



Bent's Old Fort National Historic Site Exotic Plants Monitoring Summary—2022

Purpose: To briefly summarize the results of the 2022 field season of Exotic Plant-Early Detection Protocol monitoring at Bent's Old Fort National Historic Site.

Contacts: Please direct any questions to Vegetation Ecologist Merran Owen, at merran_owen@partner.nps.gov

Transects Surveyed: Panel 3 (3.8 km)

Grid Points Surveyed: None

Number of Extra-Area Surveys Completed: None

Field Crew: M. Owen

Dates of Survey: August 4–5, 2022

Data Availability: All data are available to view and download through the Southwest Network Collaboration Exotics Dashboard, hosted on the NPS ArcGIS Portal.



Exotic plant monitoring along the Bent's Old Fort Loop Trail, 2022. NPS/MERRAN OWEN

Monitoring Protocol

Each year, the Southern Plains Inventory & Monitoring Network (SOPN) monitors pathways of exotic plant introduction at Bent's Old Fort National Historic Site (NHS) (BEOL) and other network parks. The areas sampled are typically linear transects along roads, trails, boundary lines, and stream channels that are at high risk for exotic plant invasion and infestation. The transects for each park are divided into three panels, with one panel sampled each year. In select years, exotic plant data are also collected at predetermined grid points spaced 150 meters (m) apart, covering the entire park acreage minus any areas excluded for safety or difficulty of access. Grid-point surveys are done to determine the extent and distribution of exotic plants within the park interior landscape. All transect and grid-point locations at BEOL are shown in Map A-1. Surveys of additional areas, referred to as "extra-area surveys," may also be completed upon request from park staff.

To sample transects, surveyors walk the transect length and map exotic plant infestations that occur within 30 m of the center line. Infestations are documented as points or polygons. Points are recorded as one of three size classes: under 1-m radius, 1.1 to 5-m radius, and 5.1 to 10-m radius. Infestations larger than a 10-m radius or those that exist as long, continuous stretches are recorded as polygons. Data collected for infestations include plant species name, the size of the patch, canopy cover, number of plants present in the patch, phenology (e.g., flowering or fruiting stage), and level of site disturbance. At grid points, surveyors record the exotic plant species found within a 10-m radius of the point, as well as canopy cover and phenology for each species.

The Southern Plains Network surveys for a short list of species that is customized to each park. Our intent is to document infestations for which we recommend treatment, and to monitor species of high concern. The monitoring list for BEOL ([Table 1](#)) was drawn from the park's Natural Resource Condition Assessment (NRCA), completed by Struthers et al. (2015). In the NRCA, exotic plants found in 2010–2013 BEOL surveys were ranked across a series of factors, following a system designed by Morse et al. (2004). Factors included the plant's ecological impact, management difficulty, current distribution and abundance, and trends in distribution and abundance. The rankings were then used to classify plants into the following categories: highest concern, high concern, medium concern, and low concern. The eight highest ranking plants were designated as high priority species for the park, all of which are included in our monitoring. For further detail, see the BEOL NRCA (Struthers et al. 2015).

Please contact the Vegetation Ecologist (see above) for further customization of the BEOL monitoring list (Table 1). Additional species will be added as requested.

Monitoring Results

In early August of 2022, we sampled the 3.8 kilometers (km) of transects in Panel 3 (Map A-1). This panel includes trails along the wetland, trails through the cottonwood understory on both sides of the Arkansas River, and portions of the park boundary south of the river. No grid-point or extra-area surveys were completed. The field crew observed exotic plants on each of the transects surveyed. A total of 12 exotic plant species were recorded, eight of which are designated as high priority for the park ([Table 2](#)). All species recorded in 2022 have been observed in previous surveys of Panel 3 transects, except for perennial pepperweed (*Lepidium latifolium*). This species is difficult to identify and may have been missed in the past.

Notable Infestations

We would like to highlight the survey results for three perennial forbs: Canada thistle (*Cirsium arvense*; Map A-4), perennial pepperweed (*Lepidium latifolium*; Map A-8), and Russian knapweed (*Rhaponticum repens*; Map A-9). [Note that maps are in alphabetical order, by scientific name, in the appendix.] These three plants are all rhizomatous, meaning that they have a network of below-ground stems from which they may send up shoots and establish dense, clonal patches. In our survey, we found that Canada thistle had formed a thick ring of over 50% cover around the northwestern portion of the wetlands, and Russian knapweed and perennial pepperweed were found to occur in scattered patches in the cottonwood understory.

The most abundant exotic plant found along our transects was kochia (*Kochia scoparia*; Map A-7), with an estimated 8.09 acres infested. Infestations were largest in the prairie dog town and disturbed soils along the southeast park boundary. Infestations were also found in frequent patches along transects passing through the park bottomlands. Kochia is an annual forb, meaning that it germinates en masse in spring and early summer, flowers, sets seed, and dies by the end of the growing season. It reproduces only by seed, which it produces by the thousands, but the seeds only remain viable for a few years (Friesen et al. 2009).

Treatment Recommendations

We recommend kochia as a primary target for long-term management and control, and, as resources permit, we recommend initiating long-term management of Canada thistle, perennial pepperweed, and Russian knapweed. Of these three latter plants, perennial pepperweed was the lowest in cover and least widely distributed, making it the most feasible choice for control.

Research on kochia in non-agricultural settings is limited. Mowing is an effective form of control, though it does not kill the plant or necessarily prevent it from growing a second crop of seed. To best control seed production, we recommend mowing when flowers first appear. A study in North Dakota demonstrated that mowing in late July or early August significantly reduced kochia in the following year and allowed seeded perennial grasses to grow and establish (Iverson and Wali 1987). Some of the success of mowing may be due to the short-lived seed banks of this species, but populations can recover quickly if left unmonitored. Chemical treatments will also effectively control kochia, but broadleaf herbicides reduce the cover and biodiversity of native forbs. Since kochia is a common agricultural weed, many herbicide-resistant biotypes have evolved (Friesen et al. 2009).

Perennial pepperweed is an opportunistic plant that invades seasonally wet soils with a history of disturbance (e.g., plowing, inappropriate grazing). It is capable of forming dense monocultures, but infestations found at BEOL in 2022 were scattered and of low cover. To control infestations, the root rhizomes must be killed. Even if the visible portion of the plant is killed, new shoots may re-emerge within the course of a season if the roots are left alive to reproduce. It often takes multiple years of chemical control to exhaust and fully kill a rhizomatous root network. Research in California has shown that chemical treatments of glyphosate or chlorsulfuron applied in the spring, before the plant blooms, will significantly reduce populations. Mowing does not control perennial pepperweed and is only necessary to open-up the canopy of large, dense infestations (Renz 2002, Young et al. 1995).

Data Availability

Data for all exotic plant species recorded in 2022 are summarized in maps in Appendix A. Maps showing species distributions are presented in alphabetical order by scientific name. All data are available to BEOL

park staff and Invasive Plant Management Teams through the Southwest Network Collaboration (SWNC) Exotics Dashboard (Figure 1), hosted on the NPS ArcGIS Portal. The dashboard is a user-friendly place to download spatial files showing exact locations and sizes of infestation points and polygons. You can also view, subset, and filter the data in the Portal interface. Exotic plant data collected by SOPN since 2009 may be accessed there. To open the dashboard, activate or sign-in to your ArcGIS Portal account, contact the SOPN Vegetation Ecologist to request your name be added to the SWNC Exotics Dashboard group, and then open this group on the ArcGIS Portal. There are two dashboards available, one including data from 2009–2019, collected under a previous protocol, and one with data from 2020 to the present, collected under the protocol described in this report.

To further discuss the results of the 2022 Exotic Plant-Early Detection survey, please contact the SOPN Vegetation Ecologist or Invasive Plant Management Team staff.

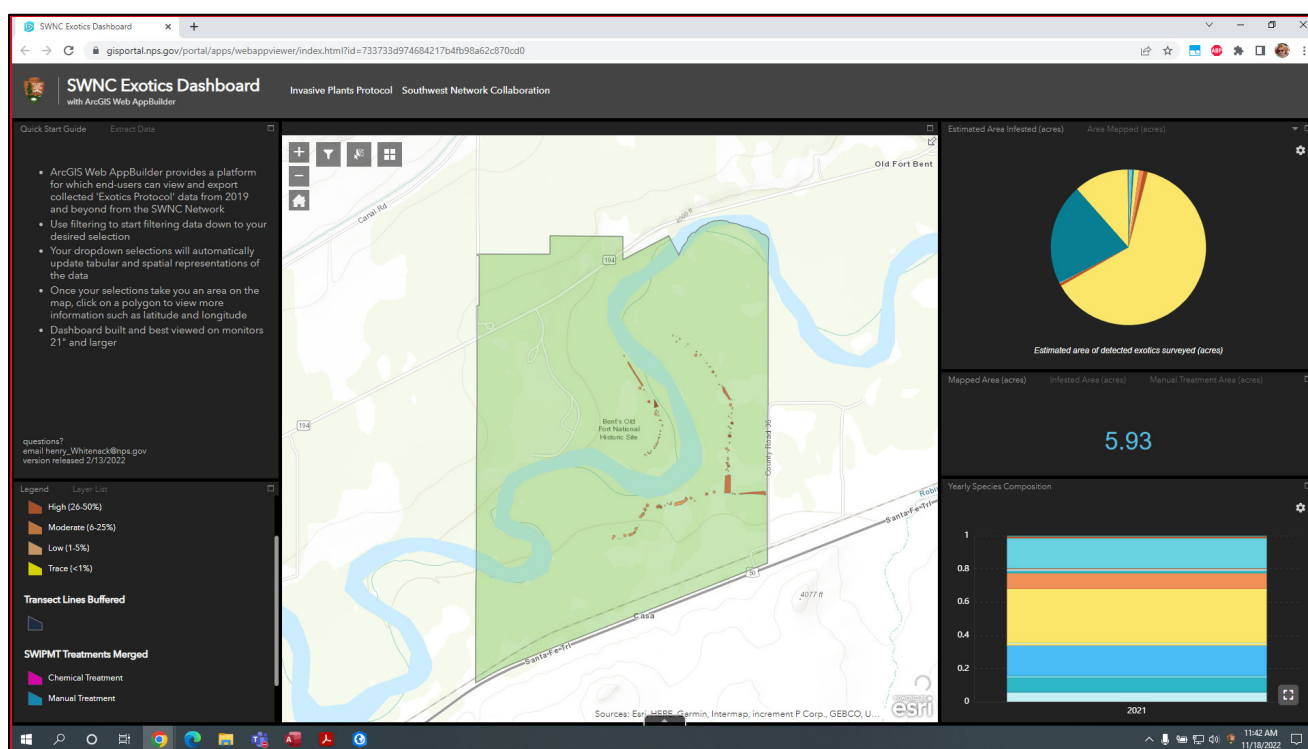


Figure 1. Screen shot of the Southwest Network Collaboration (SWNC) Exotics Dashboard, hosted on the NPS ArcGIS Portal, which can be used to view and download spatial files showing locations and sizes of exotic plant infestations.

Table 1. Exotic plant species included in the 2022 BEOL Exotic Plant-Early Detection survey. Species determined as high priority in the Natural Resource Condition Assessment are marked with an asterisk. Rankings are based on the ecological impact, management difficulty, current distribution and abundance, and trends in distribution and abundance of the exotic plant, and categories include Highest Concern, High Concern, Medium Concern, and Low Concern (Struthers et al. 2015).

Scientific Name	Common Name	Level of Concern
<i>Bromus inermis</i>	Smooth brome	NYA ¹
<i>Bromus tectorum</i> *	Cheatgrass	Highest
<i>Cirsium arvense</i> *	Canada thistle	High
<i>Convolvulus arvensis</i> *	Bindweed	Highest
<i>Cynodon dactylon</i>	Bermudagrass	NYA ¹
<i>Kochia scoparia</i> *	Kochia	High
<i>Lepidium latifolium</i> *	Perennial pepperweed	High
<i>Rhaponticum repens</i> *	Russian knapweed	Highest
<i>Salsola tragus</i>	Russian thistle	Moderate
<i>Sorghum halepense</i> *	Johnsongrass	High
<i>Tamarix</i> sp.* ²	Tamarisk	Highest
<i>Ulmus pumila</i>	Siberian elm	NYA ¹

¹NYA = Not yet assessed.

² Species of *Tamarix* are identified to genus only in SOPN Exotic Plant-Early Detection surveys.

Table 2. Exotic plant species observed in the 2022 BEOL Exotic Plant-Early Detection survey. Species determined as high priority in the Natural Resource Condition Assessment are marked with an asterisk. Infestation size is calculated as the total area mapped with the given species present; point acreage is estimated by taking the midpoint of each size class.

Scientific Name	Common Name	Life Form	Duration	Infestation Size (Est. Acreage)
<i>Kochia scoparia</i> *	Kochia	Forb ¹	Annual ²	8.09
<i>Cirsium arvense</i> *	Canada thistle	Forb	Perennial	3.88
<i>Convolvulus arvensis</i> *	Bindweed	Forb	Perennial	2.86
<i>Salsola tragus</i>	Russian thistle	Forb	Annual	2.45
<i>Rhaponticum repens</i> *	Russian knapweed	Forb	Perennial	0.46
<i>Sorghum halepense</i> *	Johnsongrass	Grass	Perennial	0.43
<i>Bromus inermis</i>	Smooth brome	Grass	Perennial	0.10
<i>Cynodon dactylon</i>	Bermuda grass	Grass	Perennial	0.06
<i>Lepidium latifolium</i> *	Perennial pepperweed	Forb	Perennial	0.04
<i>Bromus tectorum</i> *	Cheatgrass	Grass	Annual	<0.01
<i>Tamarix</i> sp.*	Tamarix	Shrub/Tree	Perennial	<0.01
<i>Ulmus pumila</i>	Siberian elm	Shrub/Tree	Perennial	<0.01

¹ A forb is an herbaceous (non-woody) flowering plant that is not a grass. The colloquial term is “wildflower.”

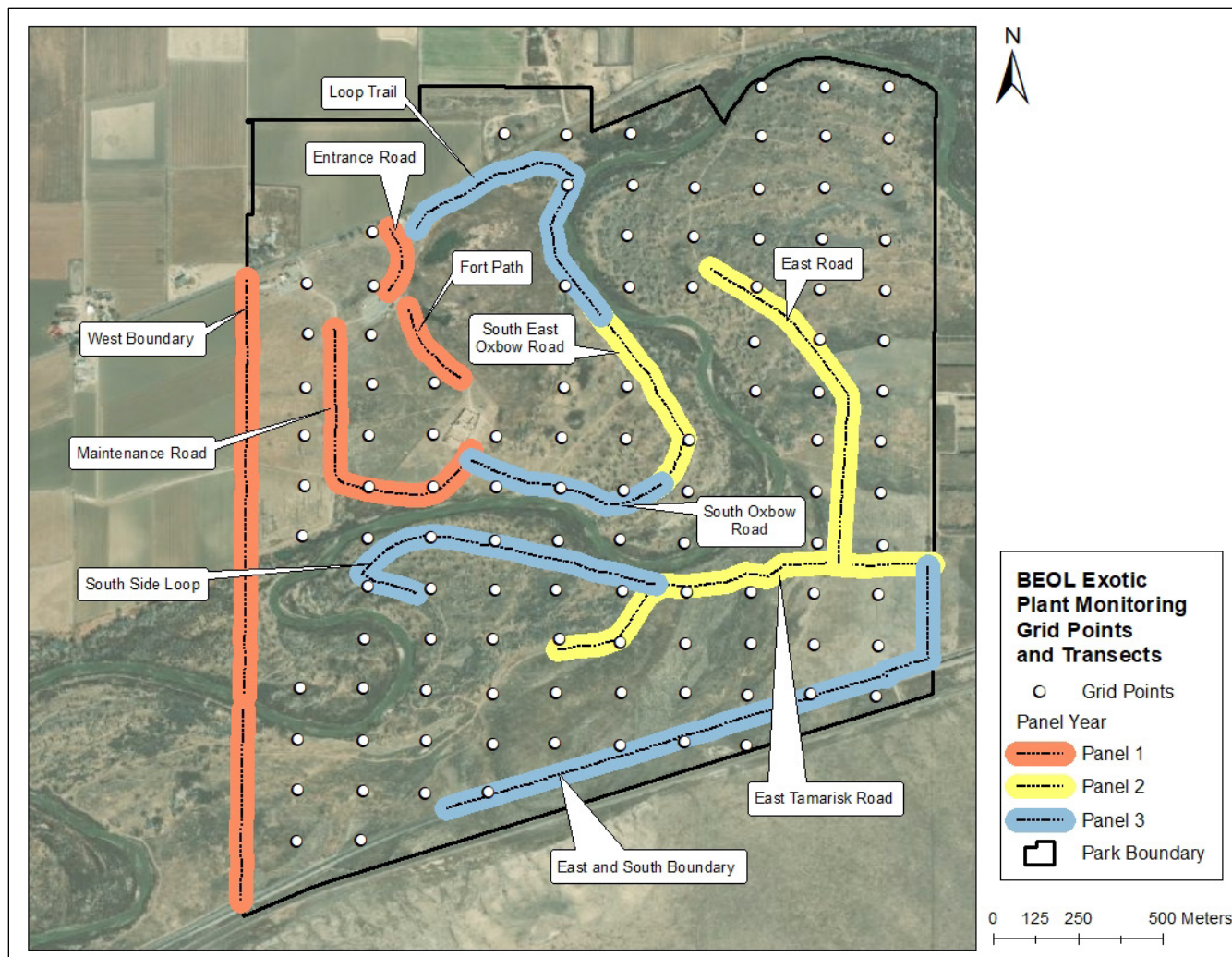
² Annual plants germinate, flower, produce seed, and die in the space of one growing season, while perennials flower and produce seed for many years.

Literature Cited

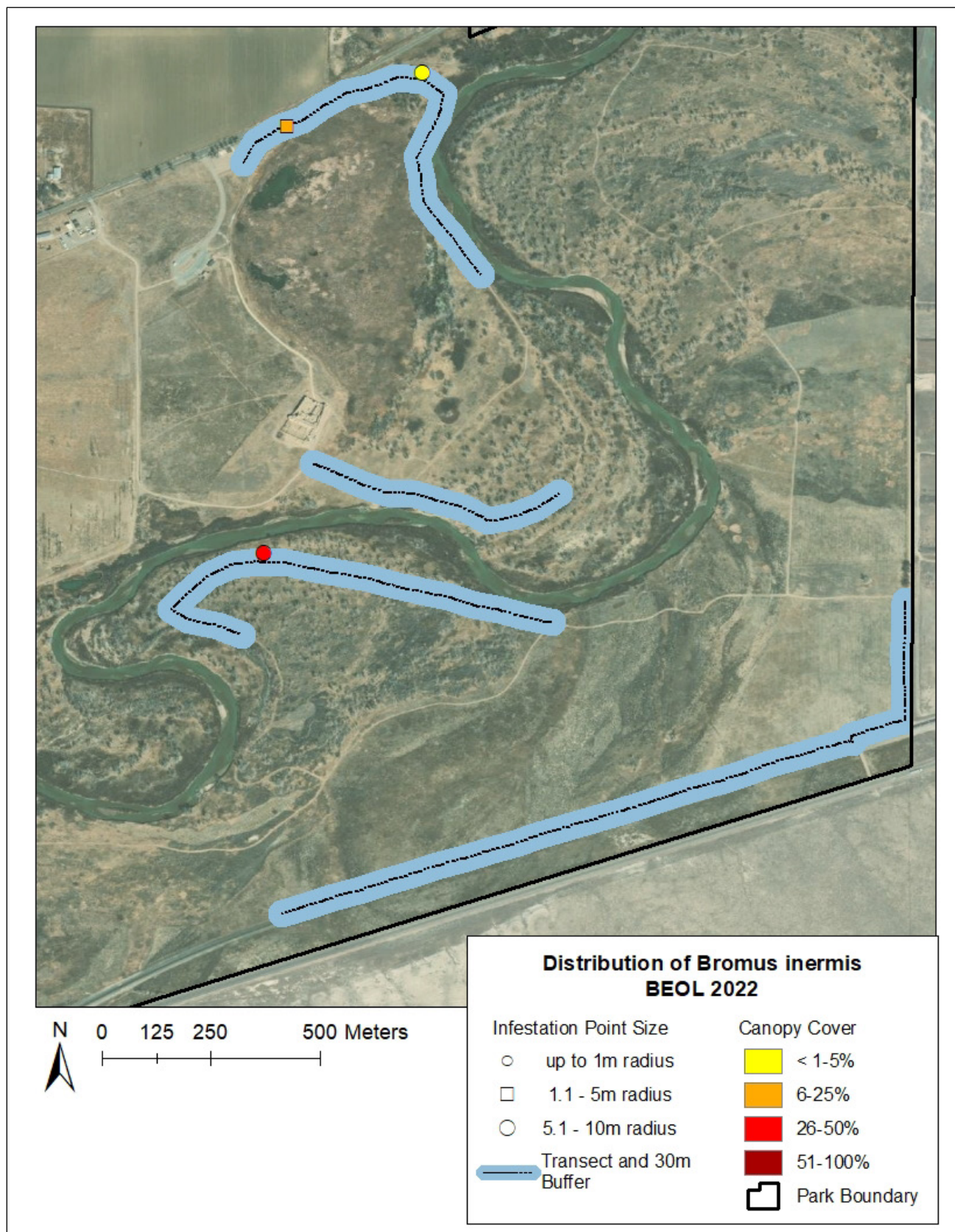
- Friesen, L. F., H. J. Beckie, S. I. Warwick, and R. C. Van Acker. 2009. The biology of Canadian weeds. 138. *Kochia scoparia* (L.) Schrad. Canadian Journal of Plant Science 89:141–167.
- Iverson, L. R., and M. K. Wali. 1987. Mowing of annual colonizers to enhance revegetation after surface mining. Reclamation and Revegetation Research 6:157–161.
- Morse, L. E., J. M. Randall, N. Benton, R. Hiebert, and S. Lu. 2004. An invasive species assessment protocol: Evaluating non-native plants for their impact on biodiversity. Version 1. NatureServe, Arlington, Virginia.
- Renz, M. J. 2002. Biology, ecology and control of perennial pepperweed (*Lepidium latifolium* L.). University of California, Davis.
- Struthers, K., R. E. Bennetts, P. Valentine-Darby, N. Chambers, T. Folts-Zettner, and H. Sosinski. 2015. Bent's Old Fort National Historic Site: Natural resource condition assessment. Natural Resource Report NPS/SOPN/NRR—2015/998. National Park Service, Fort Collins, Colorado.
- Young, J. A., C. E. Turner, and L. F. James. 1995. Perennial pepperweed. Rangelands Archives 17(4):121–123.

Appendix A. Bent's Old Fort National Historic Site Exotic Plant-Early Detection Survey Maps, 2022

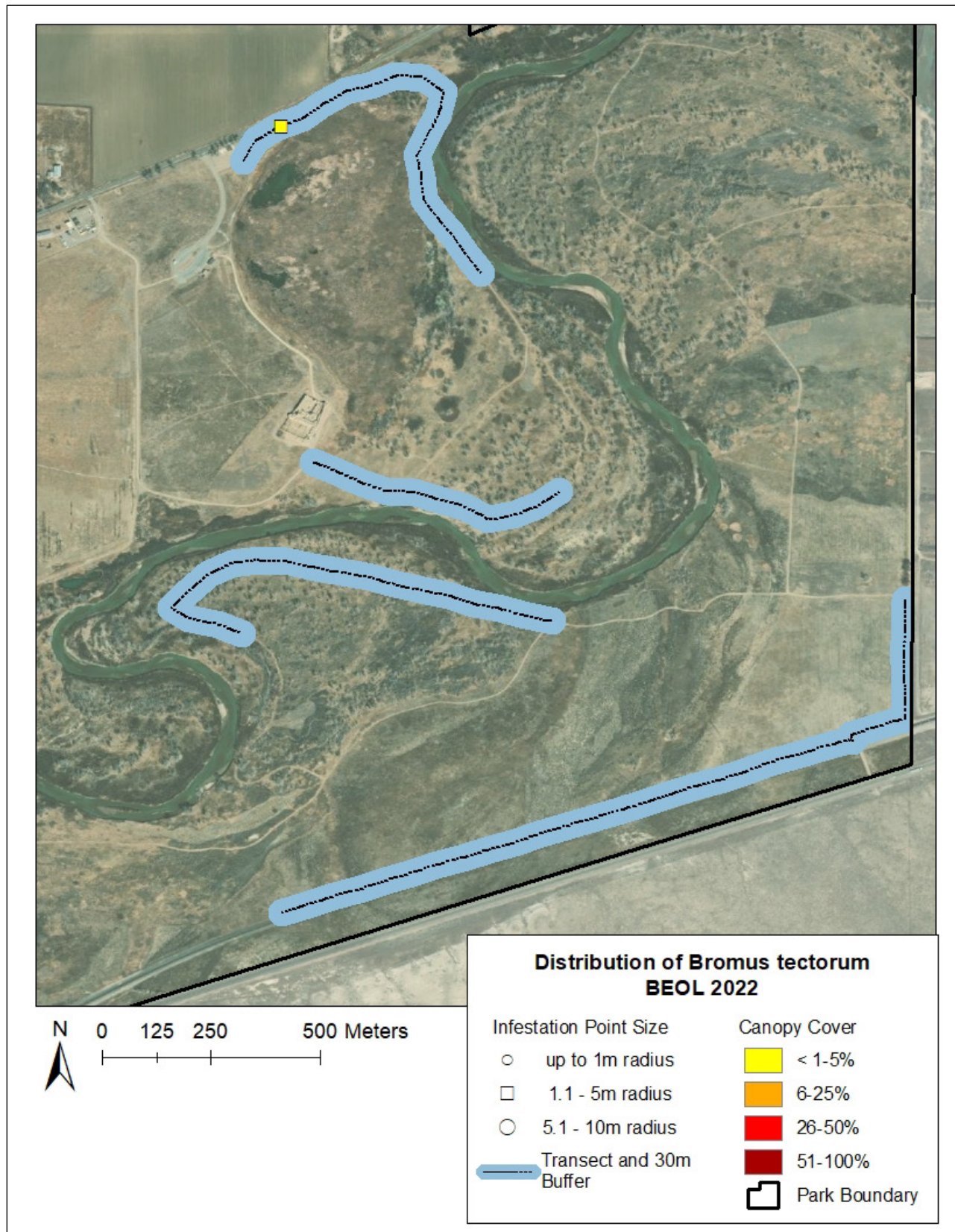
Map A-1. Map showing all exotic plant transect and grid-point locations at Bent's Old Fort NHS. Transects are broken into three panels, with one panel surveyed each year. Panel 3 (with four transects) was surveyed in 2022. Grid points are 150 m apart, and areas with >30% slope are excluded.



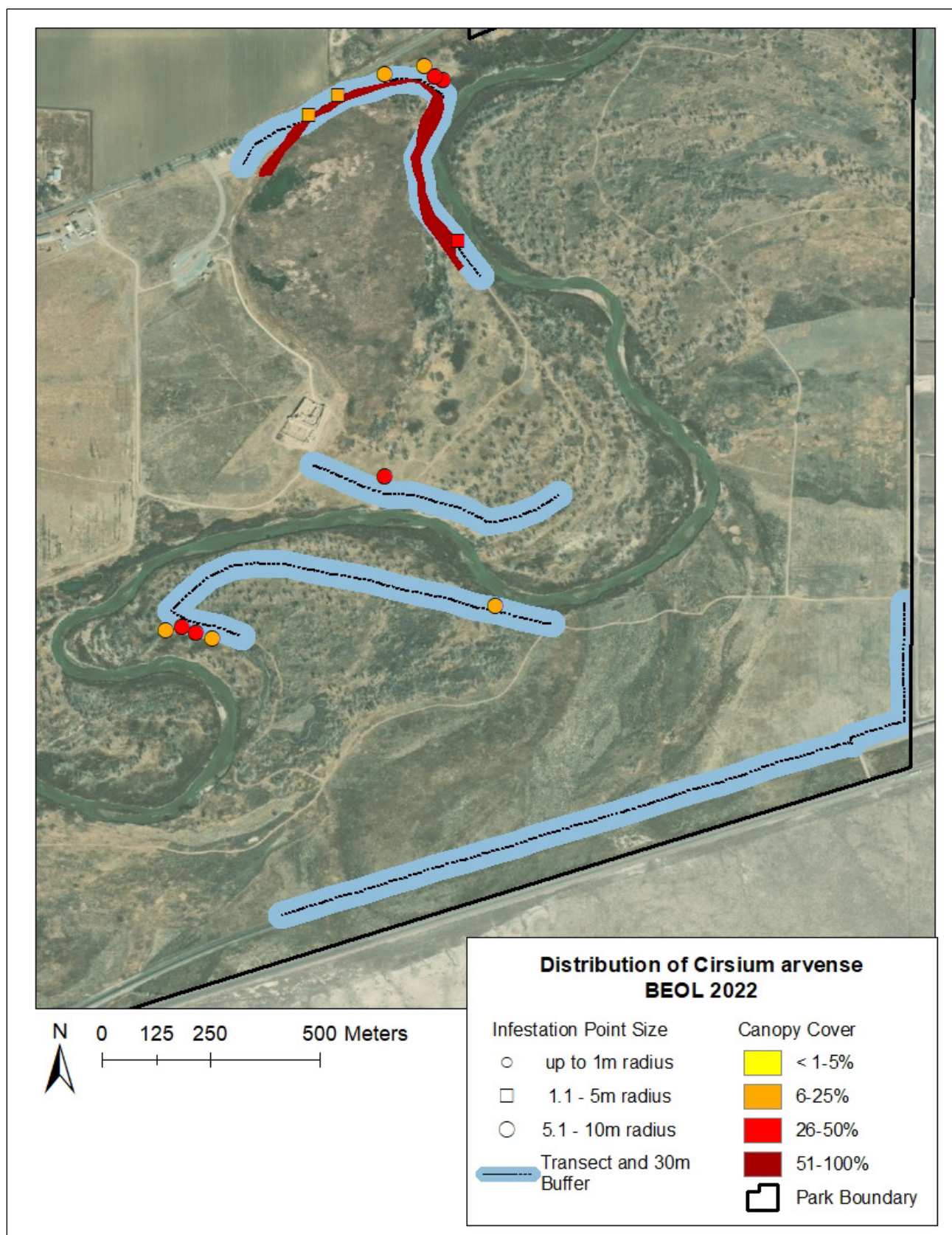
Map A-2. Smooth brome (*Bromus inermis*) distribution, infestation size, and canopy cover recorded in August 2022 surveys.



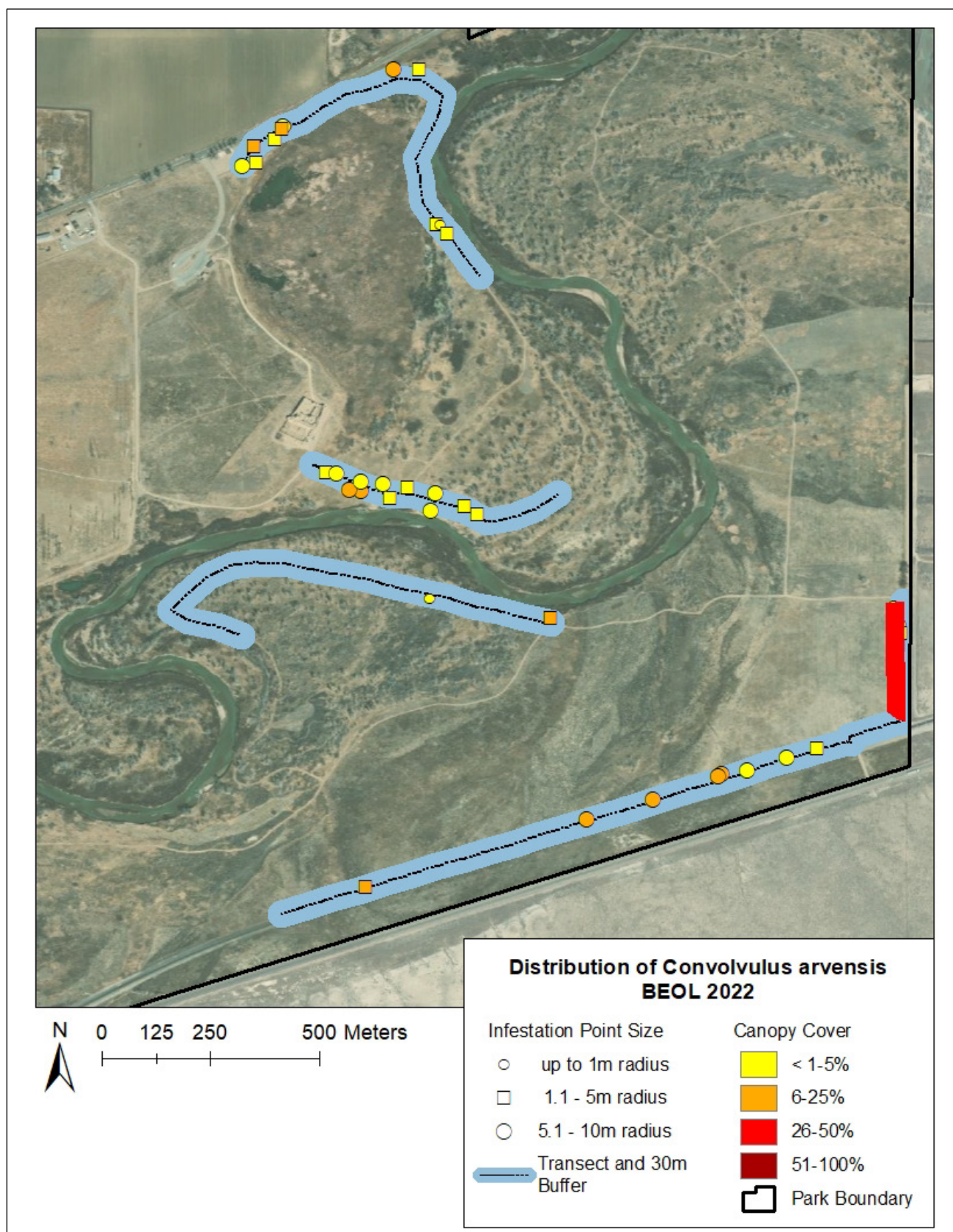
Map A-3. Cheatgrass (*Bromus tectorum*) distribution, infestation size, and canopy cover recorded in August 2022 surveys.



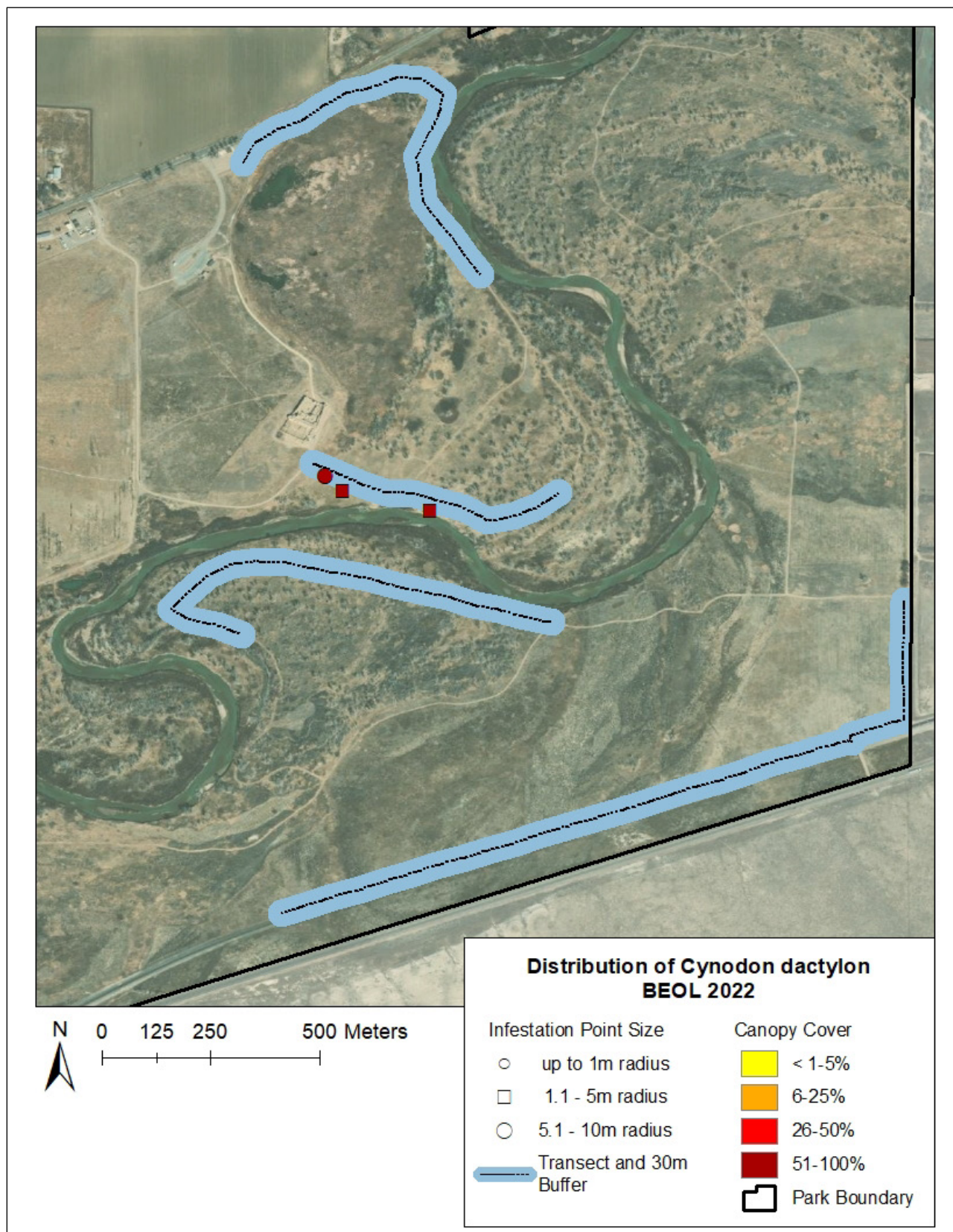
Map A-4. Canadian thistle (*Cirsium arvense*) distribution, infestation size, and canopy cover recorded in August 2022 surveys.



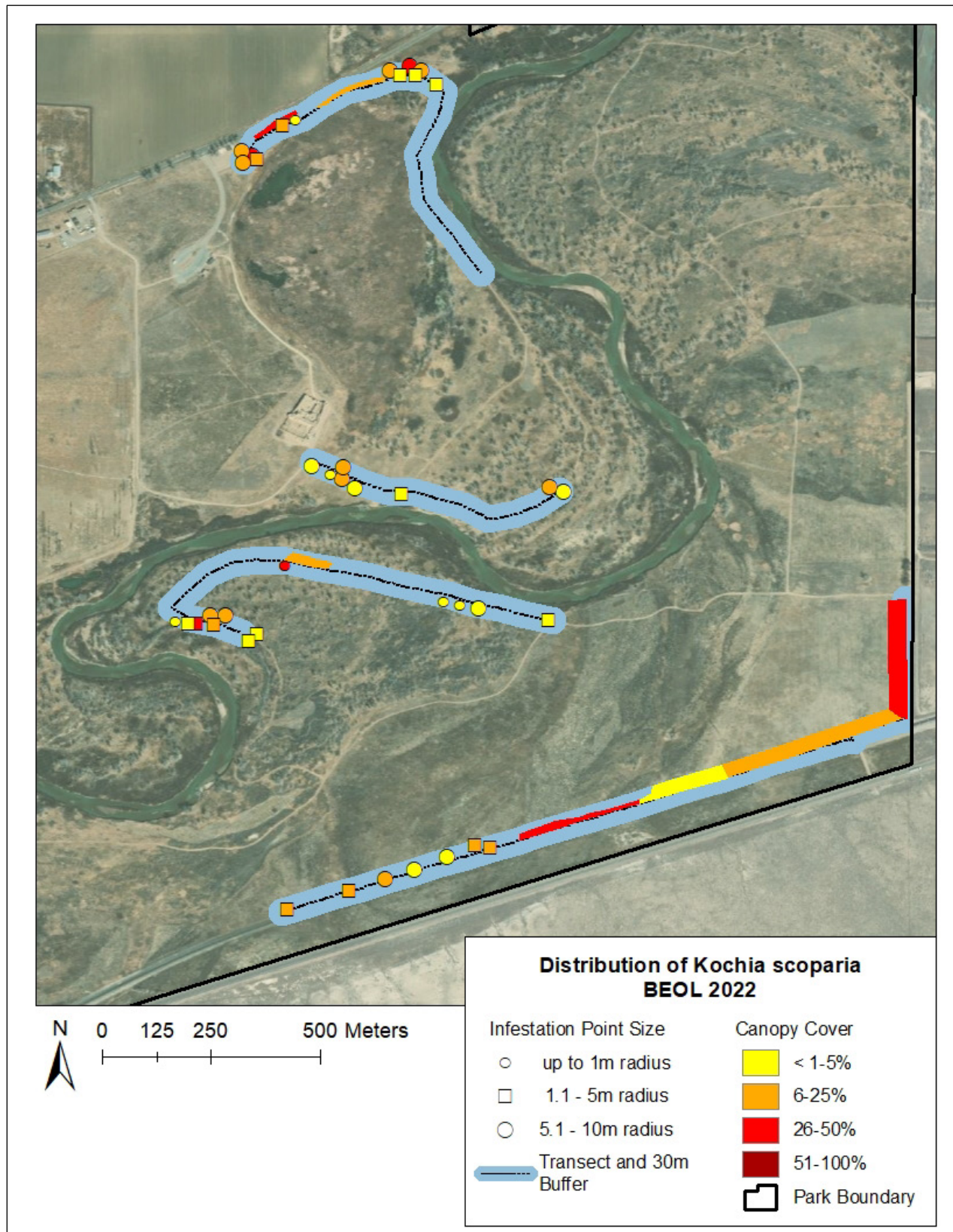
Map A-5. Field bindweed (*Convolvulus arvensis*) distribution, infestation size, and canopy cover recorded in August 2022 surveys.



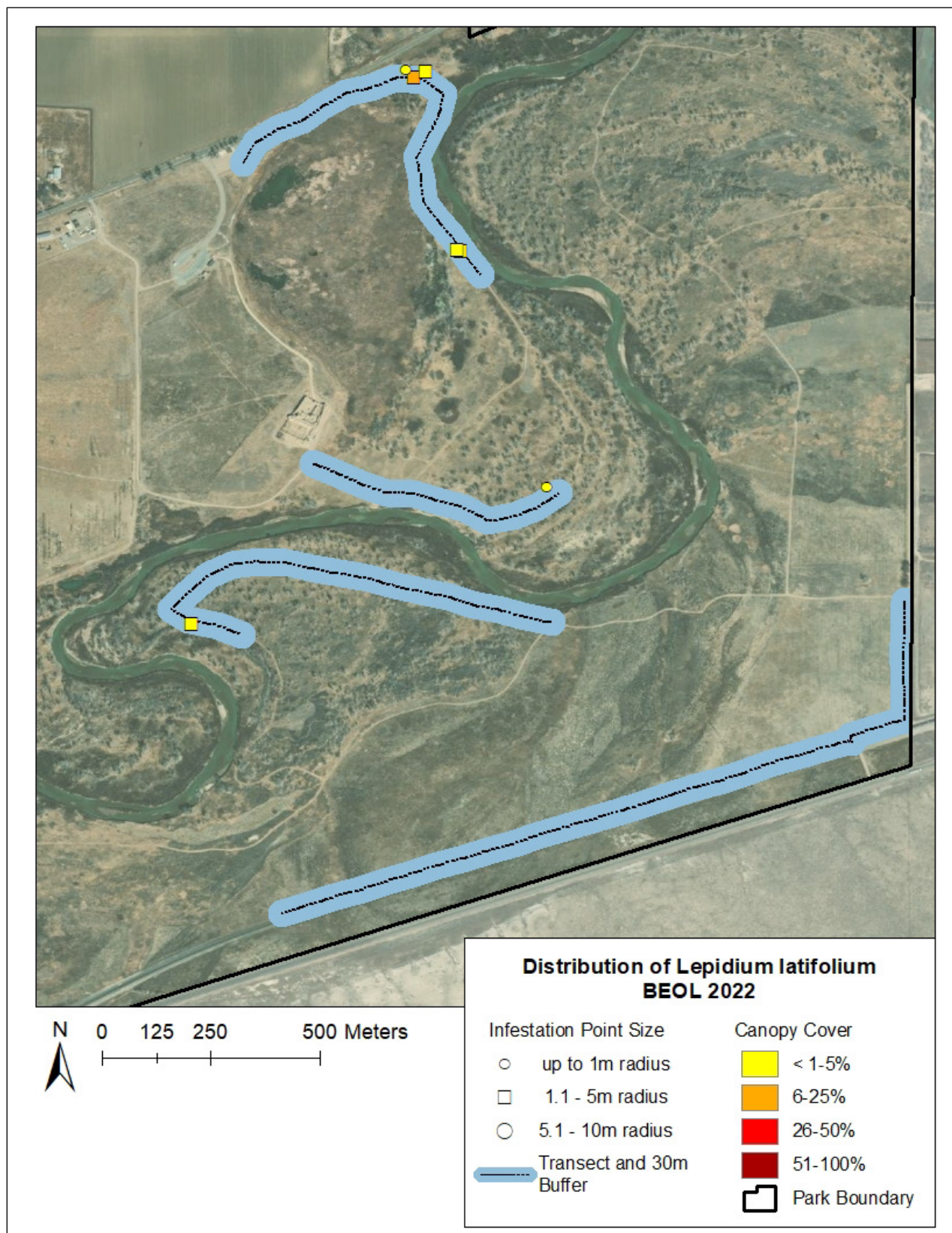
Map A-6. Bermuda grass (*Cynodon dactylon*) distribution, infestation size, and canopy cover recorded in August 2022 surveys.



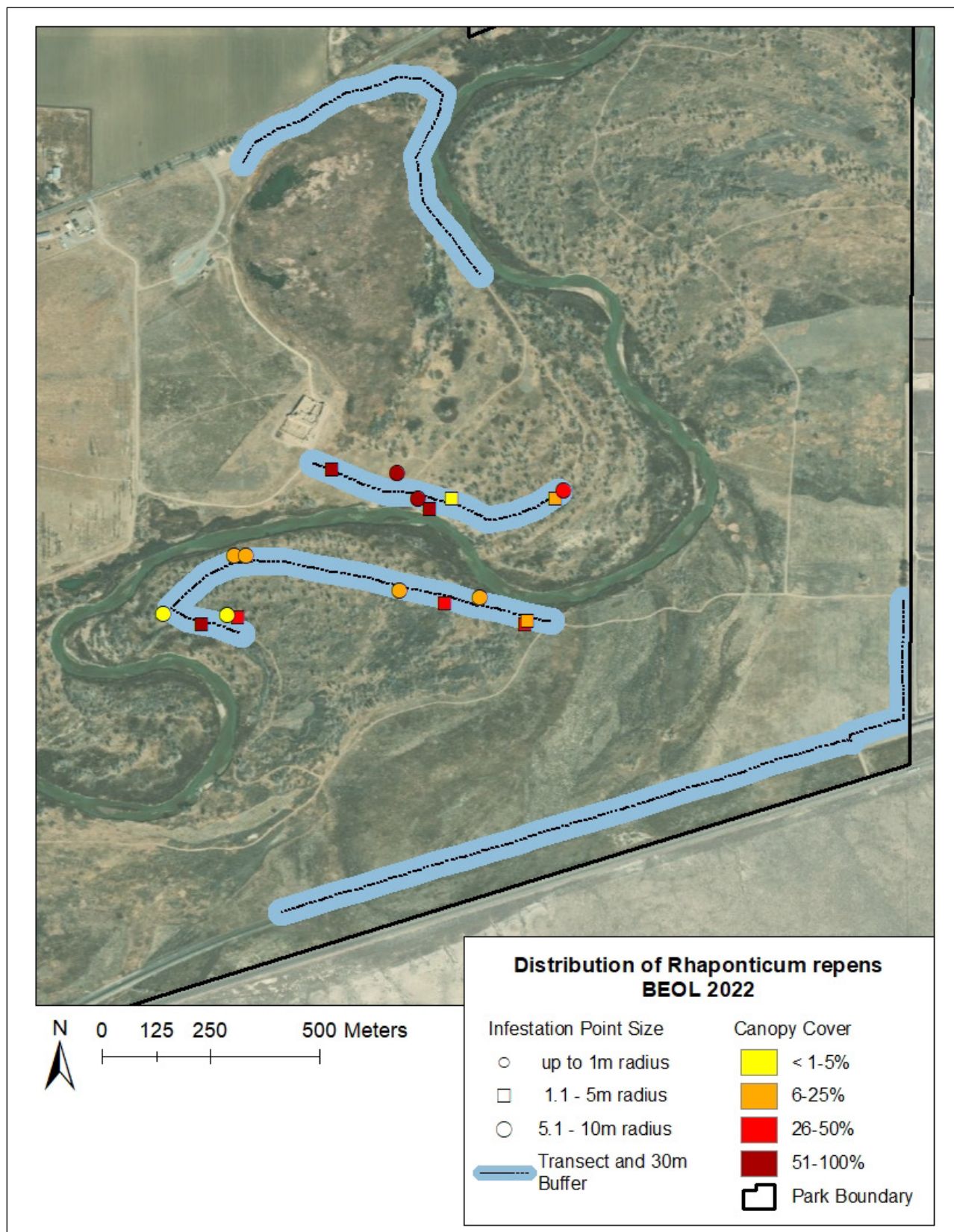
Map A-7. *Kochia* (*Kochia scoparia*) distribution, infestation size, and canopy cover recorded in August 2022 surveys.



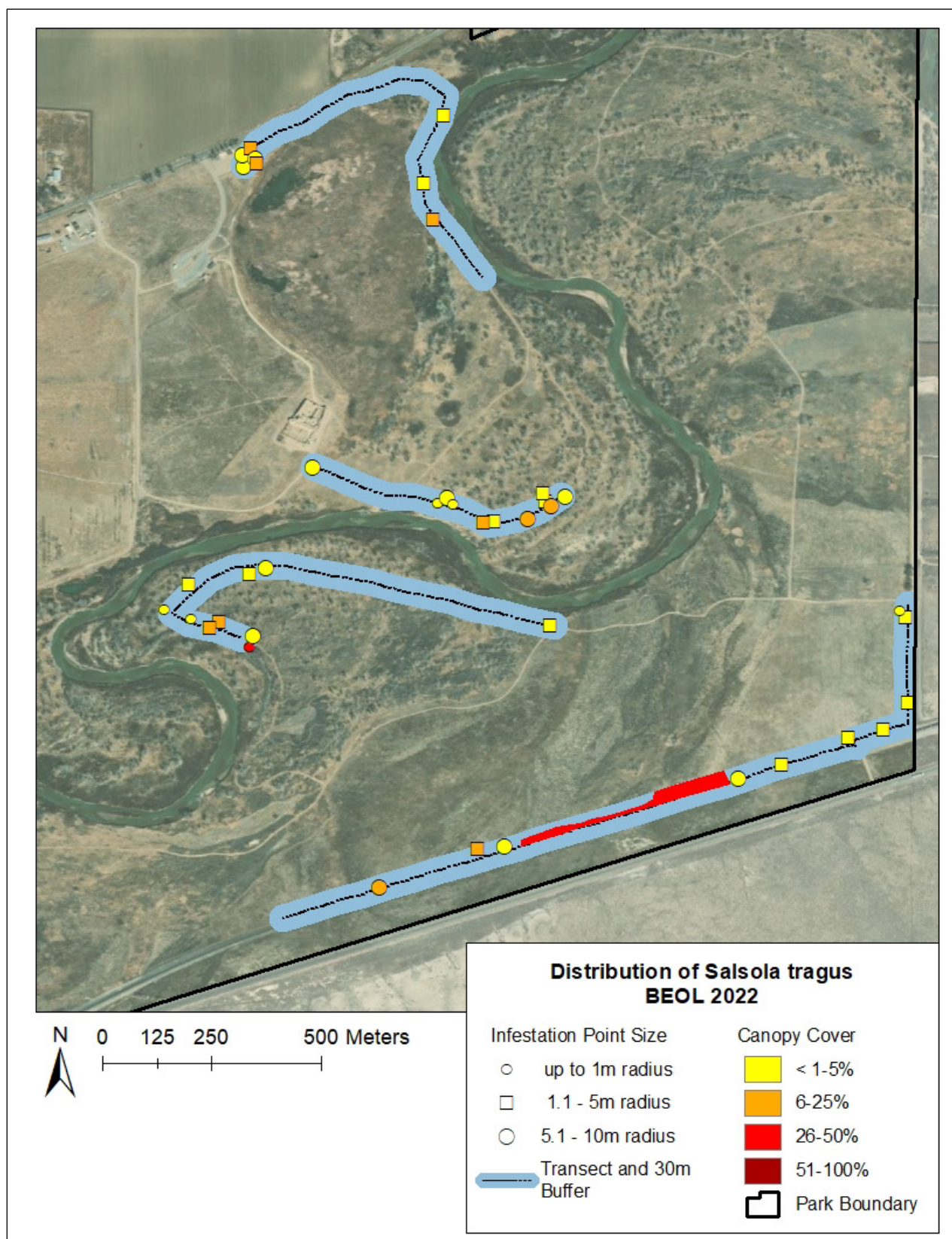
Map A-8. Perennial pepperweed (*Lepidium latifolium*) distribution, infestation size, and canopy cover recorded in August 2022 surveys.



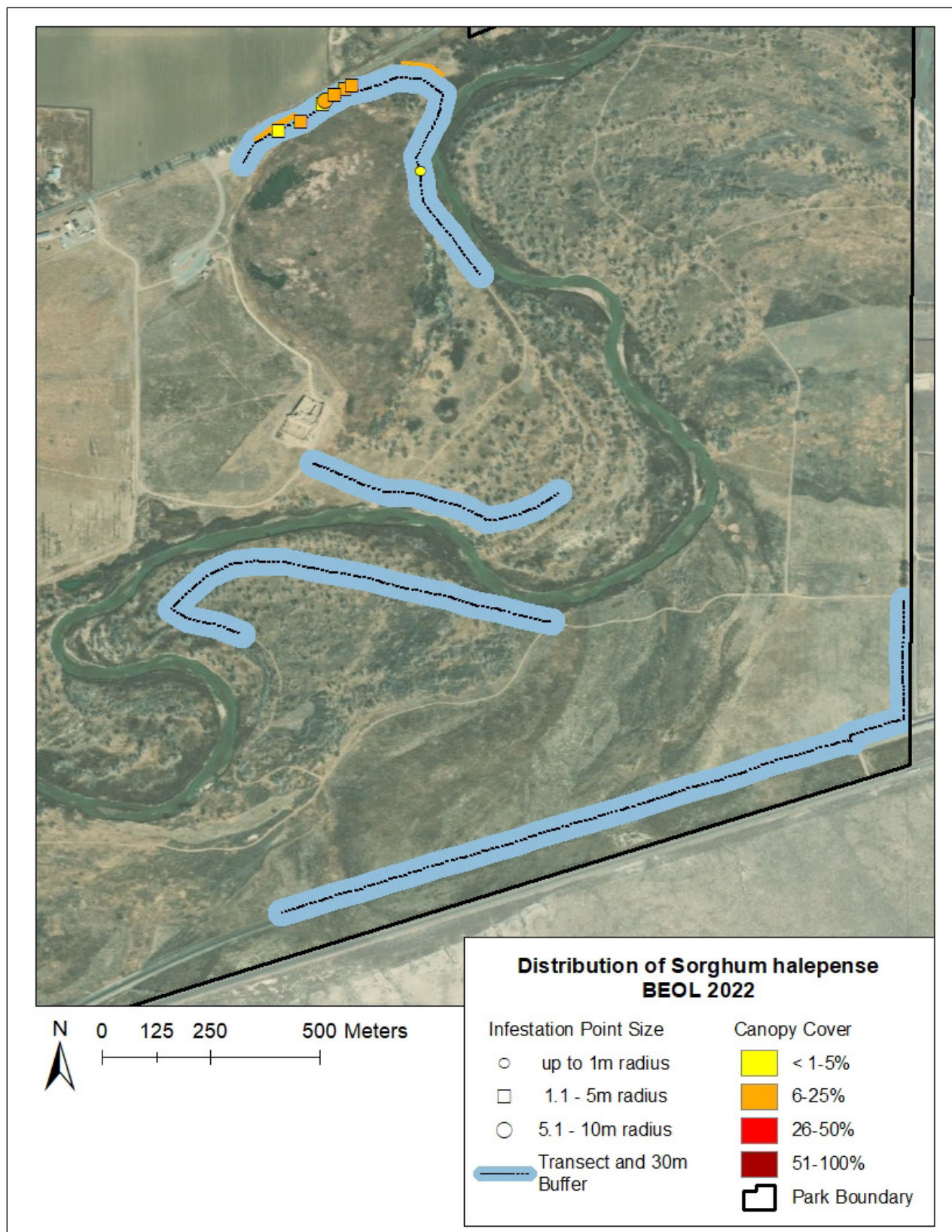
Map A-9. Russian knapweed (*Rhaponticum repens*) distribution, infestation size, and canopy cover recorded in August 2022 surveys.



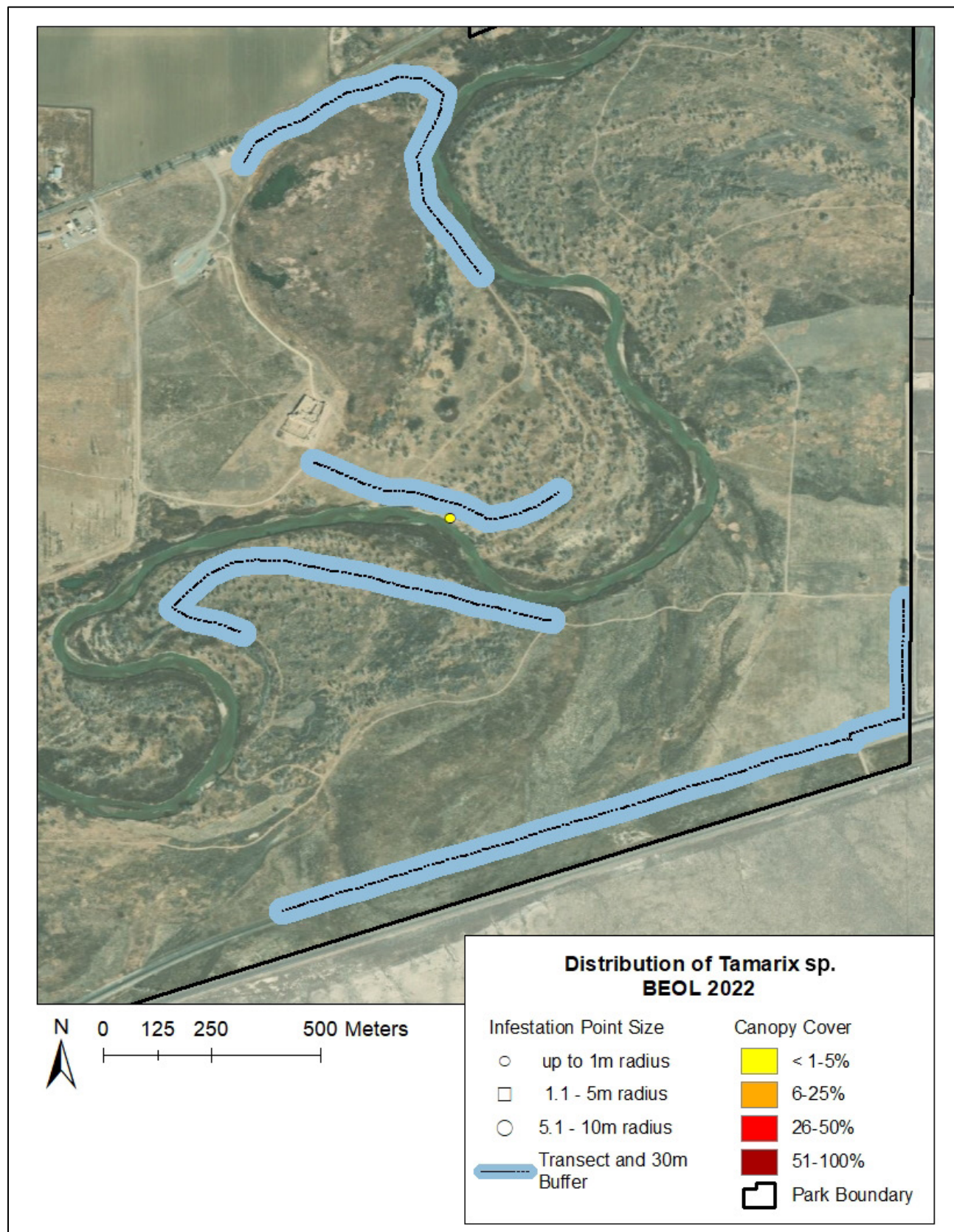
Map A-10. Russian thistle (*Salsola tragus*) distribution, infestation size, and canopy cover recorded in August 2022 surveys.



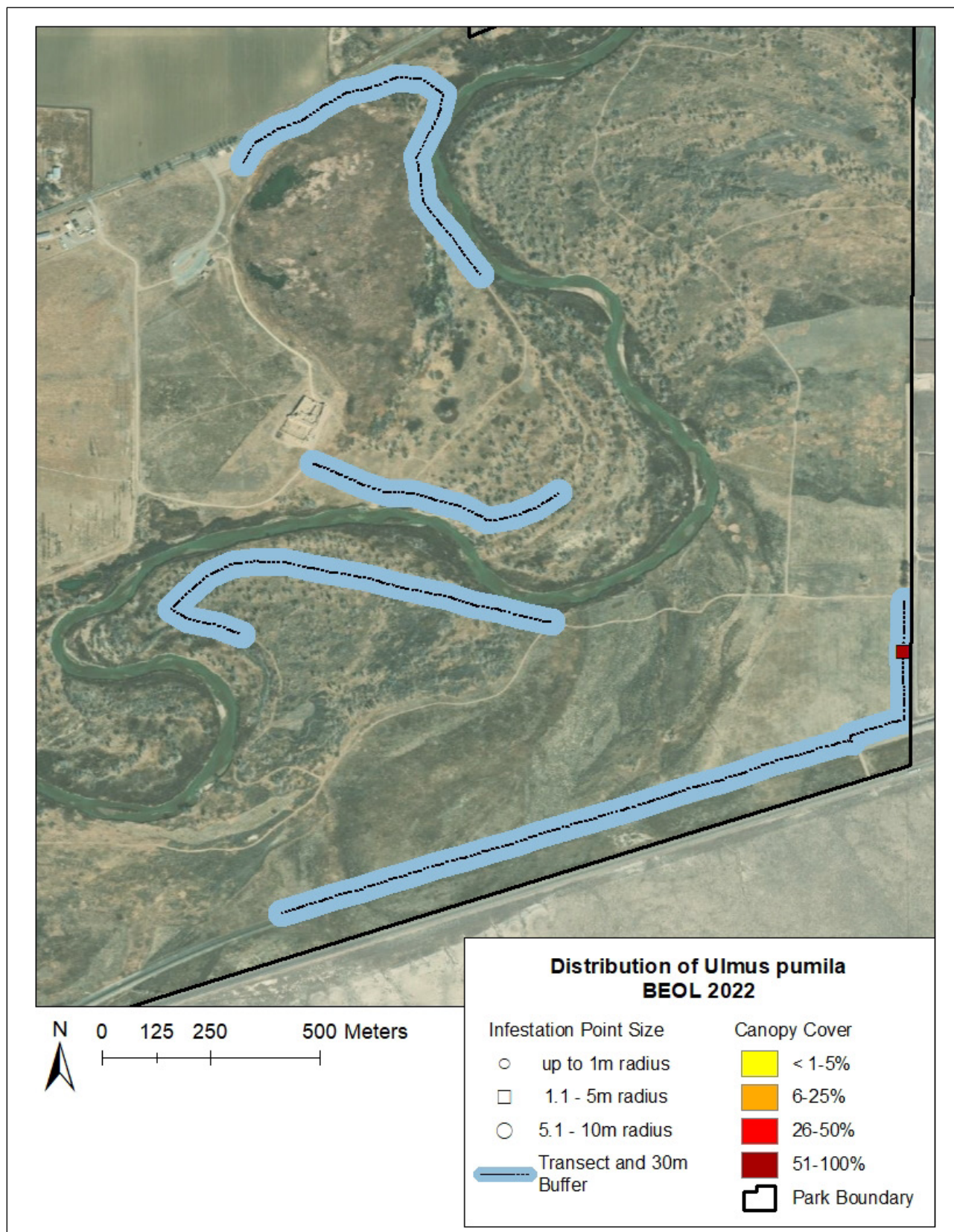
Map A-11. Johnsongrass (*Sorghum halepense*) distribution, infestation size, and canopy cover recorded in August 2022 surveys.



Map A-12. Tamarisk (*Tamarix* sp.) distribution and canopy cover recorded in August 2022 surveys.



Map A-13. Siberian elm (*Ulmus pumila*) distribution, infestation size, and canopy cover recorded in August 2022 surveys.



Report Disclaimer

This report received peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data, and whose background and expertise put them on par technically and scientifically with the authors of the information. Peer review helps to ensure that the information is scientifically credible, technically accurate, appropriate to its intended audience, and effectively presented. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were summarized and interpreted within the guidelines of the protocols. Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

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