18	24.7	62.5	subadult	unk
BF19	24.2	62.2	subadult	unk

Out of the 19 frogs, 6 stayed in the same canal segment in which they were originally captured. This means that 13 frogs moved from one canal segment to another canal segment or to an adjacent area separate from the original 5 canal segments where the capturing took place. Of these 13 bullfrogs, 12 moved from their capture location canal segment to a channel of the Wood River or Wood River floodplain over/through the levee. Only one of those relocating frogs returned to its original capturing segment during the study period. Also, at least 1 bullfrog (BF8) was likely predated upon. Early in the study (9/25/08), signals from BF8's transmitter were received from a pile of debris and mammal scat on the bank of the Wood River. Despite several attempts to physically recover BF8's carcass or transmitter from the pile of debris, they were never recovered. One bullfrog (BF4) stayed in the Wood River Canal, but moved to a different segment. BF4 also appeared to have chosen to overwinter in the water control structure north of WRC5. Table 2 shows the days frogs were documented to have made significant movements. Figure 6 shows a comparison of the distance between the capture location and the furthest location distance, and the distance between the capture location and the last location distance. Although weather data has not yet been analyzed in detail, it was noted that most of the larger movements did coincide with precipitation events at the WRW.

Figure 3



It has also been hypothesized that if frogs are moving through (as opposed to over) the levee, that they may be keying on locations in the levee where water leaks from the Wood River floodplain to the WRC. At this point it is not clear if bullfrogs are moving over or through the levy in order to get to their documented last locations (overwintering sites) on the other side. This general pattern of movement out of the WRC and into the floodplain of the Wood River for overwintering begs the question; *“Why did the bullfrog cross the levy?”* However, for management purposes, *“why”* is probably not as important as how.

Figure 4 – All Bullfrog Capture Locations and Telemetry Points

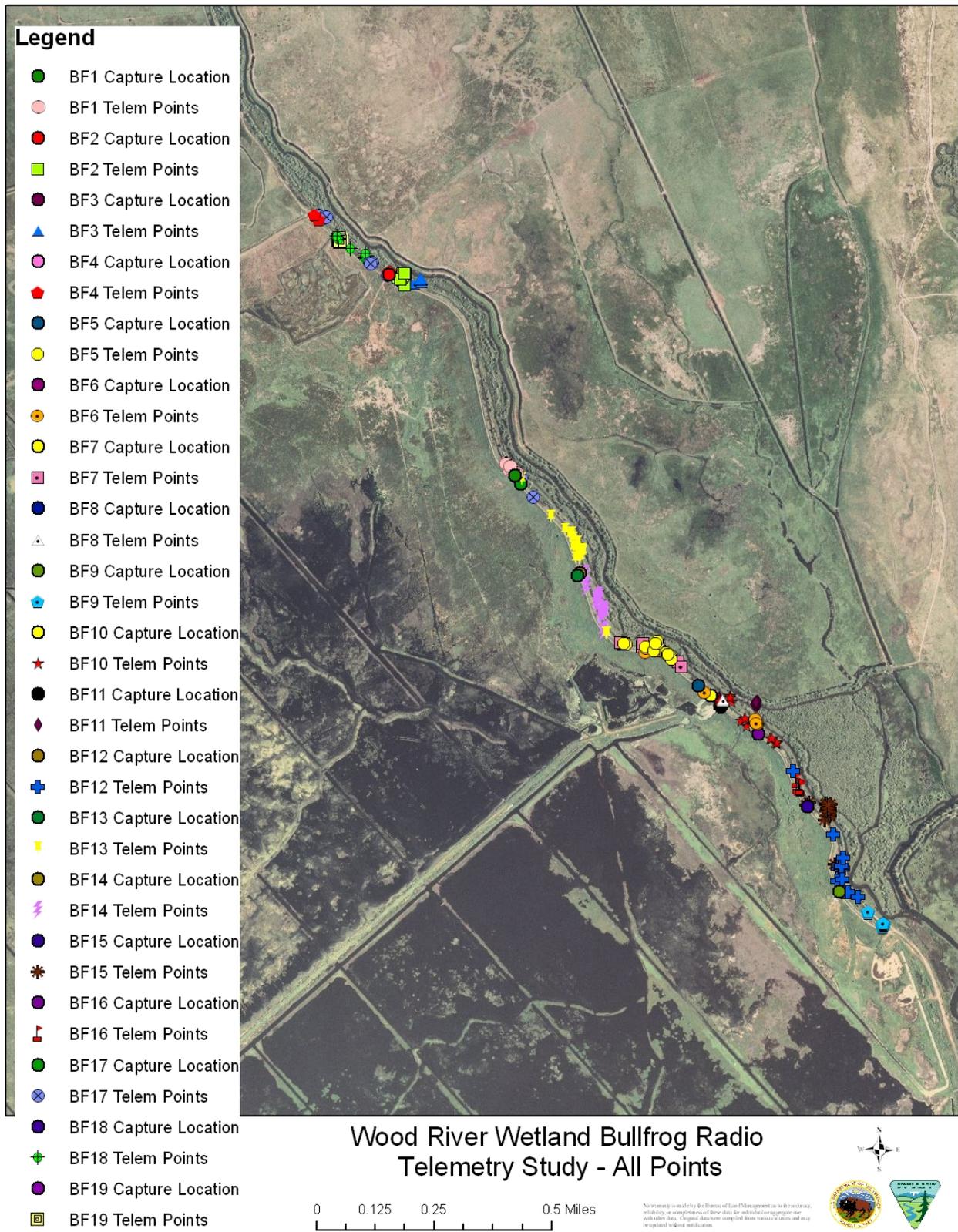


Table 2

Frog #	Capture Location	Last Documented Location	Date of Significant Movement Documented	Comment on Movement
BF1	WRC - South 4	WRC - South 4	n/a	Stayed in WRC-4, ended up in east bank of canal, appears to have overwintered in bank of WRC
BF2	WRC - North 4	Wood River Floodplain	10/7/2008	Moved over/through levee to Wood River floodplain adjacent to WRC-4 on 10/7/08, appears to have overwintered there.
BF3	WRC - North 4	Wood River Floodplain	10/7/2008	Moved over/through levee to Wood River floodplain adjacent to WRC-4 on 10/7/08, appears to have overwintered there.
BF4	WRC - North 4	WRC - North 5	10/20/2008	Made long movement from WRC-4 to WRC-5 on 10/20/08, appears to have overwintered in water control structure.
BF5	WRC - South 2	Wood River Floodplain	10/31/2008	Moved over/through levee to Wood River floodplain adjacent to WRC-2 on 10/31/08, appears to have overwintered there.
BF6	WRC - South 2	Wood River Floodplain	10/7/2008	Made 2 long movements, then moved over/through levee to Wood River floodplain adjacent to WRC-1 on 10/7/08, appears to have overwintered there?
BF7	WRC - South 2	WRC - Middle 2	n/a	Stayed in WRC-2, ended up in east bank of canal, appears to have overwintered in bank of WRC.
BF8	WRC - South 2	Wood River Floodplain	9/25/2008	Likely predated.
BF9	WRC - South 1	WRC - South 1	n/a	Stayed in WRC-1, ended up in east bank of canal, appears to have overwintered in bank of WRC.
BF10	WRC - North 1	Wood River	10/31/2008	Moved over/through levee to Wood River floodplain adjacent to WRC-1 on 10/31/08, appears to have overwintered there.
BF11	WRC - North 1	Wood River	10/7/2008	Moved over/through levee to Wood River adjacent to WRC-1 on 10/7/08, appears to have overwintered there? Predation possible?
BF12	WRC - North 1	WRC - Middle 1	9/25/2008	Made 2 long movements, stayed in WRC-1, appears to have overwintered in east bank of WRC-1.
BF13	WRC - South 3	Wood River Floodplain	11/3/2008	Moved over/through levee to Wood River floodplain adjacent to WRC-3 on 11/3/08, appears to have overwintered there.
BF14	WRC - South 3	Wood River Floodplain	10/6/2008	Moved over/through levee to Wood River floodplain adjacent to WRC-3 on 10/6/08, appears to have overwintered there.
BF15	WRC - Middle 1	Wood River Floodplain	10/8/2008	Moved over/through levee to Wood River floodplain adjacent to WRC-1 on 10/8/08, appears to have overwintered there.
BF16	WRC - Middle 1	WRC - Middle 1	n/a	Made 1 long movement, stayed in WRC-1, appears to have overwintered in east bank of WRC-1.
BF17	WRC - North 3	Wood River Floodplain	11/3/2008	Made 1 very long movement, then moved over/through levee to Wood River floodplain adjacent to WRC-5 on 11/3/08, appears to have overwintered there.
BF18	WRC - North 5	Wood River Floodplain	11/3/2008	Moved over/through levee to Wood River floodplain adjacent to WRC-5 on 11/3/08, appears to have overwintered there.
BF19	WRC - North 5	WRC - Middle 5	9/26/2008	Stayed in WRC-5, ended up in west bank of canal, appears to have overwintered in bank of WRC.

Figure 5 – Bullfrog Final Locations and Likely Overwintering Sites

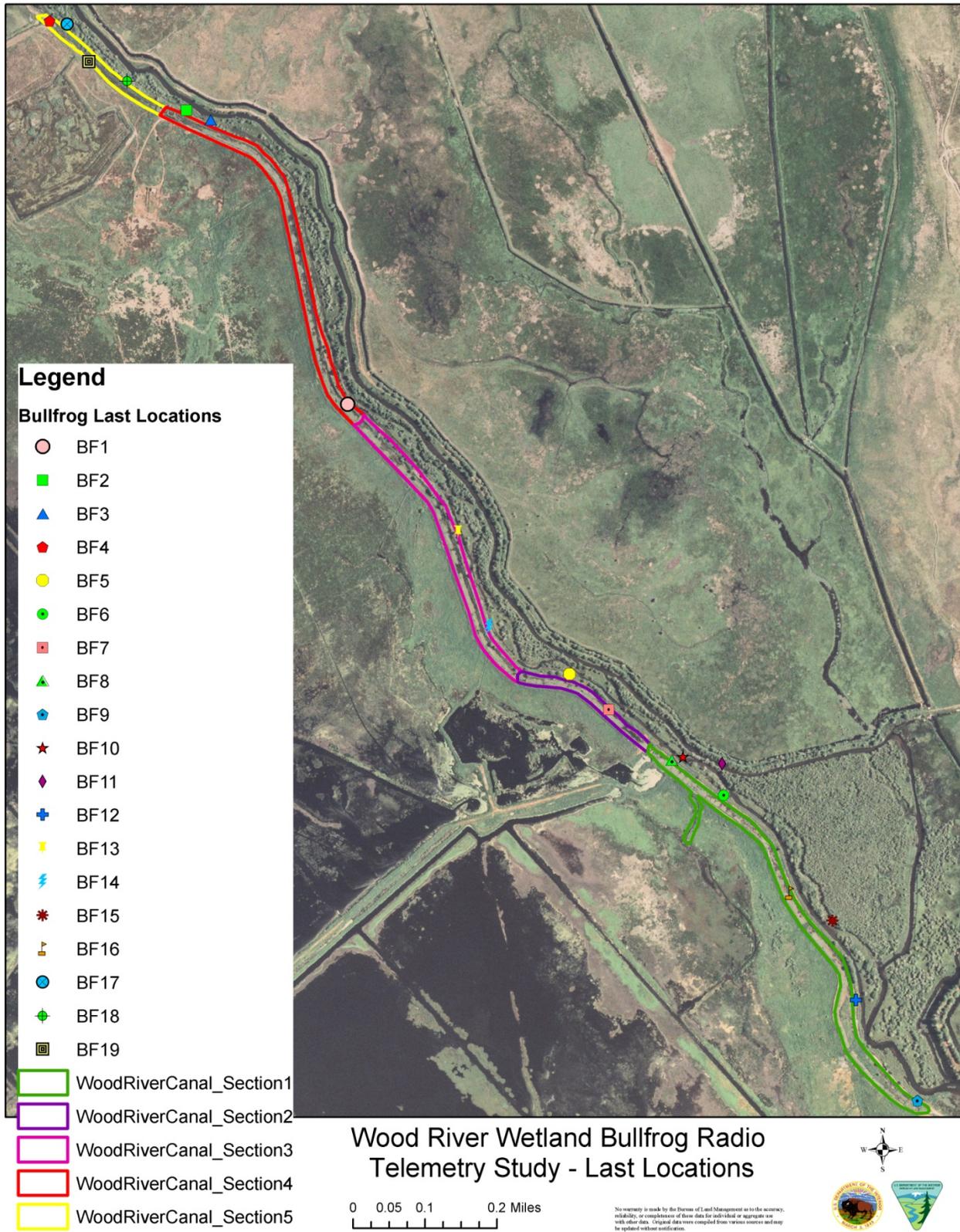
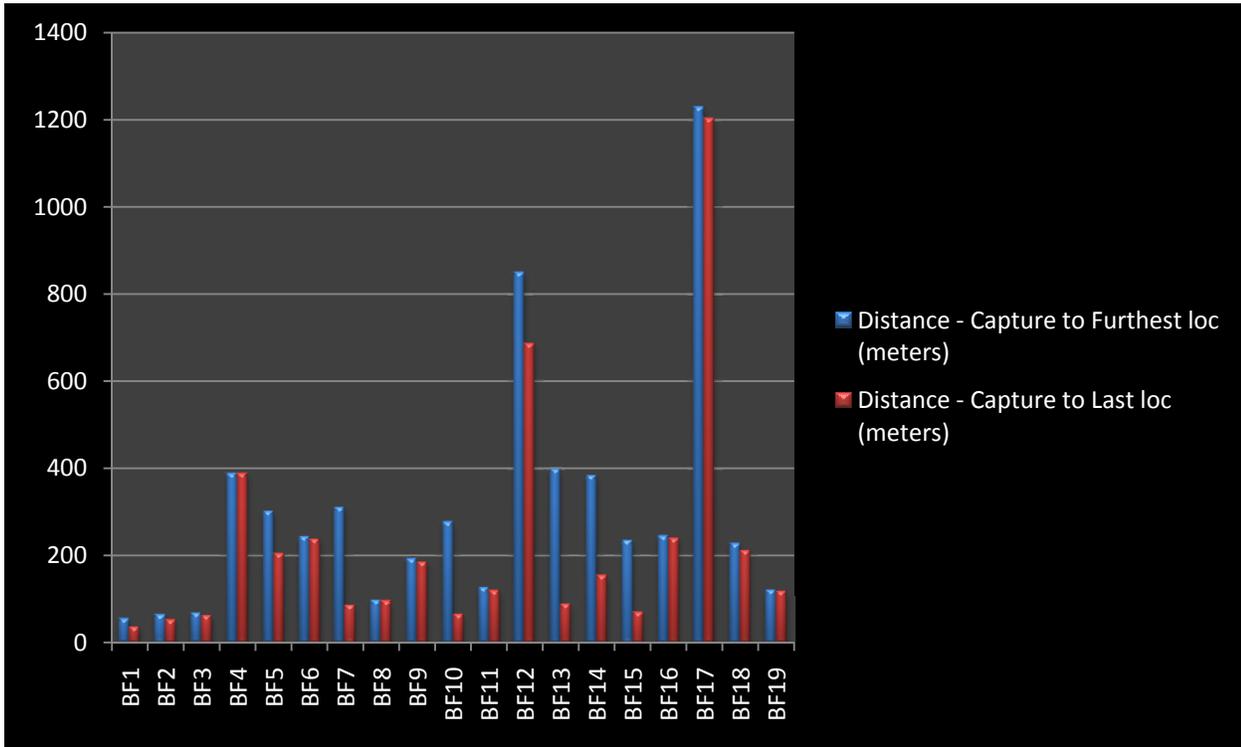


Figure 6 – Comparison of Distances between the Capture Point to Furthest Location and the Capture Point to Last Location



Future Management and Research at Wood River Wetland

Since 2007, bullfrog removal from the WRW OSF site has been a priority for the Klamath Falls Resource Area to reduce likely competition with, displacement of and predation on the OSF population.

Unfortunately, we still do not know where the spotted frogs overwinter, however, the results of this telemetry project have documented many potential bullfrog overwintering sites. These sites may be the same areas in which spotted frogs are attempting to also overwinter. If this is the case, this would add a new level of competition/displacement to the puzzle.

This new bullfrog information may allow us to more effectively trap and remove subadult and adult bullfrogs. The data gathered in the fall of 2008 has pointed out that drift fence/funnel trap arrays at appropriate locations on the levee between the WRC and Wood River floodplain may prove to be an effective removal tool in the future, especially during precipitation events. Careful use of underwater funnel traps or minnow traps may be worthwhile near or in WRC water control structures or near leaks in the levee described in the results section. The Oregon State OSF Working Group and USGS have expressed interest in conducting further analysis of the data collected during this project. This analysis could address additional questions regarding overwintering site water temperature, dissolved oxygen, vegetation association, substrate type, etc. This would likely be accomplished in the next few years, contingent on funding.

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Appendix A

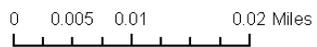




Legend

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- BF2 Telem Points
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Wood River Wetland Bullfrog Radio Telemetry Study - BF2

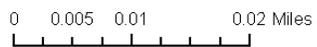


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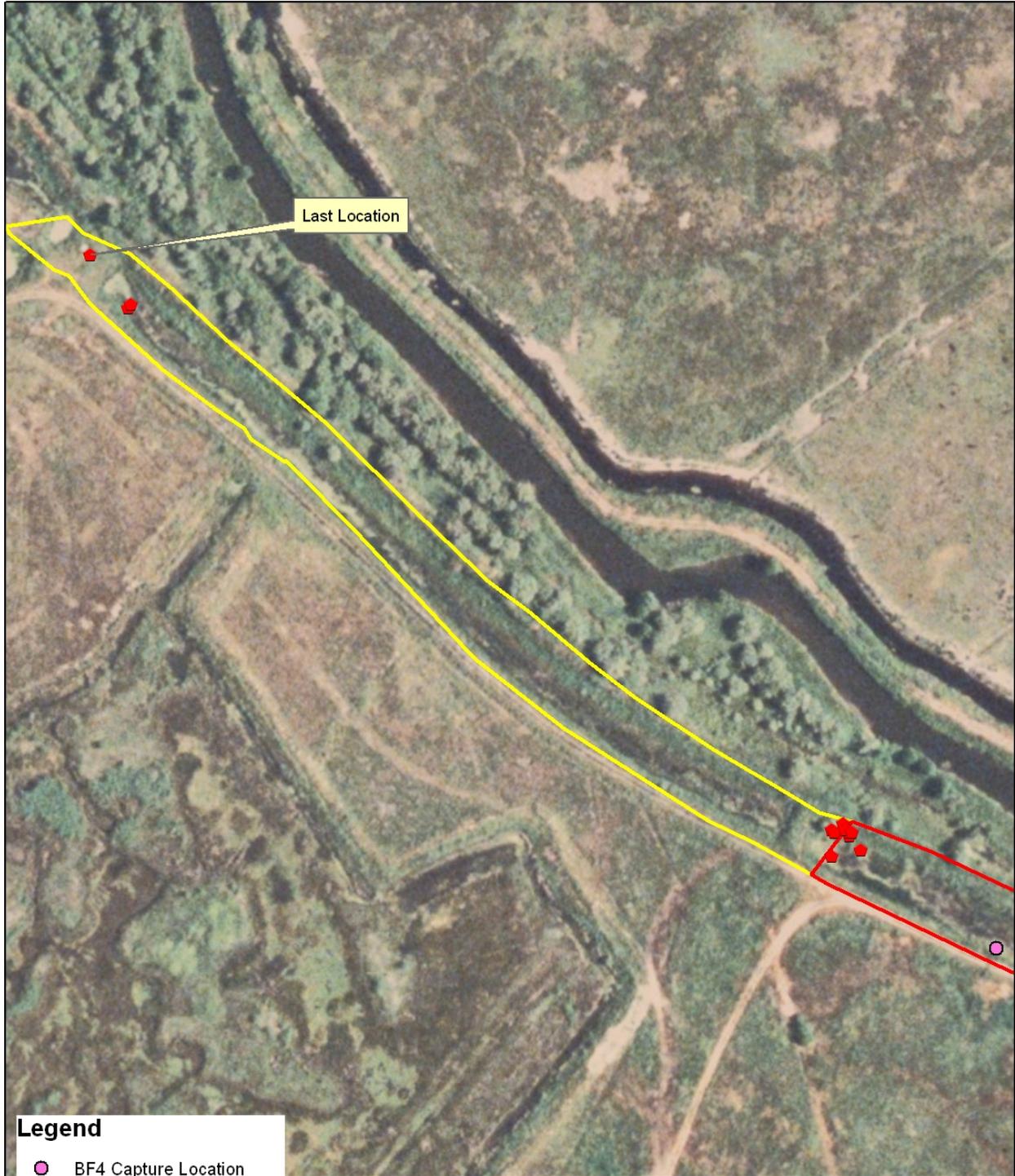
- Legend**
- BF3 Capture Location
 - ▲ BF3 Telem Points
 - WoodRiverCanal_Section4

Wood River Wetland Bullfrog Radio Telemetry Study - BF3



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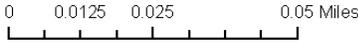




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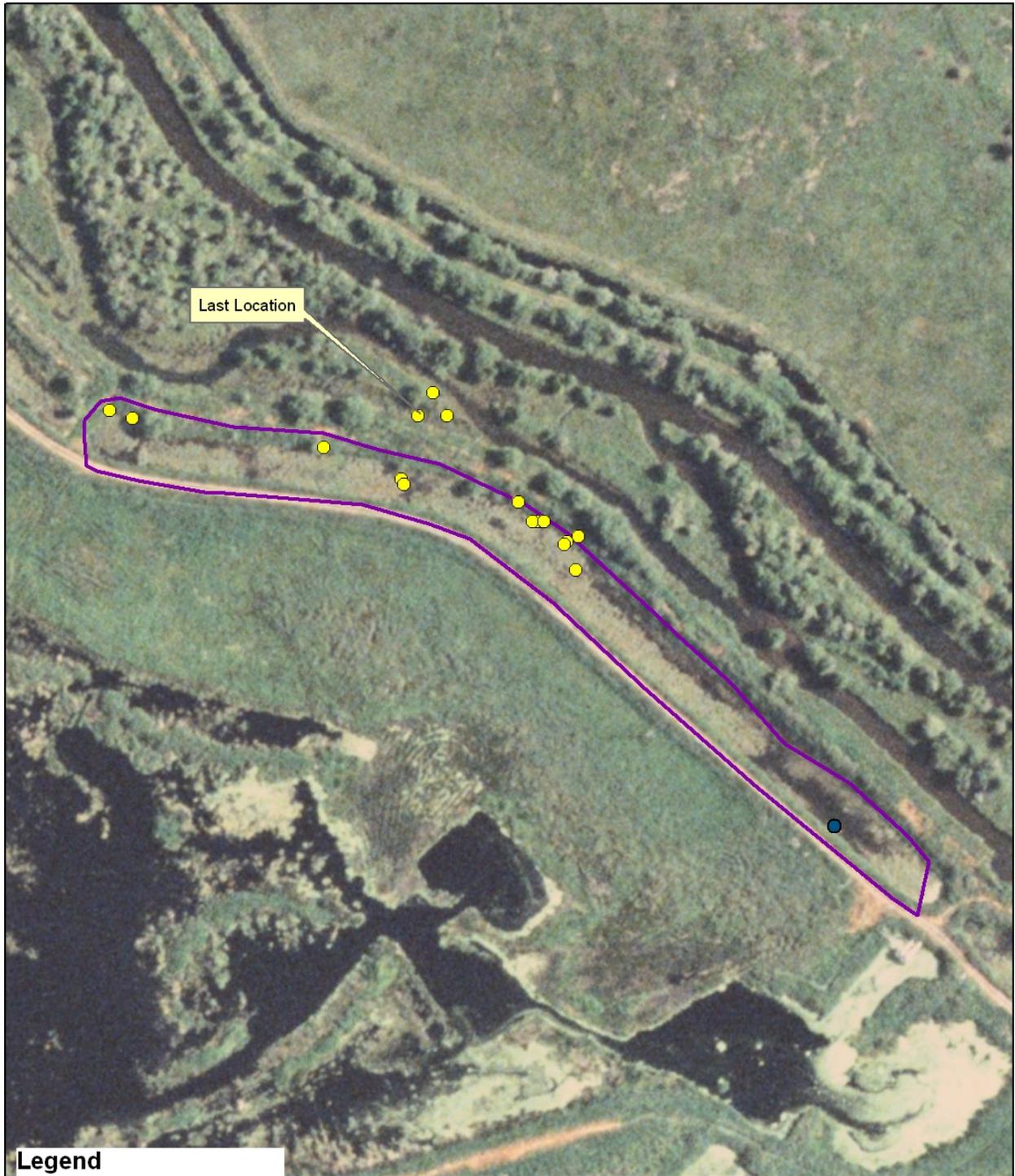
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-  WoodRiverCanal_Section4
-  WoodRiverCanal_Section5

Wood River Wetland Bullfrog Radio Telemetry Study - BF4



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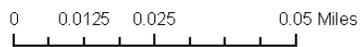




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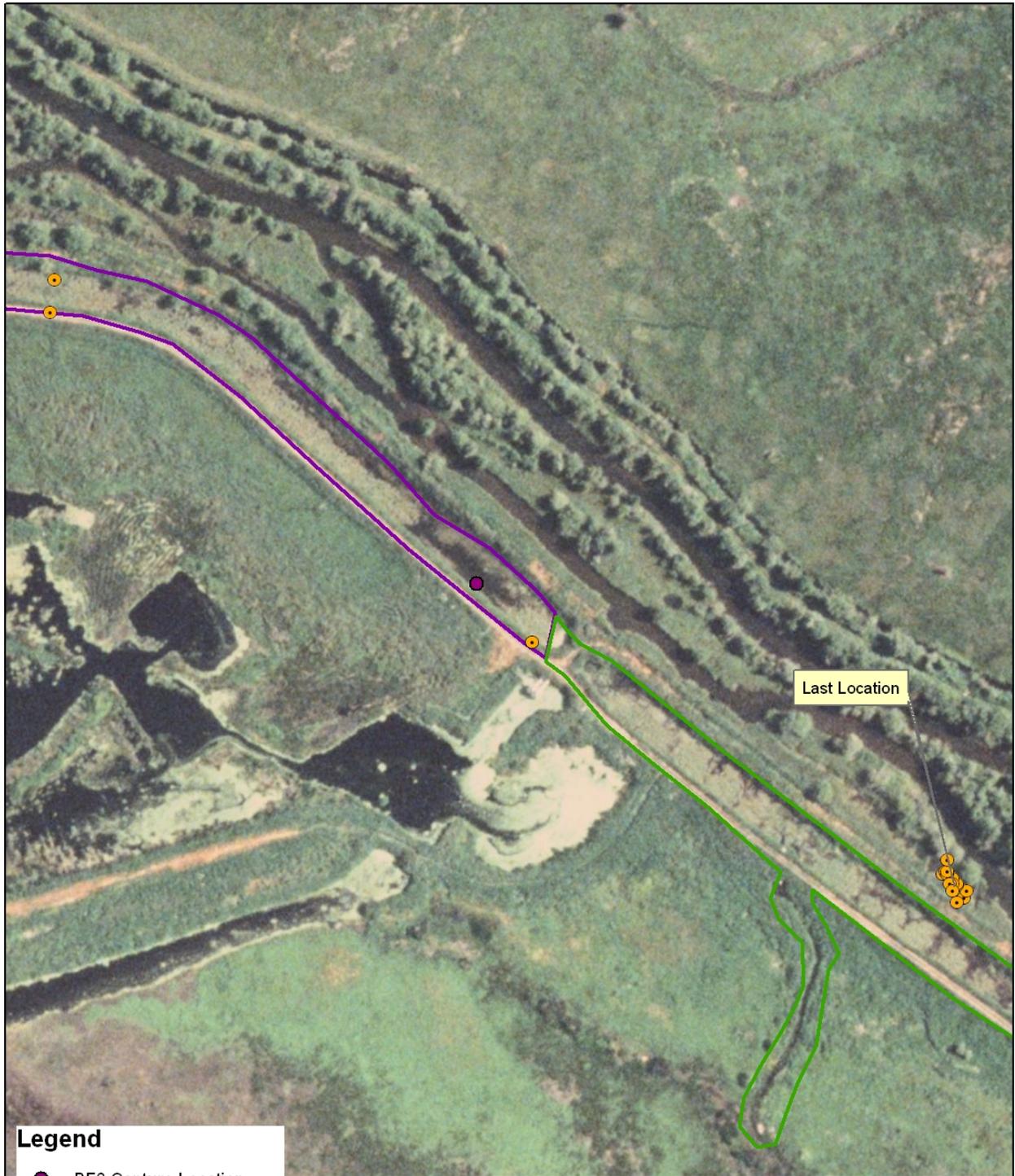
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- WoodRiverCanal_Section2

Wood River Wetland Bullfrog Radio Telemetry Study - BF5



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- Legend**
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 - BF6 Telem Points
 - WoodRiverCanal_Section1
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**Wood River Wetland Bullfrog Radio
Telemetry Study - BF6**



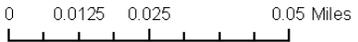
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- Legend**
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 - BF7 Telem Points
 - WoodRiverCanal_Section2
 - WoodRiverCanal_Section3

Wood River Wetland Bullfrog Radio Telemetry Study - BF7



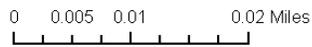
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- Legend**
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 - ▲ BF8 Telem Points
 - WoodRiverCanal_Section1
 - WoodRiverCanal_Section2

**Wood River Wetland Bullfrog Radio
Telemetry Study - BF8**



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Legend

- BF9 Capture Location
- ⬠ BF9 Telem Points
- WoodRiverCanal_Section1

Wood River Wetland Bullfrog Radio Telemetry Study - BF9



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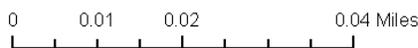




Legend

- BF10 Capture Location
- ★ BF10 Telem Points
- WoodRiverCanal_Section1

Wood River Wetland Bullfrog Radio Telemetry Study - BF10



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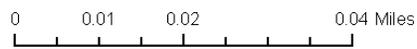




Legend

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- ◆ BF11 Telem Points
- WoodRiverCanal_Section1

Wood River Wetland Bullfrog Radio Telemetry Study - BF11



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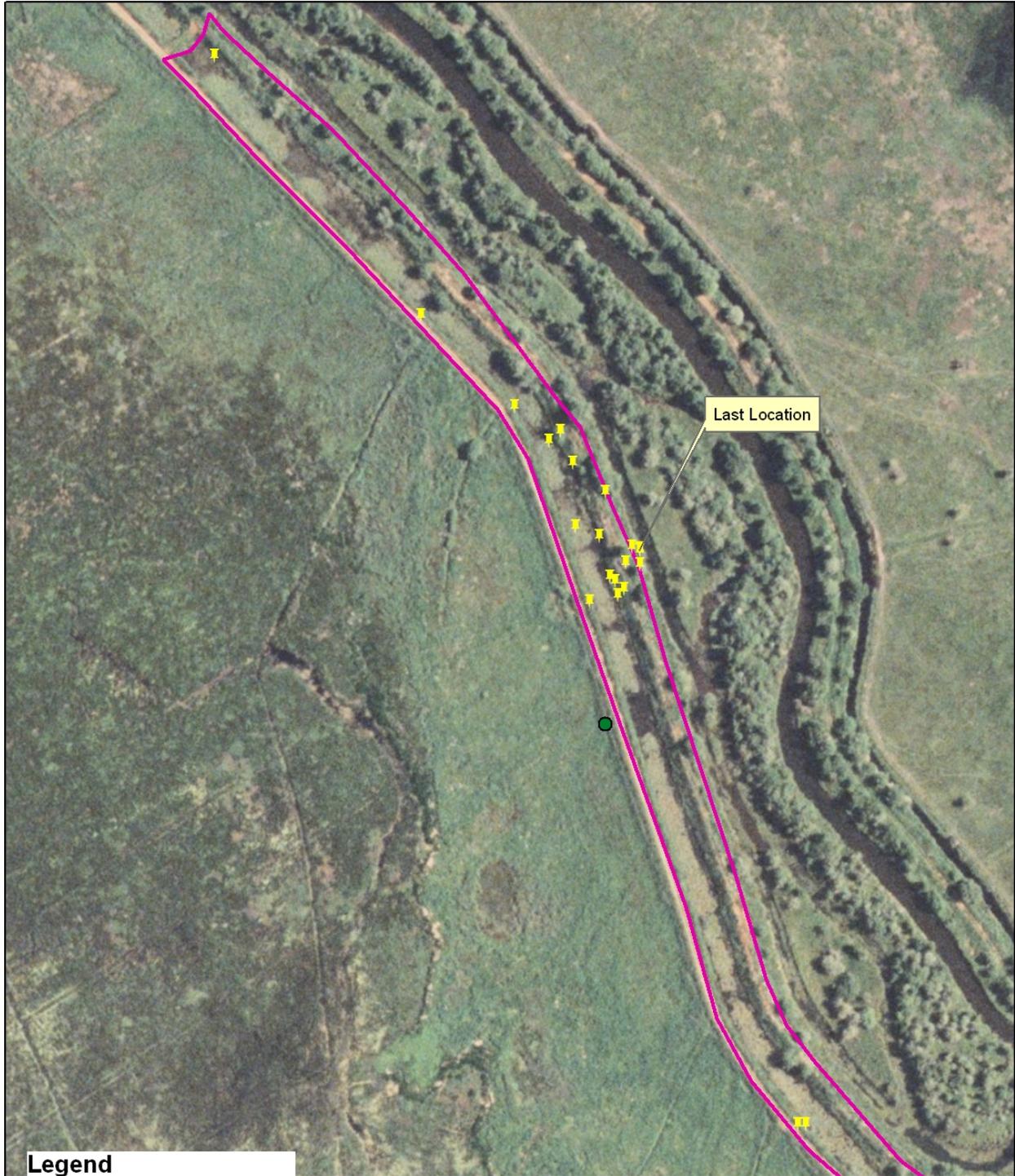
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Wood River Wetland Bullfrog Radio Telemetry Study - BF12



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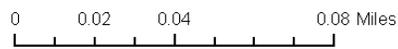




Legend

- BF13 Capture Location
- ▲ BF13 Telem Points
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Wood River Wetland Bullfrog Radio Telemetry Study - BF13



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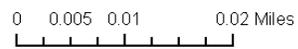




Legend

-  BF14 Capture Location
-  BF14 Telem Points
-  WoodRiverCanal_Section3

Wood River Wetland Bullfrog Radio Telemetry Study - BF14



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Legend

- BF15 Capture Location
- ✱ BF15 Telem Points
- WoodRiverCanal_Section1

Wood River Wetland Bullfrog Radio Telemetry Study - BF15



No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual users separate from other data. Original data were compiled from various sources and may be updated without notification.





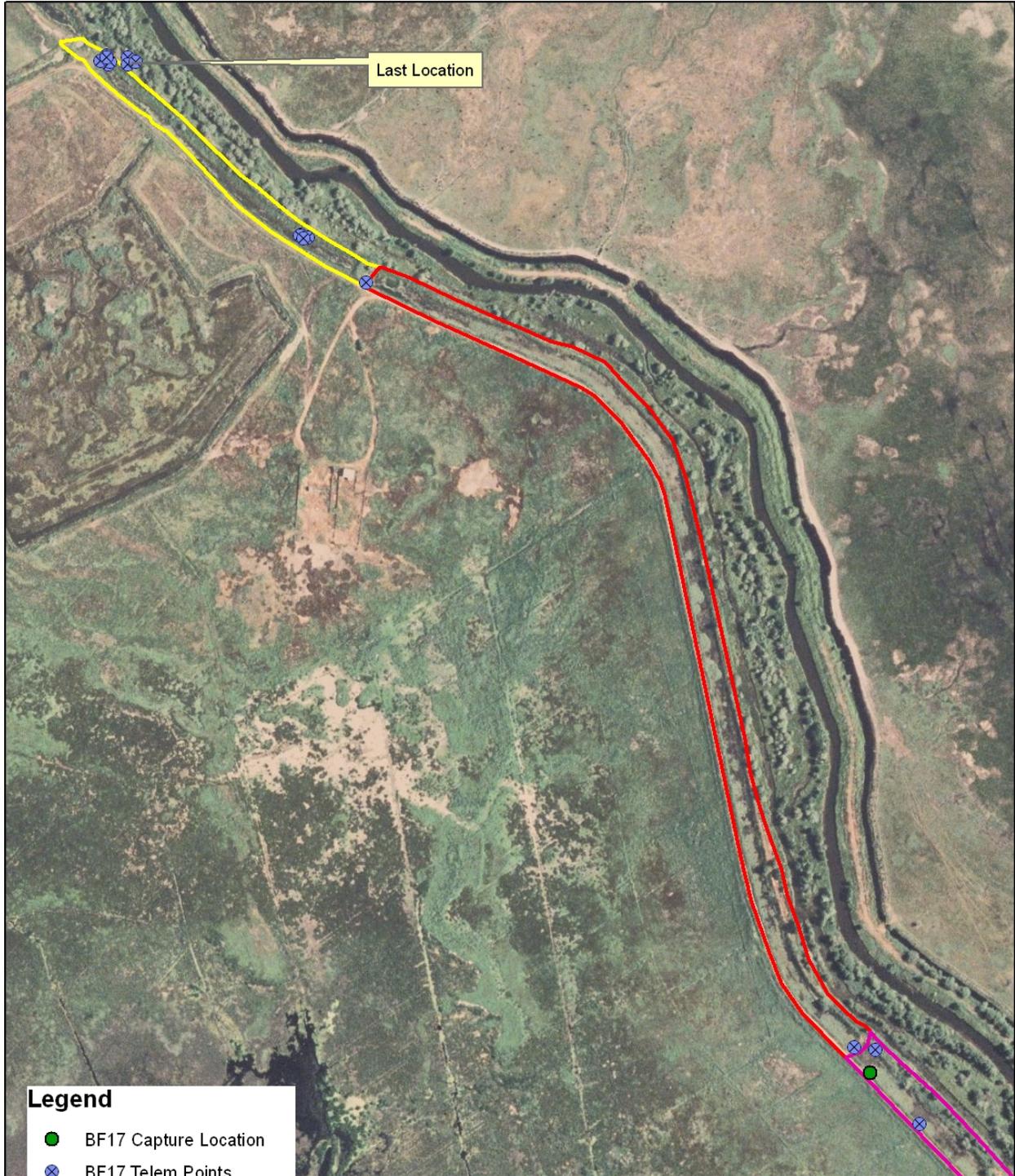
Legend

- BF16 Capture Location
- ▬ BF16 Telem Points
- WoodRiverCanal_Section1

Wood River Wetland Bullfrog Radio Telemetry Study - BF16



No warranty is made by the Illinois Department of Natural Resources as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources and may be updated without notification.



- Legend**
- BF17 Capture Location
 - ⊗ BF17 Telem Points
 - ▭ WoodRiverCanal_Section5
 - ▭ WoodRiverCanal_Section4
 - ▭ WoodRiverCanal_Section3

Wood River Wetland Bullfrog Radio Telemetry Study - BF17

0 0.035 0.07 0.14 Miles

No warranty is made by the Division of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources and may be updated without notification.

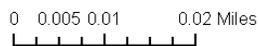




Legend

- BF18 Capture Location
- + BF18 Telem Points
- WoodRiverCanal_Section5

Wood River Wetland Bullfrog Radio Telemetry Study - BF18



No warranty is made by the Illinois Department of Natural Resources as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources and may be updated without notification.



Legend

- BF19 Capture Location
- BF19 Telem Points
- WoodRiverCanal_Section5

Wood River Wetland Bullfrog Radio Telemetry Study - BF19

0 0.005 0.01 0.02 Miles

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The following 8 photographs are examples of bullfrogs belted with radio transmitters:









Some of the crew:



The crew attempting to capture frogs during the day:



Launching a canoe for night capturing:



Thick wocus stands made capturing frogs very difficult:

