Grand Canyon National Park and Grand Canyon National Park Foundation

Fall 2006 Report
Management & Control of Tamarisk and Other Invasive Vegetation
at Backcountry Seeps, Springs and Tributaries
in Grand Canyon National Park
(Phase II-B, Second Year of Phase II of Comprehensive Project)
Revised May 2, 2007 – FINAL VERSION

Arizona Water Protection Fund Contract Number 06-138WPF

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I. Abstract

Grand Canyon National Park's backcountry seeps, springs and tributaries of the Colorado River are among the most pristine watersheds and desert riparian habitats remaining in the coterminous United States. These riparian systems deserve a high level of protection from invasive exotic plants. It is well documented that the encroachment of invasive plant species into natural areas is a serious problem worldwide, second only to habitat fragmentation. The Arizona Statewide Invasive Species Advisory Council developed a Statewide Invasive Species Management Plan and without argument, the board agreed that tamarisk (*Tamarix ramosissima*) poses one of the greatest threats to Arizona's diverse landscapes. There is no doubt that Grand Canyon National Park (GRCA) and Hualapai Tribal lands contain some of the most intact and productive riparian ecosystems in the state. These precious ecosystems are still becoming overrun with tamarisk and are in need of attention. Prior to the receipt of this current grant, all of the tamarisk management work was completed on GRCA lands, managed by the National Park Service (NPS), as stated in the 1975 Grand Canyon National Park Enlargement Act [an Act of Congress on January 3 (88 Stat 2089) (Public Law 93-620).] The National Park Service (NPS) and Grand Canyon National Park Foundation (GCNPF) recognize the need to work at the watershed level in order to maximize the effectiveness of management actions and to truly work on the landscape scale required to address this ecological issue. During this phase (Phase II-B), the tamarisk management project was expanded to include work on adjacent Hualapai Tribal lands that are outside of the park's boundary.

The Grand Canyon National Park Foundation (GCNPF) received a grant from the Arizona Water Protection Fund (AWPF) to control invasive plants in selected riparian areas within Grand Canyon National Park (GRCA) and adjacent Hualapai Tribal lands, allowing native plant communities to recover and persist. The grant supports a partnership between GCNPF, the NPS and the Hualapai Tribe and funds this project through December 31, 2008, with work occurring in 30 areas within GRCA and on adjacent Hualapai Lands. This work is Phase II-B of a large-scale backcountry invasive plant management program. The primary objectives of this phase of the overall project are to remove tamarisk and other invasive exotic plants from 30 tributaries of the Colorado River and to monitor the success of the tamarisk removal through pre- and post-removal monitoring. This project will significantly reduce invasive plant distribution within the treated area and allow native vegetation to reestablish without exotic plant competition. This work is a follow up of the very successful Phase I and Phase II-A, also funded by the AWPF, in which crews removed 193,496 tamarisk trees from 105 project areas. The lessons learned during the implementation of Phase I and II-A have allowed the Project Coordinator, Lori Makarick, to improve upon the management and monitoring portions of the project.

To date, crews have removed 17,575 tamarisk trees including 13,508 seedlings, 2,822 saplings, and 1,245 mature trees from over 50 hectares in Phase II-B project sites. The total tamarisk canopy cover removed from the project sites was 5,715 square meters, allowing native vegetation access to critical resources such as nutrients, sunlight and water. This report includes all of the data from the backcountry and river trips completed in the fall of 2006. The AWPF Commission has funded all or a portion of this report.

Please Note: The data and photographs for this report have all been entered into the project database, which is included on the enclosed compact disk, minus the complete set of project photographs. To open the database, click on the grca.mdb file. Upon review and acceptance from AWPF, this report will be available on Grand Canyon National Park's website (www.nps.gov/grca) in the .pdf format.

II. Introduction

a. Overview of project status

The Grand Canyon ecoregion's backcountry seeps, springs and tributaries of the Colorado River are among the most pristine watersheds and desert riparian habitats remaining in the coterminous United States. These riparian systems deserve a high level of protection, particularly from the invasion of exotic plant species. Grand Canyon National Park Foundation (GCNPF) received a grant from the Arizona Water Protection Fund (AWPF) to control invasive plants at selected riparian areas within Grand Canyon National Park (GRCA) and on adjacent Hualapai lands, allowing native plant communities to recover and persist. The grant funds a project through December 31, 2008, with work occurring in 30 areas within GRCA and on adjacent Hualapai Tribal lands. The grant supports a partnership between GCNPF, the National Park Service (NPS) and the Hualapai Tribe. This report contains the details from the invasive plant control efforts completed to date. The AWPF Commission has funded all or a portion of this report.

This work is Phase II-B of a landscape-level backcountry invasive plant management project. The primary objectives of this phase of the overall project are to remove tamarisk and other invasive exotic plants from 30 tributaries of the Colorado River in GRCA and on adjacent Hualapai lands and to monitor the success of the management actions through pre- and post-removal plant monitoring. This project will significantly reduce invasive plant distribution within the treated areas, allowing native vegetation to reestablish without exotic plant competition. This work is a follow up of the very successful Phase I and II-A, also funded by the AWPF, in which crews removed 193,496 tamarisk trees from 105 project areas. The data from Phase I showed that only 7% of the initially treated trees required follow-up control and that nearly all project areas displayed nearly 100% reduction of tamarisk cover and frequency. The lessons learned during the implementation of Phase I and II-A have allowed the project managers to improve upon the management and monitoring portions of the project.

In February 2002, prior to the initiation of Phase I, the NPS released an Environmental Assessment/ Assessment of Effect for this overall project. Staff received and analyzed public comments and prepared a Finding of No Significant Impact Statement (FONSI), signed by the regional office on June 18, 2002. These documents continue to guide the implementation of this project. The park received a written response to the informal consultation with the U.S. Fish and Wildlife Service (USFWS) on January 25, 2001. That letter, along with the incorporation of their recommended changes, completed the Section 7 consultation required for this project. On April 8, 2002, the State Historic Preservation Officer (SHPO) provided the park with written concurrence on the project moving forward.

With the initiation of each new phase of the project, project managers and coordinators re-examined the compliance documents to ensure all consultation, permits and determinations remain valid. Prior to the initiation of Phase II-B, both Reuben Terán, AWPF Project Manager, and GRCA superintendent Joe Alston re-consulted with the SHPO. The SHPO again stated a determination of "no impact" for the grant work.

The GRCA superintendent also sent a letter to the USFWS as a follow-up on the preliminary consultation from 2001. On February 28, 2005, GRCA staff received a letter from the USFWS

stating that Phase II tamarisk management actions "are not likely to adversely affect the Southwestern willow flycatcher" since they will occur in areas that are not proposed critical habitat, updating the consultation and approval. During the May 2006 monitoring trip, crews documented changed conditions in two of the tributaries (Spring and Three Springs Canyons) included under this grant. The park's Wildlife Biologist and Vegetation Program Manager documented the current conditions with Habitat Assessment forms, Tamarisk Mapping forms, and photographs. The changes were caused by flash floods, which removed the dense vegetation that at one time might have contained potential habitat to support Southwestern willow flycatchers. At this time, both of these areas contain ideal conditions for the removal of invasive vegetation. To this end, GRCA Superintendent Joe Alston sent a letter to USFWS on December 12, 2006 requesting an amendment to the Biological Assessment (BA) to include tamarisk removal in Spring Canyon and Three Springs Canyon as implemented in other canyons. The letter is included in Appendix C, along with the additional Habitat Assessment forms that were not completed during the May 2006 trip. The Project Coordinator will provide the Project Manager with the USFWS's response as part of the Task #1 deliverables for this project.

Prior to the initiation of Phase II-B, the Hualapai Tribe completed a document entitled "Environmental Assessment for Proposed Tamarisk Eradication and Riparian Restoration on the Hualapai Reservation." The document was signed on January 5, 2006 with a Finding of No Significant Impact. By April 2006, the Project Coordinator had acquired the partnership agreement with the Hualapai Tribe, as well as the required park and tribal permits for Phase II-B, completing the final requirements of Task #1 in the grant contract. In addition, following the May 2006 monitoring river trip, the Project Coordinator revised the Tamarisk Monitoring and Management Plans and re-submitted them to AWPF in order to finalize the deliverables listed in Task #2 of the grant contract.

The Tamarisk Management Plan called for five backpacking trips, two tamarisk removal river trips, and two monitoring river trips. During the fall 2006 season, crews completed three backpacking trips and one river trip. The backpacking trips included areas accessed from the North Bass and Tonto Trails, which are listed as main trail corridor trips in the project contract. This report includes all of the data from the backpacking and river trips completed in the fall of 2006.

b. Justification for recent work

Tamarisk (*Tamarix* spp.), commonly known as salt cedar, is an invasive exotic tree that grows in dense stands along rivers and streams in the western United States. Tamarisk, introduced to the U.S. in the 19th century as an erosion control agent, spread throughout the West and caused major changes to natural environments. Tamarisk reached the greater Grand Canyon area during the late 1920s and early 1930s, and became a dominant riparian zone species along the Colorado River following completion of Glen Canyon Dam in 1963. The impacts caused by tamarisk are well documented (refer to Reference Section of the EA/AEF and Stevens 2001). These prolific non-native trees displace native vegetation, create conditions that are inhospitable for the germination of native plant seeds, impact wildlife abundance, and increase fire frequency. Salt cedar is an aggressive competitor, often developing monoculture stands and lowering water tables, which can negatively affect wildlife and native vegetative communities (Duncan 1996). Adapted to a wide range of environmental conditions, tamarisk fills previously unoccupied niches. Once established in an area, it typically spreads and persists.

In the Southwest, riparian areas account for less than 2% of the land, yet over 65% of southwestern wildlife depend on these areas. Riparian habitats are the most productive, most biologically diverse, most valuable and most threatened habitats in the American Southwest (Johnson et al. 1985). Tributaries and side canyons of the Colorado River, and seeps and springs in the Grand Canyon ecoregion, are worthy of the highest level of protection from non-native plant invasion. The recent encroachment of tamarisk into these tributaries poses a significant threat to the integrity of the natural ecosystems. GRCA and GCNPF are committed to the preservation of native plant communities and native ecosystems (NPS 1995a, NPS 1995b, and GCNPF Mission Statement). NPS management policies require park managers "to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and genetic and ecological integrity of the plant and animal species native to those ecosystems" (NPS 2001). Park managers are directed to give high priority to the control and management of exotic species that can be easily managed and have substantial impacts on park resources (NPS 1985, NPS 2001). GCNPF's mission is to project and preserve Grand Canyon's irreplaceable natural, cultural and historic resources while enhancing the visitor experience. In addition, the Hualapai Tribe considers the removal of tamarisk to be a beneficial activity in terms of water quality and quantity improvements and the restoration of wildlife habitat. The removal of tamarisk from these tributaries protects valuable resources, increases native plant diversity, and provides an excellent opportunity for stewardship through the extensive volunteer program.

III. Methods

a. Area of interest in recent analysis

Under this contract (#06-138WPF), crews will remove tamarisk from 30 areas within Grand Canyon National Park and on adjacent Hualapai Tribal lands. The numbers of tamarisk trees found during the preliminary surveys (i.e. feasibility of control at this time) and the extent of the seeps, springs, and riparian habitat found within the project areas were factors in project area selection.

All of the project areas in Phase II-B occur below Phantom Ranch, and the majority of them located in the Western reaches of the Grand Canyon, typified by Mohave Desert influences. High species diversity, high species density, and high productivity generally characterize riparian areas. Continuous interactions occur among riparian, aquatic, and upland terrestrial ecosystems through exchanges of energy, nutrients, and species. Warren et al. (1982) provided the following description of Grand Canyon riparian areas:

> "Riparian woodlands (or forests) characterized by cottonwood-willow associations are primarily restricted to the larger perennial streams and drainages of the Colorado Plateau region of northern Arizona. The great biological importance and floristic diversity of these cottonwood-willow riparian forests is disproportionate to their limited total area…. Riparian scrub usually occurs along ephemeral or intermittent watercourses (such as desert arroyos), or in narrow canyons which are periodically scoured by floods. Riparian scrub communities are characterized by a broad continuum of vegetative associations that range from mesic vegetation types to xeric growth along desert arroyos (Brown et al., 1980). These arroyos often contain water only one day or less each year and the resulting vegetation is commonly composed of a mixture of facultative riparian species and upland species. This is in contrast

to mesic species, which are generally absent from the surrounding uplands…. Side canyons throughout the park with perennial water support riparian vegetation characterized by cottonwood (*Populus fremontii*) and willow (*Salix* spp.) which is generally very similar to that found in similar situations throughout northern Arizona (Phillips and Phillips, 1979)…."

Each stream, spring, seep, or dry wash, has a different association of species, depending on environmental features including elevation, permanence of water, substrate, frequency of flooding, and colonization (Warren et al., 1982). Riparian vegetation typically occurs in small, discrete stands or patches. The floristic diversity in wetland and riparian composition is highly variable, but is extremely high when compared to the upland vegetation. Typical stands may consist of broad-leaved deciduous trees in the overstory, with a mixture of shrubs and grasses in the understory. Species typical of drainages with perennial water sources are:

- Fremont cottonwood (*Populus fremontii*)
- Long-leaf brickellbush (*Brickellia longifolia*)
- Catclaw acacia (*Acacia greggii*)
- Willow (*Salix exigua*, *Salix goodingii*)
- Monkey flower (*Mimulus cardinalis*)
- Mesquite (*Prosopis glandulosa*)
- Seep willows (*Baccharis emoryii*, *Baccharis salicifolia*)

Species typical of drainages with dry washes or intermittent water are:

- Catclaw acacia (*Acacia greggii*)
- Baccharis (*Baccharis sergiloides, B. sarathroides*)
- Snakeweed (*Gutierrezia sarothrae*)
- Apache plume (*Fallugia paradoxa*)
- Utah agave (*Agave utahensis*)
- Mormon tea (*Ephedra* spp.)
- Four-wing saltbush (*Atriplex canescens*)
- Fremont cottonwood (*Populus fremontii*)
- Skunkbush (*Rhus trilobata*)
- Red-bud (*Cercis occidentalis*)
- Alkali goldenbush (*Isocoma acradenia*)

Upland species, described below, are also present in these dry or intermittent washes. Trees and shrubs tend to be scattered, but may also form dense thickets. Species composition varies depending on moisture availability, elevation, and geographic location in the canyon. Within the park, tamarisk occurs in the many of the side canyon and tributaries; however, the distribution and density is highly variable.

The vegetation surrounding the tributaries is generally very different from desert scrub communities, which are composed of plant species from three of the four North American desert floras. The Sonoran desert scrub has the highest plant species diversity. A two-season rainfall regime and lack of freezing temperatures characterizes the Sonoran desert. The Mojave desert scrub has higher local species diversity with shrubs as the dominant component. Winter rains and the absence of freezing temperatures characterize this desert. The Great Basin desert receives more

winter rain than the Mojave and frequently has severe winter freezes and the lowest diversity of the three (Warren, et al. 1982).

The three deserts within GRCA overlap significantly in distribution, with many species shared among them; however, certain species are characteristic of each community. Big sagebrush (*Artemisia tridentata*), rabbitbrush (*Ericameria* spp.), Mormon tea (*Ephedra* spp.) and a variety of perennial grasses dominate the Great Basin desert scrub. These associations are typically found in the eastern portion of the canyon and comprise the vegetation surrounding some of the upper and middle tributaries. Typical Mojave desert species include creosote bush (*Larrea tridentata* var. *tridentata*), white bursage (*Ambrosia dumosa*), Mormon tea (*Ephedra* spp.), blackbrush (*Coleogyne ramosissima*), turpentine broom (*Thamnosma montana*), and other species. They most often occur in the central and western portion of the canyon. The Sonoran desert species include brittlebush (*Encelia farinosa*), catclaw acacia (*Acacia greggii*), ocotillo (*Fouquieria splendens*) and desert willow (*Chilopsis linearis*). Sonoran associations occur in the lower portion of the canyons, and many of these species can grow directly in infrequently scoured drainages. The project areas for this grant occur from Colorado River Mile 8 (Badger Canyon) to Colorado River Mile 225.5, covering portions of each of the major desert ecosystems.

b. Project Logistics

Phase II-B of the invasive plant management work brought with it many new insights and subsequent improvements from lessons learned from earlier experiences with the project. In May 2006, crews surveyed and mapped project areas for tamarisk distribution, completed habitat assessments and installed long-term photopoints in transect areas. During the surveys, crews established 500 meter-long mapping sections in drainages to more consistently estimate tamarisk distribution. The standardized section length makes data collection in the control phase of the project much more straightforward, and allows for standard comparison units between areas. In all of the project areas, crews took representative photographs which were included with the Habitat Assessments and Tamarisk Mapping documents. Based on past input from crew leaders, it is easier to install the additional permanent photopoints during the control trips; therefore, crews take before and after pictured of project areas during the work implementation.

Crews completed the invasive plant management work from September through November 2006. The field crew supervisor prepared trip schedules and river trip itineraries, which were reviewed and approved by park management, prior to each trip (please refer to Table 1. Phase II-B Project Area List and Completion Status, Table 2. Fall 2006 Trip Schedule, Table 3. Fall 2006 Hualapai Partnership River Trip Participant List, Table 4. Fall 2006 Hualapai Partnership River Trip Itinerary, Table 5. Spring 2007 Proposed Field Schedule for additional Phase II-B areas). The goal of the control work was to target 13 tributaries on the September/October river trip, 6 tributaries on the February/March trip and the remainder from trails via backpacking trips. Pending weather and logistics, crews will complete three additional backpacking trips and a river trip with this Phase II-B in the spring 2007 season.

The fall 2006 work included extensive backpacking trips to some of the most remote areas in the park, in addition to a river trip, with each project area introducing a new set of unique challenges. The field crew supervisor, Kate Watters, organized the fall logistics and schedule consisting of three backpacking trips and an 18-day river trip all during a 12-week period. In addition, three other

people served as crew leaders (Loren Bell, Steve Till, and Kari Malen), all of which were funded by the grant. Kelly McGrath, an intern through the Eugene Polk Internship funded by the Grand Canyon National Park Foundation, served as the fourth crew leader. All of the crew leaders that worked on the project during Phase II-A returned to work after summer seasonal field work in various places on the Colorado Plateau. These folks continued to build on their expertise and project knowledge, and all are now very dedicated, knowledgeable, physically fit, and absolutely invaluable to the project.

The fall season kicked off with a crew leader training trip (funded through Phase II-A), which included a day of orientation to and organization of the program field gear on the South Rim and three days of tamarisk removal work in Hance Creek. The field crew supervisor organized the training with input from the crew leaders. The topics included a project overview, data collection updates, control method review, herbicide application and safety, crew leader peer evaluations, evacuation and injury reporting, backcountry check-in policy, leave no trace practice, volunteer supervision, and climbing safety. In addition to program staff, Paul Austin, a Backcountry Ranger with the park, joined the trip and provided needed training on search and rescue and evacuation protocols, as well as climbing safety. During the training, the crew leaders discussed the need for a structured peer evaluation technique in order to facilitate constructive criticism from co-leaders and the field supervisor about their performance. The development of the new form (included in Phase II-a Fall 2006 report) has provided a valuable method for supplemental crew leader training and improvement.

The backpacking trips were eight days long and consisted of a varying number of volunteers and one to two crew leaders. The backpacking trips continue to pose great challenges for the crew. The biggest feat involved with the execution of tamarisk work is carrying the tools and herbicide required to remote locations in addition to the 40 pounds of gear needed for a standard backpacking trip. Second to that is finding a constant supply of hearty volunteers to share the heavy work load for a week at a time. Crews were able to complete work via backpacking in Horn, Salt and White Creeks, Cedar Spring and the Spring East of Cedar Spring.

At Slate Creek, which is accessed via long, steep, remote trails, crews were able to stash gallons of herbicide from the river, cutting down on the distance that crew leaders had to carry jugs of herbicide and tools. Despite efforts to cut down on tools and gear, the main challenge of the backpacking trips is the extremely heavy packs that crew leaders and volunteers must carry in order to make the project possible. Trips are generally eight days long including hiking and driving time, which in most cases allowed for only four and sometimes five solid days of work. Days begin early with breakfast at 6:30 and crews heading off to work by 7:30. The workdays ended at about 4:30 or 5:00, leaving the crew the task of making dinner in the rapidly approaching darkness and cold. The long workdays and extensive trail commutes did not hamper the spirits of the volunteer participants, as they are a stalwart, dedicated crowd of individuals.

Due to the remoteness of Grand Canyon's terrain, it is necessary to access the majority of the project areas from the Colorado River. The 14-person September/October river trip launched from Lees Ferry and took out at Diamond Creek. All of the project areas on the river trip were located on the lower half of the river, below Phantom Ranch, allowing all of the work crew to hike into Phantom Ranch to meet the boat crew. The itinerary was set for a 20-day trip to allow

for sufficient time to access and work in canyons on the itinerary. This also requires a fitting a tremendous amount of gear onto the five boats.

The NPS boatshop crew provided excellent meals and logistical support, as well as physically helping to get the work done. The workdays were long and included many areas with dense patches of enormous, mature tamarisk trees. The Hualapai crew consisted of three hard-working and hearty young men from Peach Springs paid through the AWPF grant. Unfortunately, the fourth Hualapai crew member, Ronald Beecher II, had to be evacuated during the hike down the South Kaibab to meet the boats at Phantom Ranch, due to a prior injury to his Achilles tendon that kept him from joining the trip. In addition, two Hualapai Tribal hydrologists joined the trip; they were funded by Alex Cabillo at Hualapai Natural Resources. The hydrologists were able to continue to sample long term water quality at five sites, including National, Mohawk, Beecher Spring, Granite Park, and Pumpkin Spring. Alex Cabillo is extremely supportive of the tamarisk removal and combining their hydrology data with the tamarisk management project. Once the hydrologists completed their sampling work, they spent the remainder of the days cutting tamarisk trees along with the remainder of the crew.

Due primarily to the fast and efficient work of the work crew and secondarily to the challenge of securing appropriate camps, the trip rescheduled their take out cutting the trip short by two days. The trip was extremely successful as 12 of the 13 project areas that were targeted on the itinerary were completed. This was due largely to the tremendous effort put forth by all trip participants, including the boatmen, who worked tirelessly alongside the Hualapai and GRCA crews. Another reason for the great accomplishment was the accurate mapping done by crews on the May 2006 monitoring trips. The detailed data collected by those crews made the trip itinerary easy to plan, and as it turned out, the crew stayed ahead of schedule the entire trip.

Phase II-B project areas that were completed on the Hualapai Partnership River trip include: 121.5 Mile Canyon, 140 Mile Canyon, Mohawk Canyon, Honga Spring, Prospect Canyon, 190 Mile Wash, Granite Park Canyon, 217 Mile Canyon, 221 Mile Canyon, 221.5 Mile Canyon, 222 Mile Canyon and 224 Mile Canyon. Granite Park was 75% complete on the Hualapai Partnership trip, but due to a private river trip that was camped at that beach, crews were not able to stay overnight and spend another day to complete the remaining work, which contributed to the trip taking out two days early. Fortunately, a Colorado River Fund trip in November was able to finish the remaining work at Granite Park, as well as complete tamarisk removal in Topaz Canyon. In addition to these areas, crews were also able to use the extra time in the itinerary to complete 225 Mile Canyon, which was an outstanding area from Phase II-A of the project.

Granite Springs Canyon proves to be a large undertaking, with a 3 mile hike one way up the drainage just to reach the work and at least 4 full days needed to finish the area. This is complicated by the fact that there is no camp in the cobble-laden debris fan. Crews planned to get two days of work accomplished at this area, but due to these circumstances, had to camp ½ mile above the site, work a long day, and then camp ½ mile below the site. This was another reason the river trip ended a few days early. The field crew supervisor evaluated other options for completing this canyon via various approaches; including helicopter, backpacking and up-running the five miles from Diamond Creek in a Hualapai River Runners motor boat. GRCA compliance calls for the minimum tool employed to complete the task, which leaves backpacking

as the least invasive, yet doable option. The problem is lack of available backpacking spike camps in this canyon and overall access. On the spring 2007 Hualapai Partnership river trip crews will put in another full day of work in this area and will scope out the upper portion of the drainage for a potential backpacking trip reached from the rim. This is the only area that we foresee difficulties with completion during the time frame of the grant, due to the aforementioned circumstances.

Table 1. Phase II-B Project Areas List and Completion Status

River Mile	River Side	Canyon Name	Seedling	Sapling	Mature	SW IFL Habitat Assess. Complete	Transect Area	Work Complete	Work Scheduled 2007
90	L	Horn Creek	0	0	31	**X**		X	
92.5	L	Salt Creek - Upper*	unknown	unknown	unknown	**X**		X	
93	L	Cedar Spring	unknown	unknown	unknown	**X**		X	
93	L	Spring East of Cedar Spring*	unknown	unknown	unknown	**X**		X	
96.7	L	Topaz Creek	136	143	14	X	X	X	
98	L	Slate Creek	99	234	281	X			
100.5	L	Agate Canyon	63	49	106	X			Spring '07
101	L	Sapphire Canyon	40	152	91	X			Spring '07
102	L	Turquoise Canyon	unknown	unknown	unknown	**O**			Spring '07
104.5	L	Ruby Canyon – Upper	unknown	unknown	unknown	**O**			Spring '07
105.8	L	Above Serpentine	2	3	3	X			Spring '07
108	R	White Creek	0	0	25	X		X	
108	R	Flint Creek*	unknown	unknown	unknown	**O**			Fall 2007
121.5	L	121.5 Mile Creek L[1]	unknown	unknown	unknown	X		X	
140	L	140 Mile Canyon	16	0	14	X	X	X	
149.5	R	Springs Below Matkat*	unknown	unknown	unknown	**O**			2007 River
151	R	151 Mile - Suddenly Spring*	unknown	unknown	unknown	X			2007 River
166.5	L	National Canyon	370	10	18	X	X		2007 River
171.6	L	Mohawk Canyon	456	63	18	X	X	X	
177	L	Honga Spring	14	20	10	X		X	
179	L	Prospect Canyon	4	5	2	X		X	
190	L	190 Mile Wash	1123	167	148	X		X	
204.4	L	Spring Canyon*	200	200	50	X, C			2007 River
209	L	Granite Park Canyon	2300	227	227	X	X	X	
215.7	L	Three Springs	15300	2931	141	X, C	X		2007 River
217	L	217 Mile Canyon	220	7	0	X		X	
220.5	L	Granite Spring Canyon	1030	754	357	X			2007 River
221	L	221 Mile Canyon*	0	0	2	X		X	
221.5	L	221.5 Mile Canyon*	0	0	2	X		X	
222	L	222 Mile Canyon	135	29	23	X		X	
224	L	224 Mile Canyon*	0	3	7	X		X	

NOTE For all sites, park vegetation staff will work with Park and Hualapai archeologists before ground disturbance to ensure archeological compliance.

X Tamarisk and SWIFL surveys completed and areas cleared for project initiation.

O Southwest willow flycatcher habitat surveys need to be completed before tamarisk control.

C Additional consultation with USFWS must be completed before tamarisk control.

* Area added to project area list.

[1] This canyon was named 122 Mile in previous versions; correct name is 121.5 Mile Creek L.

Work in canyons listed as Spring '07 and Fall '07 in work scheduled column are backpacking trips.

Table 2. Fall 2006 Trip Schedule

Trip Dates	Trip Leaders	Project Area	Work Project	Total Participants
September 16-23	Kari*, Loren	North Bass Trail / White Creek	Invasive Plant Mgmt, Photodocumentation	2 volunteers, 2 GRCA crew leaders
October 1-October 16	Kate*, Loren, Kari, Steve	River Trip	Invasive Plant Mgmt, Photodocumentation	4 Hualapai Crew, 4 GRCA crew leaders
November 8-15	Kari*	Horn Creek, Salt Creek, Cedar Spring	Invasive Plant Mgmt, Photodocumentation	5 volunteers, 1 GRCA crew leader
November 19-25	Kari, Steve	Slate Creek	Invasive Plant Mgmt, Photodocumentation	12 volunteers, 2 GRCA crew leaders

Table 3. Fall 2006 Hualapai Partnership River Trip Participant List

Role	Upper Half	Lower Half
Trip Coordinator / Project Leader	Do Not Fill	Kate Watters
Head Boatman / Trip Leader	Johnny Janssen	Johnny Janssen
Boatman	Tim Stephenson	Tim Stephenson
Boatman	Simone Langress	Simone Langress
Boatman	Jeri Riley	Jeri Riley
Boatman	Lisa Gelzis	Lisa Gelzis
NPS Crew Leader #1	Eric York (GRCA paid)	Loren Bell
NPS Crew Leader #2	Andy Shepard (GRCA paid)	Steve Till
NPS Crew Leader #3	Tim Laws (GRCA paid)	Kari Malen
Hualapai Leader #1	Do not fill	Childs Quarta
Hualapai Leader #2	Do not fill	Gary Gonzalez
Hualapai Leader #3	Do not fill	Cody Bravo
Hualapai Leader #4	Do not fill	Vacant
Hualapai Hydro Tech #1	Do not fill	Harry Sahneyah
Hualapai Hydro Tech #2	Do not fill	Alvin Crooke

Table 4. Fall 2006 Hualapai Partnership River Trip Itinerary

Date	Day	River Mile	Work Location	Projects	Camp (mile and side)
9/27	1		None	TRANSIT	North Area, 20 R
9/28	2		None	TRANSIT	Saddle Area, 47 R
9/29	3		None	TRANSIT	Lava Area, 65.5 R
9/30	4		None	TRANSIT	Cremation, 87 L
10/1	5		Leave 10 gallons of herbicide at Boucher	Phantom Exchange – people in by 10am – then head to camp for project training / orientation	Crystal, 98 R
10/2	6		Transit 121.5 Mile Creek L	TRANSIT Photodocumentation, Invasive Plant Management	121.5 Mile L
10/3	7		121.5 Mile Creek L	Photodocumentation, Invasive Plant Management	Point Camp above Galloway, 131 R
10/4	8		140 Mile L	TRANSIT Photodocumentation, Invasive Plant Management	Kanab, 144 R
10/5	9		Transit National hydrology	Photodocumentation, Invasive Plant Management	Mohawk, 171.5, L
10/6	10		Mohawk	Photodocumentation, Invasive Plant Management, Hydrology	Mohawk, 171.5, L
10/7	11		Mohawk Honga Spring	Photodocumentation, Invasive Plant Management, Hydrology	Honga, 177, L
10/8	12		Prospect Beecher Spring hydro, 183.4	Photodocumentation, Invasive Plant Management, Hydrology	190 R
10/9	13		190 Mile L	Photodocumentation, Invasive Plant Management, Hydrology	196 Mile, L
10/10	14		Granite Park Canyon L	Photodocumentation, Invasive Plant Management, Hydrology	Below 209 on the R
10/11	15		217 Mile L Pumpkin Spring	Photodocumentation, Invasive Plant Management, Hydrology	220 R
10/12	16		Granite Springs, 220.5 L	Photodocumentation, Invasive Plant Management, Hydrology	221 R
10/13	17		221 L 221.5 L 222 Mile L 224 Mile L	Photodocumentation, Invasive Plant Management	Diamond Creek
10/14	18		225.5 R	Photodocumentation, Invasive Plant Management	Take out

Table 5. Spring 2007 Proposed Field Schedule

Trip Dates	Trip Leaders	Project Area	Work Project	Total Participants
January 4-12	Melissa*, Hillary	Agate Canyon, Sapphire Canyon	Invasive Plant Mgmt, Photodocumentation	7 volunteers, 2 GRCA crew leaders
February 22 - March 7	Loren*, Kelly, Steve, Kari	River Trip	Invasive Plant Mgmt, Photodocumentation	3 volunteers, 4 Hualapai crew, 4 GRCA crew leaders
March 21-28	Hillary*, Melissa	Turquoise Canyon	Invasive Plant Mgmt, Photodocumentation	6 volunteers, 2 GRCA crew leaders
March 21-28	Loren*, Kelly	Serpentine and Ruby Canyons	Invasive Plant Mgmt, Photodocumentation	6 volunteers, 2 GRCA crew leaders

c. Invasive plant management methods and conditions

After incorporation of public comments into the Environmental Assessment / Assessment of Effect (EA/AEF) document, which is required under the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA), project managers selected the final control methods. For this project, staff use a combination of methods including mechanical, chemical, and cultural (i.e. seeding). The field crew leaders select the methods for each project location based on site characteristics and weather conditions. A brief description of each method follows:

Manual Removal

Crews use this method to remove tamarisk seedlings (and sometimes larger trees) in washes, streambeds, and non-sensitive areas, and to control other invasive species such as horehound (*Marrubium vulgare*), Himalaya blackberry (*Rubus discolor*), Ravenna grass (*Saccharum ravennae*), Sahara mustard (*Brassica tournefortii*), puncture vine (*Tribulus terrestris*), silverleaf nightshade (*Solanum elaeagnifolium*), sowthistle (*Sonchus* spp.), and prickly lettuce (*Lactuca serriola*), camelthorn (*Alhagi camelorum),* perennial pepperweed *(Lepidium latifolium) and* Russian thistle *(Salsola tragus)*. Workers use geology picks and shovels to loosen the soil surrounding the plants and then remove the entire root system, or at least to below the root crown.

Girdle Method

Crews use hand saws, bow saws or hatchets to cut several centimeters into the water-conducting tissue (phloem) of standing trees, with the cut within one meter of the ground surface (usually within 20 cm) and fully meeting at the ends. Using hand-pressurized sprayers, herbicide applicators then apply the chemical directly into the cut and onto the bark from the cut to the base of the tree.

Cut Stump Method

Crews cut the tree trunks near ground level with handsaws and then spray the cut surface with herbicide. The tree's phloem absorbs the mixture and transports it to the roots, with quick application increasing the effectiveness. Pressurized hand sprayers allow precision herbicide application with minimum overspray or drift risk. Crews extensively use this method alone and in combination with girdling.

Basal Bark Application

With this method, herbicide applicators spray the entire stem from near ground level up to about 40 cm. They apply the herbicide with hand held pressurized sprayers, which have small nozzles and coarse spray settings that allow for direct spraying with minimal drift or overspray. This method is much less labor intensive, but is less effective on mature trees so limited use on smaller saplings and seedlings occurs, often in combination with other methods.

Mitigation Measures

The following specific measures apply to all methods used for the project:

- Debris is disposed of to minimize visual impact (i.e. off trail, out of the drainage).
- Cut stumps are hidden from view to the extent possible.
- Soil is tamped where manual removal is used to help minimize establishment of other invasive exotic species and to minimize visual impact.
- Tree cuts are made on tree sides least visible to backcountry users.
- When pruning, a minimal number of branches are cut to minimize visual impact.

Much of the debris remains on site to decompose and provide habitat for wildlife. Crews minimize the visual impacts of the project by employing a combination of control methods at each project site and being aware of the visibility of the cuts and girdles.

Herbicide Use

The herbicides used for control were triclopyr-based general use herbicides. Crews used Garlon® 4 in a mixture of 25% with 75% methylated soybean oil (MOC). They used Garlon® 3a mixed with 50% water when working close to water. The application tool is a 32-ounce stainless steel sprayer, pressurized with bicycle pumps. These sprayers are well suited for the backcountry conditions the Grand Canyon offers as they are virtually indestructible, easy to repair in the field, and are light.

Pesticide certification is not required for the application of any of these herbicides; however, park vegetation staff adopted the policy of having trained and certified applicators on site during application. During these trips, the project leader and all field crew leaders had Arizona State pesticide certification. All project participants received herbicide orientation and training from the project leader. Project participants understood and abided by the established Personal Protective Equipment (PPE) requirements and rules outlined in the safety plan for the project. Rubber gloves, long sleeve shirts, long pants, and eye protection were part of the PPE necessary for this project. All project participants reviewed the job hazard analyses (JHAs) for exotic plant removal and herbicide application.

Project participants followed all information and instructions on the herbicide label. All herbicide containers were leak- and spill resistant. This year the field crew supervisor purchased fluorinated high density polyethylene plastic jugs in various sizes to cut down on the chance of leaks and spills, especially since the containers are hauled in backpacks, on boats and mules. All application equipment and chemicals were stored in sealed ammunition cans or large silver boxes during transport on rafts and pack mules, and all storage containers had the product's specimen label and the Material Safety Data Sheet (MSDS) clearly displayed underneath a waterproof plastic sheet. The

MSDS contains fire and explosive hazard data, environmental and disposal information, health hazard data, handling precautions, and first aid information. All trip participants reviewed the MSDS with the project leader and understood the first aid instructions described on the MSDS. One boat contained all herbicide and application equipment, herbicide containers, and PPE disposal containers, isolated from food and personal items. On backpacking trips, herbicide containers are only carried by crew leaders in heavy duty plastic dry bags which are strapped to the outside of backpacks.

d. Analysis of methods and tests

Although current scientific literature documents successful control methods for tamarisk, refinement to the methods continue to occur in Grand Canyon's remote backcountry areas. Please refer to Appendix A (Representative Project Photographs) for visual examples of methods and field crews at work. Other parks, agencies and non-profit organizations learn about these methods through outreach and education.

During the fall of 2006, the field crew leaders continued to improve upon the South Rim storage area where all of the project equipment, herbicide and gear are stored in a locked trailer. Although the methods and tools are paramount to completing tamarisk removal, the quality of food eaten while working is also critical. The crew supervisor created packing lists, menus, and food purchase lists with feedback from crew leaders and volunteers in order to streamline the trip preparation process. The field crew supervisor also purchased bulk food for backpacking trips in order to supplement the backpacking trip menus. The Polk Intern vastly improved the backpacking trip menu and organization of the bulk food area during her tenure. The volunteers rave about the food provided on the backpacking trips!

The biggest challenge with the control methods continues to be the lack of availability of good, inexpensive sturdy replacement blades for the hand saws. Despite fact that the experimentation with various qualities of hand saws, the winner every time is the little green folding saw. The replacement blades are almost as expensive as the saw itself, and they bend and break easily. It is not possible to sharpen the blades, so we had to purchase new saws this fall, as well as countless blades. The productivity and morale of volunteer workers plummets in the face of dull blades, so the project tries to keep spares on hand on every trip.

IV. Results

a. Results of recent data collection

<u>Tamarisk and Other Invasive Species Control Results</u>

During fall 2006, crews removed 17,575 tamarisk trees including 13,508 seedlings, 2,822 saplings, and 1,245 mature trees (Table 6. Tamarisk Control Summary, Figure 1. Tamarisk Treatment by Size Class). On each trip and at each project site, crew leaders analyzed the site and determined which control methods to use (Figure 2. Tamarisk Treatment by Method). Crews removed 5,715 square meters of tamarisk canopy cover removed from 50 infested hectares within the 20 project sites where work began this fall.

In addition, crews also removed 4,983 individual plants of other invasive exotic species from project areas on AWPF funded river and backpacking trips. This number also reflects exotic plants that were removed on river trip funded through the Grand Canyon Conservation Fund and the Colorado River Fund (Table 7. Control Summary – Other Invasive Species, Figure 3. Other Invasive Species Treated).

Table 6. Tamarisk Control Summary

	SIZE CLASS			CONTROL METHOD					AREA TREATED	
Canyon Name	**Seedlings**	**Saplings**	**Mature**	**Pulled**	**Cut/Girdle Combo**	**Girdle**	**Basal Bark**	**Cut Stump**	**Cover (m2)**	**Area Infested (m2)**
121.5 Mile Creek L	2398	380	100	2149	1	0	0	728	447	17500
140 Mile L	32	48	37	29	0	0	0	88	231	5000
190 Mile Canyon	470	212	155	454	1	0	0	382	601	12500
217 Mile Canyon	12	4	0	12	0	0	0	4	2	5000
221 Mile Spring	0	1	3	0	0	0	0	4	10	5000
221.5 Mile Stream	2	3	2	2	0	0	0	5	30	5000
222 Mile Canyon	39	15	19	29	0	0	0	44	136	20000
224 Mile Canyon	0	3	6	0	0	0	0	9	68	10000
Cedar Spring	394	24	7	397	0	0	0	28	36	5000
Granite Park Canyon	487	609	195	502	0	0	0	789	803	27500
Granite Springs	115	237	173	56	0	1	0	468	639	37000
Honga Spring	19	58	41	21	1	0	0	96	209	6000
Horn Creek	39	112	16	3	0	0	0	164	119	13000
Spring East of Cedar Spring	104	155	50	86	0	0	12	211	295	20000
Mohawk Canyon	8102	398	127	8227	1	0	0	399	585	57500
Prospect Canyon	5	12	15	4	1	0	0	27	93	15000
Salt Creek	16	14	6	16	0	0	0	20	38	5000
Slate Creek	59	230	163	31	0	0	0	421	1028	30500
Topaz Canyon	45	122	19	0	0	0	0	186	61	22500
White Canyon	1170	185	111	1174	0	0	0	292	281	169500
TOTALS	13508	2822	1245	13240	5	1	12	4365	5715	503500

*Note: We will review and update the numbers for the Spring East of Cedar Spring in the next report; we believe there was a database malfunction.

Figure 1. Tamarisk Treatment by Size Class

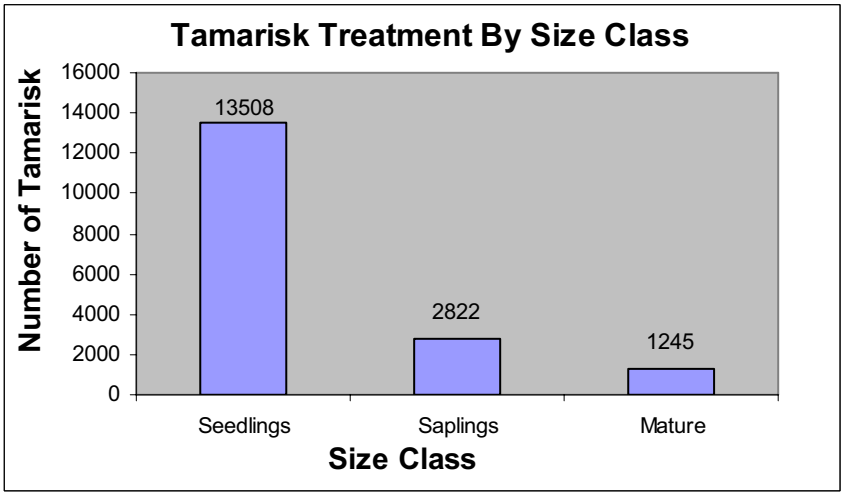


Figure 2. Tamarisk Treatment by Method

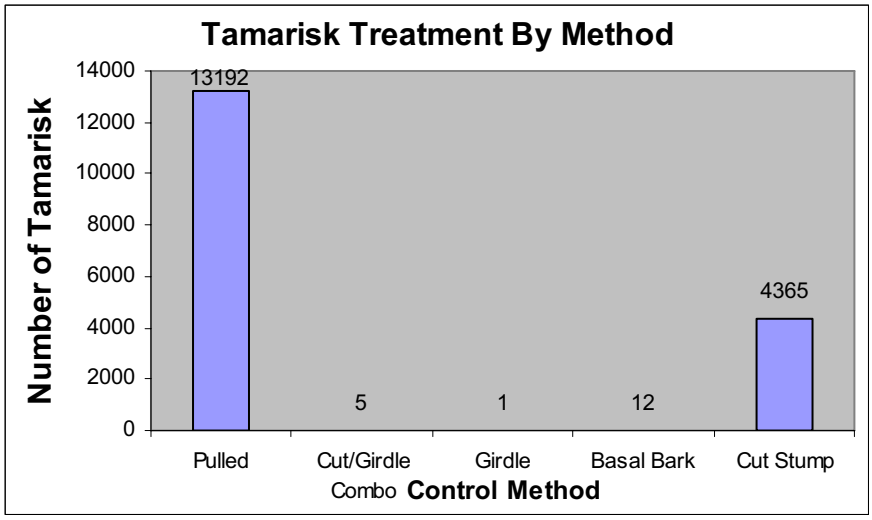
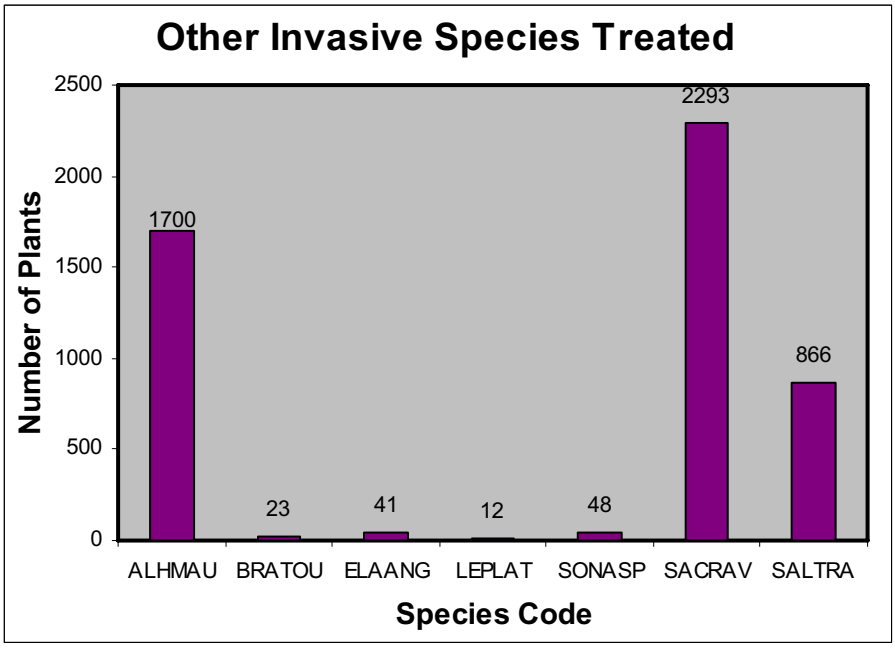


Table 7. Control Summary – Other Invasive Species

Common Name	Scientific Name	Species Code	# of Plants
Camelthorn	*Alhagi maurorum*	ALHMAU	1700
Sahara mustard	*Brassica tournefortii*	BRATOU	23
Russian olive	*Elaeagnus angustifolia*	ELAANG	41
Perennial pepperweed	*Lepidium latifolium*	LEPLAT	12
Sowthistle	*Sonchus asper*	SONASP	48
Ravenna grass	*Saccharum ravennae*	SACRAV	2293
Russian thistle	*Salsola tragus*	SALTRA	866
		TOTAL:	4983

**Includes work completed on river trips funded through Grand Canyon Conservation Fund and Colorado River Fund.*

Figure 3. Other Invasive Species Treated



During the fall of 2006 crews worked in 20 of the 30 project areas for Phase II-B and completed work at 18 areas (Horn Creek, Upper Salt Creek, Cedar Spring, Spring East of Cedar Spring, Topaz Creek, White Creek, 121.5 Mile Creek L, 140 Mile Canyon, Mohawk Canyon, Honga Spring, Prospect Canyon, 190 Mile Wash, Granite Park Canyon, 217 Mile, 221 Mile, 221.5 Mile, 222 Mile and 224 Mile Canyons). Most of the sites, regardless of level of completion will require follow-up work in the form of seedling control, which will be completed with supplemental funding sources. Of the 20 sites visited to date, only Slate Creek and Granite Springs Canyon will require additional visits to complete the preliminary control and this work is scheduled for spring 2007. Work in the remainder of the unvisited project areas is scheduled for spring 2007, with the exception of Flint Creek which is scheduled for fall 2007.

Crews were able to complete work via backpacking in Horn, Salt and White Creeks, Cedar Spring and the Spring East of Cedar Spring. A crew of 13 college students from Texas Tech spent eight days at Slate Creek over Thanksgiving break, giving it their all, but unable to finish. The remainder

of the work in this canyon may have to be left to the NPS to complete with other funding sources, due to the fact that the backpacking budget allows for only five trips. It is a two day hike minimum to Slate, Agate and Sapphire Canyons, and the additional complication of no year round reliable water sources makes them difficult undertakings. Agate, Sapphire, Turquoise, Ruby and Serpentine are scheduled for three spring backpacking trips. These will be the most challenging areas that crews have attempted to date, due to lack of available water sources and the extensive mileage that needs to be covered in order to reach them. Flint Creek is an area that was added following the May 2006 river trip with the idea that it could be completed in tandem with White Creek, as it is a tributary of that drainage. However, due to lack of volunteers available for the White Creek trip (only 2 volunteers and 2 crew leaders were able to work that area) and its remote trailhead on the North Rim, which will be covered in snow until June, the work in Flint Creek will have to be completed in the fall of 2007.

Appendix D, Project Mapping, contains the control and photopoint locations for the project sites in which crews have completed work. Crews were unable to get Global Positioning System (GPS) readings at 10 of the specific locations (Table 8. Locations Lacking UTM Readings); however, prior to the production of the final report, the Project Coordinator and field crew leaders will locate these sites with in the Geographic Information System (GIS) database. The final report will include detailed maps displaying the work completed in each project area, transect locations, photopoint locations and supplementary project information.

Table 8. Locations Lacking UTM Readings

Location Description	Easting	Northing	Type
Salt Creek 2	0	0	Phase IIb control
White 17	0	0	Phase IIb control
White 18	0	0	Phase IIb control
White 3	0	0	Phase IIb control
PP 190 Mile 1	0	0	Phase IIb photopoints
PP Honga 1	0	0	Phase IIb photopoints
PP Mohawk 2	0	0	Phase IIb photopoints
PP Redwall 1	0	0	Phase IIb photopoints
PP Salt Creek 2-1	0	0	Phase IIb photopoints
PP Salt Creek 2-2	0	0	Phase IIb photopoints

Herbicide Use

During the fall of 2006 crews used a total of 13.09 gallons of mixed herbicide and only 3.54 gallons of actual herbicide product in the project sites (Table 9. Herbicide Use).

Table 9. Herbicide Use

Common Name	Scientific Name	Herbicide Type	Mixed Herbicide Used (gallons)	% Herbicide in Mixture	Actual Herbicide Used (gallons)
Tamarisk	*Tamarix ramosissima*	Garlon ® 3a	1.09	50	0.54
Tamarisk	*Tamarix ramosissima*	Garlon ® 4	12	25	3
		Herbicide Totals	13.09		3.54

Volunteer Summary

Volunteers are crucial to project's success and accomplishments. Volunteers donated a total of 1507 hours to the tamarisk and invasive species management portion of this project during fall of 2006 (Table 10. Volunteer Contribution to Project). The hours were all accrued during backpacking trips because there were no volunteers on the Hualapai Partnership river trip. The volunteer hours are valued at $17.50 per hour according to NPS guidelines, for a total matching contribution to the management portion of this project of $26,373.

During the fall of 2006, great strides were made in the realm of volunteer recruitment, as GCNPF hired Terra Crampton as the volunteer coordinator in May 2006. Terra is very meticulous and made significant contributions to the development of the volunteer recruitment and paperwork process and improved communications with the park's volunteer coordinator, Lisa Collins. Terra and the crew supervisor worked to refine and downsize the paperwork volunteers have to complete before each trip, based on input from volunteers and crew leaders. All but two of our trips were not full to capacity with prepared and enthusiastic volunteers, which was a vast improvement from last spring. Terra was also able to recruit several college groups for backpacking trips, which is ideal. Terra will be moving into a fundraising position this winter/spring, and the GCNPF will be training a new person to take over the time intensive duties of recruiting, contacting and preparing volunteers for backpacking trips this spring.

Vast improvements continue to be made in the shared GCNPF and Grand Canyon Trust, GCT website (http://www.gcvolunteers.org), which has information about each trip and allows volunteers to apply online. The grant provided funds to give uniquely designed tee shirts to volunteers who donated their time on backpacking or river trips, as a small token of the many hours of hard labor they contributed. The dedication and perseverance of all of the volunteers was amazing and contributed to the overall success of the project. GRCA staff and crew leaders are constantly amazed by the positive influence volunteers have on the Backcountry Vegetation Program. Besides the fact that this daunting project would not be feasible without them, volunteers also provide endless support emotionally and sometimes financially to the success of our program. Many volunteers have life-changing experiences on tamarisk management trips and often return to do several trips a year or even serve as future crew leaders. For example, Kelly McGrath, a teacher

who brought her Oregon high school students out last spring for a backpacking tamarisk control trip in South Canyon, quit her job as a teacher and served the program this fall in an official capacity as the Polk Intern. She wrote an article about her experience, which will be published in an upcoming edition of Nature Notes.

Table 10. Volunteer Contribution to Project

Name	Work Project	Start Date	End Date	Hours
Dean Reese	Tamarisk Backpacking	9/20/2006	9/21/2006	12
Dean Wadsworth	Tamarisk Backpacking	9/17/2006	9/24/2006	78
Ryan Bell	Tamarisk Backpacking	9/15/2006	9/24/2006	105
Gisela Kluwin	Tamarisk Backpacking	11/8/2006	11/15/2006	62
Leon Bassen	Tamarisk Backpacking	11/8/2006	11/16/2006	72
Steve Delaney	Tamarisk Backpacking	11/6/2006	11/16/2006	80
Joe Jonakin	Tamarisk Backpacking	11/5/2006	11/16/2006	102
Kalina Cox	Tamarisk Backpacking	11/7/2006	11/16/2006	72
Savanna Reeves	Tamarisk Backpacking	11/18/2006	11/25/2006	77
Sari Nesbit	Tamarisk Backpacking	11/18/2006	11/25/2006	77
James Wyatt	Tamarisk Backpacking	11/18/2006	11/25/2006	77
Trevor Williams	Tamarisk Backpacking	11/18/2006	11/25/2006	77
Erin Hoelting	Tamarisk Backpacking	11/18/2006	11/25/2006	77
Clinton Peters	Tamarisk Backpacking	11/18/2006	11/25/2006	77
Jeff Schulze	Tamarisk Backpacking	11/18/2006	11/25/2006	77
Nate Reynolds	Tamarisk Backpacking	11/18/2006	11/25/2006	77
Grant Durham	Tamarisk Backpacking	11/18/2006	11/25/2006	77
Jessica Schweiters	Tamarisk Backpacking	11/18/2006	11/25/2006	77
Kurt Caswell	Tamarisk Backpacking	11/18/2006	11/25/2006	77
Jordan Messerer	Tamarisk Backpacking	11/18/2006	11/25/2006	77
	Total Volunteer Hours Backpacking Total			1507
	Value of Donated Volunteer Hours			$26,373

Project Monitoring

A large element of this project is the long-term monitoring, which will help to display the success of this project, and understand how the removal methods are affecting native plants. Please refer to the approved monitoring plan for the overall design and implementation scheme. Skilled crews installed the majority of the monitoring components on the May 2006 river trip. The monitoring components include vegetation, soil and hydrological sampling in 25% of the project areas. During the spring 2006 crews installed monitoring transects in the following areas:

- Topaz Creek
- 140 Mile Canyon
- National Canyon
- Mohawk Canyon
- Granite Park Canyon
- Three Springs

Topaz Creek was accessed in late April via a backpacking trip with one leader and 3 volunteers.

NPS staff entered these data into the project database and performed preliminary statistical analyses over the summer. All associated transect information with Phase II-B canyons will be included in the final report.

In each project area, crews also mapped tamarisk populations, completed habitat assessment for southwestern willow flycatchers, and installed permanent photopoints. On the fall 2006 trips, crews installed additional photopoints. To date, crews have installed 40 distinct photopoints (in addition to the transect photopoints) in the project areas, with pre- and post-work photographs taken from each point. Appendix B includes the photodocumentation for the project areas that were visited in fall 2006; a complete set of photographs will be submitted with the final report.

All of the data, including links to the photographs, are included in the project database. As another project matching contribution, NPS personnel and contract employees continue to work on the database design and development. The current version of the database and all project data (except the actual photographs which make the database too large for CDs) are included on the report disk. To access the database, click on the grca.mdb file. The final report for this project will include a full complement of the data for this project.

Wildlife Observations

Crews collect information on wildlife distribution and activity at all of the project areas. Crews record observations of wildlife species (including mammals, birds, insects, reptiles and amphibians) by common name and a description of the activity (Table 11. Wildlife Observations). This qualitative data on wildlife species presence in project areas will provide distribution information to park wildlife biologists.

Table 11. Wildlife Observations

Observer	Location	Wildlife Species	Activity
Kate Watters	Mile 6 L	Peregrine falcon	Resting and flying
Kate Watters	Mile 9 L	Peregrine falcon	Resting and flying
Lori Makarick	Mile 148 L	Cooper's hawk	Resting and flying
Kari Malen	White Creek	Whip snake	Saw 3 separate snakes slithering in the Supai. The longest was 3.5-4 ft.
Loren Bell	White Creek	Glow bugs	Several small 1" caterpillar looking bugs with glowing rear ends (like fireflies) only they walked and locomoted on their glowing posterior.
Kari Malen	White Creek	2 Tomato Worms	Devouring an entire Datura wrightii plant.
Loren Bell	Swamp Point Road	Beef-a-Lo	Standing in the road
Steve Till	121.5 Mile	Snake - 10" tan with dark brown ovals on back with dots	Running for the hills
Kate Watters	121.5 Mile	Pink rattler	Languidly rattling in the morning sun
Kate Watters	222 Mile	Tadpoles and red-spotted toads	Swimming, hopping during that awkward stage between the two phases.
Loren Bell	224 Mile	Grey fox	Walking up canyon, unhurried
Kate Watters	140 Mile	Red-spotted toad and Side-blotched lizard	Hopping and running
Kate Watters	140 Mile	Bark scorpion	Fleeing and scurrying
Steve Till	Mohawk Canyon	Grand Canyon pink rattle snake	Lounging in cool, wet ground near the stream
Kate Watters	Mohawk Canyon	Millipede	Crawling on rock
Kate Watters	Upper Mohawk - East Fork	Monarch butterfly	Flying
Kari Malen	Mohawk Canyon	Tomato horn-worm	Eating
Kate Watters	Upper Mohawk Canyon	Canyon wren	Chirping
Loren Bell	Mohawk Canyon	Speckled rattlesnake	Traveling
Steve Till	Honga	Many-tailed Swallowtail	Flying
Kari Malen	Granite Park	Scorpion	Running
Kari Malen	Three Springs	Squirrel	Running around
Loren Bell	Granite Springs	Tarantula	Freaking out
Kate Watters	Granite Springs	Red-spotted tadpoles	Swimming
Kari Malen	Granite Springs	Centipede	Crawling

b. Project Matching Contribution

In addition to the volunteer contribution, GCNPF and NPS have also provided in-kind and financial support. For the months of September through December 2006, a total matching of $16,806 was contributed to this project.

Grand Canyon National Park provided contributions to this project by paying for the base salaries of staff members, leaving only the overtime to be paid for by this grant. The GRCA ranger division provided two of the boatmen for the fall river trip. For the first year since the project's inception, GRCA provided $25,000 of supplemental support for the Backcountry Vegetation Program's projects. A portion of these funds have been used to date to support Kate Watters as the field supervisor, which, in combination with the AWPF funds, allowed Kate to have more non-field time to coordinate the project activities. The funds also partially supported Kim Fawcett, who enters all of the project data. This matching contribution for the fall of 2006 was included in the Phase II-A report for a total of $15,000. The additional salaries covered by GRCA funding are as follows:

Johnny Jannsen, trip leader	$6,450
Jeri Riley, boatman	$5,330
Lori Makarick	$4,126
Steve Mietz	$900

The Grand Canyon Science Center continues to provide critical support in the contribution of the project coordinator's time on this project. During the spring, Lori Makarick worked 120 hours on this project, valued at $34.38 / hour, totaling $4,126. Steve Mietz, GIS Program Manager, worked about 20 hours on this project, valued at $45 / hour, totaling $900.

c. Project Press

This project continues to receive good press coverage. Each issue of GRCA's visitor guide includes an article about this project. The field crew supervisor updated the Tamarisk Management Site Bulletin and created an informational poster about the project for the Backcountry Office at the South Rim. Loren Bell, a crew leader for the project, wrote an article for South by Southwest, and Kelly McGrath, the Polk Intern through the GCNPF wrote an article for Grand Canyon Nature Notes. Both articles are due out in Spring/Summer 2007 and will be included in the next progress report. Refer to Appendix E. Project Press for examples of recent press coverage.

V. Discussion and Conclusions

a. Discussions and conclusions about results comparing current and past control results

Many of the project areas within Phase II-B are more difficult to access than those that were in Phase I or II-A and contain dense patches of tamarisk trees. The project made great strides this fall, 17 of the 30 project areas can be called complete. By spring of 2007, barring unforeseen weather and logistical changes, all 30 of Phase II-B areas will be free of tamarisk! Despite challenges, in a

short period of time crews were able to remove an incredible number of invasive plants from project areas. Based on the work that was completed in 2006, crews have removed 17,575 tamarisk trees during the implementation of this grant, and hopefully come close to finishing the initial tamarisk removal in these remote project sites.

While there are fewer project sites in Phase II-B as compared to Phase I or II-A the sites are much more difficult to access. Completing management work in 30 project areas in one field season will be a major challenge. Given the remoteness of the majority of these canyons, the schedule does not always allow the crews to revisit the project areas one year later in order to complete the necessary follow-up control work that helps to make this project successful. This leaves much of the essential maintenance work unfunded but committed to by the NPS. With the current state of the NPS budget, it will be challenging to get back to these project areas in the next two years, but both GCNPF and GRCA staff are committed to doing their best to ensure that this project continues. The field crew supervisor will be creating a maintenance schedule for all of the Phase I, Phase II-A and Phase II-B project areas. The Project Coordinator prepared and submitted a funding proposal to GRCA management that includes 5 years of continuing work in these areas.

b. Discussion and conclusions about results with relation to related literature.

This report contains the control data from the invasive plant control trips to date and information about preliminary project results. The final monitoring trip will be in May 2008 and the final report for this project will contain control conclusions and discussion.

VI. Management Recommendations

a. Overview of management options.

The monitoring results from Phase I helped to refine the control methods and management options for this project. The National Park Service has an affirmative responsibility to protect and preserve the resources located within its units. National Park Service (NPS) Management Policies require park managers "to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and genetic and ecological integrity of the plant and animal species native to those ecosystems" (NPS 2001). Park managers are directed to give high priority to the control and management of exotic species that can be easily managed and have substantial impacts on the Park's resources (NPS 1985, NPS 2001).

This project further verified that the control of tamarisk and other invasive plant species in the park's side canyons and tributaries is feasible. A vast body of literature documents the impacts that tamarisk has on southwestern ecosystems. Stevens (2001) summarizes the impacts and ecology of tamarisk. Since the control is feasible and tamarisk poses a substantial impact on the resources located within GRCA, the continuation and expansion of this project should occur. Park management have been supportive of this project, and with continued documentation and successful implementation, the support should remain strong. Prior to future grants, the project coordinator must critically examine what is physically possible during one field season. Project leaders recommend that future phases span more than 18 months in order to allow for two preliminary visits to each project areas and one final visit.

b. Management recommendations and justification.

The EA/AEF for this overall project included three phases of tamarisk management and tributary restoration. The work completed under this grant contract is Phase II-B of the overall project. The fall 2006 control trips were very successful and project leaders anticipate that the methods used will lead to successful management of tamarisk populations in the project areas. GCNPF and GRCA decided not to apply for a third grant to move into Phase III, as the Project Coordinator would like to focus treatment efforts cyclic maintenance on all 130 of the project areas from Phase I, II-A and II-B. We recommend that GCNPF and GRCA staff work together to secure another grant that would allow crews to revisit all of the previously treated project areas. Crews should systematically retake all of the photographs and re-read all of the vegetation transects during a two-to three-year period. GRCA is currently retaking photographs and completing follow-up control, but in the form of volunteer groups (e.g. Grand Canyon Youth) due to continued budget cuts within the NPS. Project leaders continue to recommend integration of this project into the overall resource and vegetation management plans.

After completion of the final monitoring trip, project leaders should prepare articles for both internal NPS publications and peer-reviewed journals. The AWPF funding and support for this project has been essential to getting this project off the ground and protecting and restoring the park's valuable riparian ecosystems. The partnership between GRCA and the GCNPF has also been integral to the success of the project. The primary recommendation at this point is to continue the work, and to expand the project to include all of the tamarisk populations in the side canyons and tributaries of the park.

VII. Literature Cited

Brown, B.T., K.A. Butterfield, R.R. Johnson, and M.S. Moran. 1980. Pp. 422-432 in Proceedings of the Second Conference on Scientific Research in the National Parks, Volume 7: Ecosystem Studies. An Inventory and Classification of Surface Water Resources in Grand Canyon National Park, Arizona. USDI, National Park Service, Washington, D.C.

Duncan, K.W. 1996. Saltcedar and Native Species in New Mexico. 1996. Presentation at Saltcedar Management and Riparian Restoration Workshop, Las Vegas, NV. September 1996.

Johnson, R.R., C.D. Ziebell, D.R. Patton, P.F. Fottiott and R.H. Hamre (eds). 1985. Riparian ecosystems and their management: reconciling conflicting uses. USDA For. Serv. Gen . Tech. Rept. RM-120.

National Park Service. 2001. National Park Service Management Policies. Washington, DC: United States Department of the Interior, National Park Service.

National Park Service. 1995a. General Management Plan, Grand Canyon National Park. Grand Canyon, AZ: United States Department of the Interior, National Park Service, Denver Service Center.

National Park Service. 1995b. Grand Canyon National Park Strategic Plan. Grand Canyon National Park. Grand Canyon, AZ: United States Department of the Interior, National Park Service.

National Park Service. 1985. Guide for pesticide use in the national park system. Washington, DC: United States Department of the Interior, Biological Resources Division, National Park Service.

Phillips, B.G., R.R. Johnson, A.M. Phillips, and J.E. Bowers. 1979. Pp. 141-155 in Proceedings of the Second Conference on Scientific Research in the National Parks, Volume 4: Resource Analysis and Mapping. Resource Values of the Aquatic and Riparian Vegetation of Roaring Springs, Grand Canyon. USCA National Park Service, Washington, D.C.

Stevens, L.E. 2001. A synthesis of information on the ecology and management of saltcedar (Tamaricaceae: *Tamarix ramosissima*), with emphasis on the Grand Canyon Region: Final Progress Report. Report Prepared for the Arizona Water Protection Fund.

Warren, P.L., K.L. Reichhardt, D.A. Mouat, B.T. Brown, and R.R. Johnson. 1982. Technical Report Number 9 - Vegetation of Grand Canyon National Park. Prepared for National Park Service, Grand Canyon National Park. Contracts No. CX8210-7-0028 and CX8000-9-0033 Contribution No. 017/06. Cooperative National Park Resources Studies Unit, University of Arizona, Tucson, AZ.

APPENDIX A

Representative Project Photographs – Fall 2006 Tamarisk Management Report Phase II-B

Management & Control of Tamarisk and Other Invasive Vegetation at Backcountry Seeps, Springs and Tributaries in Grand Canyon National Park

Picture 1. The hard working river crew

Picture 2. Backpacking across the Tonto to Slate Creek

Picture 3. Starting the day with warm-up stretches

Picture 4. Volunteers hard at work slaying tamarisk

Picture 5. Spraying stumps with herbicide

Picture 6. Repairing stainless steel herbicide sprayers

APPENDIX A

Representative Project Photographs – Fall 2006 Tamarisk Management Report, Phase II-B

Management & Control of Tamarisk and Other Invasive Vegetation at Backcountry Seeps, Spring and Tributaries in Grand Canyon National Park

Picture 7. Hualapai crew members make frybread

Picture 8. Fierce boatwomen tackle tamarisk when not on the oars

Picture 9. 190 Mile Canyon tamarisk thicket before

Picture 10. 190 Mile Canyon tamarisk thicket after cutting crew

APPENDIX A

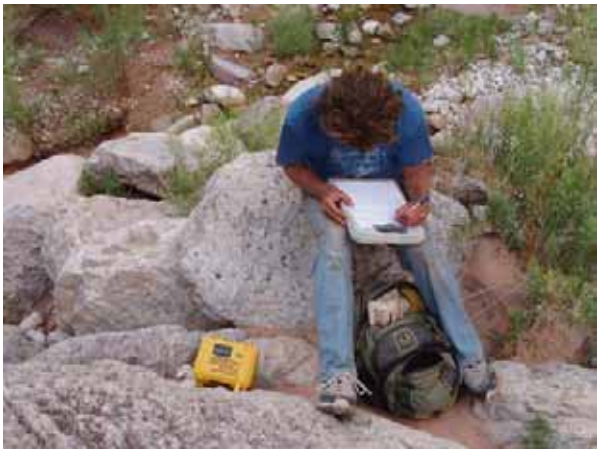
Representative Project Photographs – Fall 2006 Tamarisk Management Report Phase II-B

Management & Control of Tamarisk and Other Invasive Vegetation at Backcountry Seeps, Springs and Tributaries in Grand Canyon National Park

Picture 11. Photopoint and data collection in the fading light

Picture 12. Teamwork removing giant tamarisk from canyon seep

Picture 13. Excavating and cutting tamarisk from drainage bottom



Picture 14. A moment for recording data

Picture 15. Crewleaders take control of the kitchen

Picture 16. A bird's eye view of river camp

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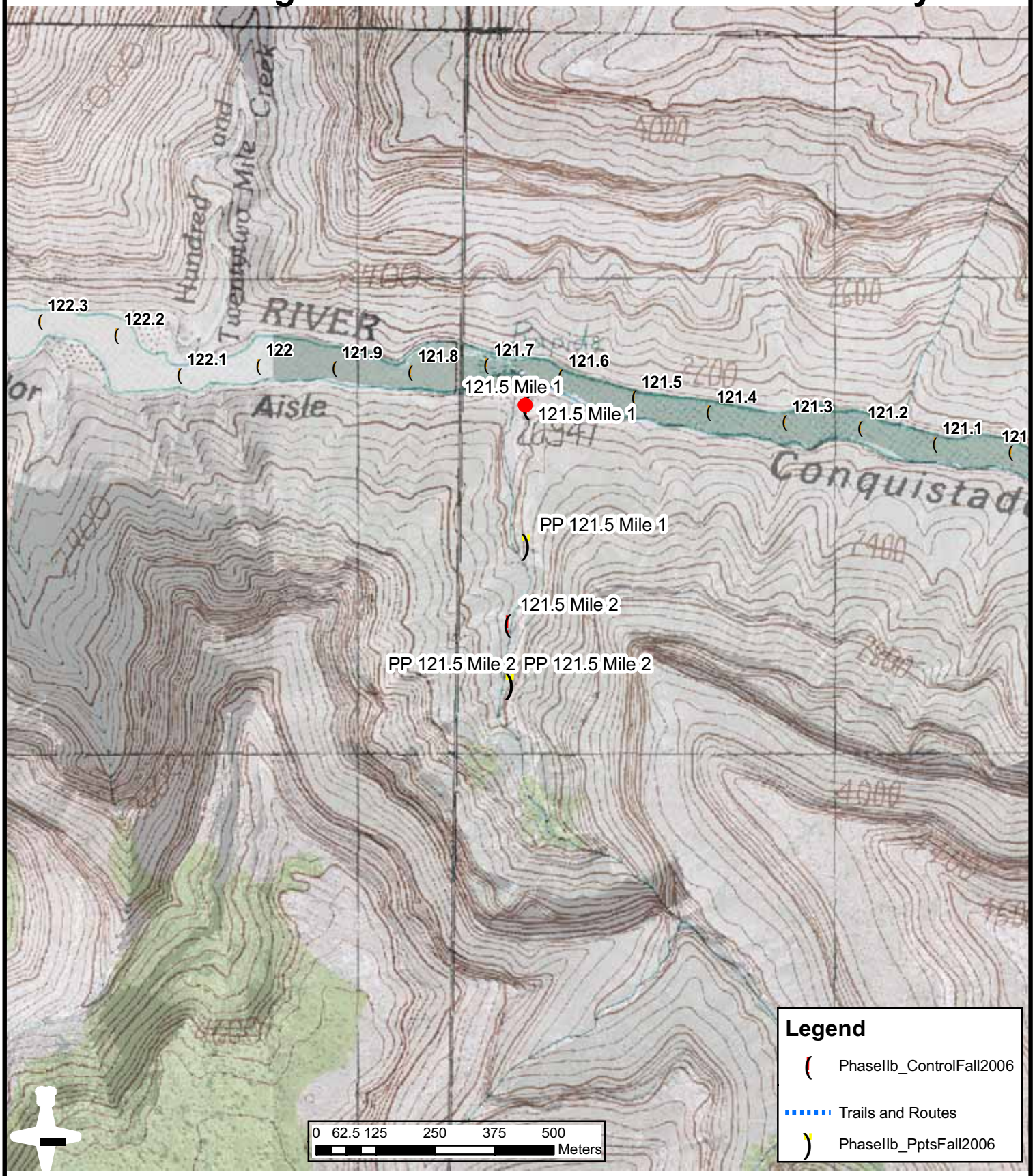

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December 2006

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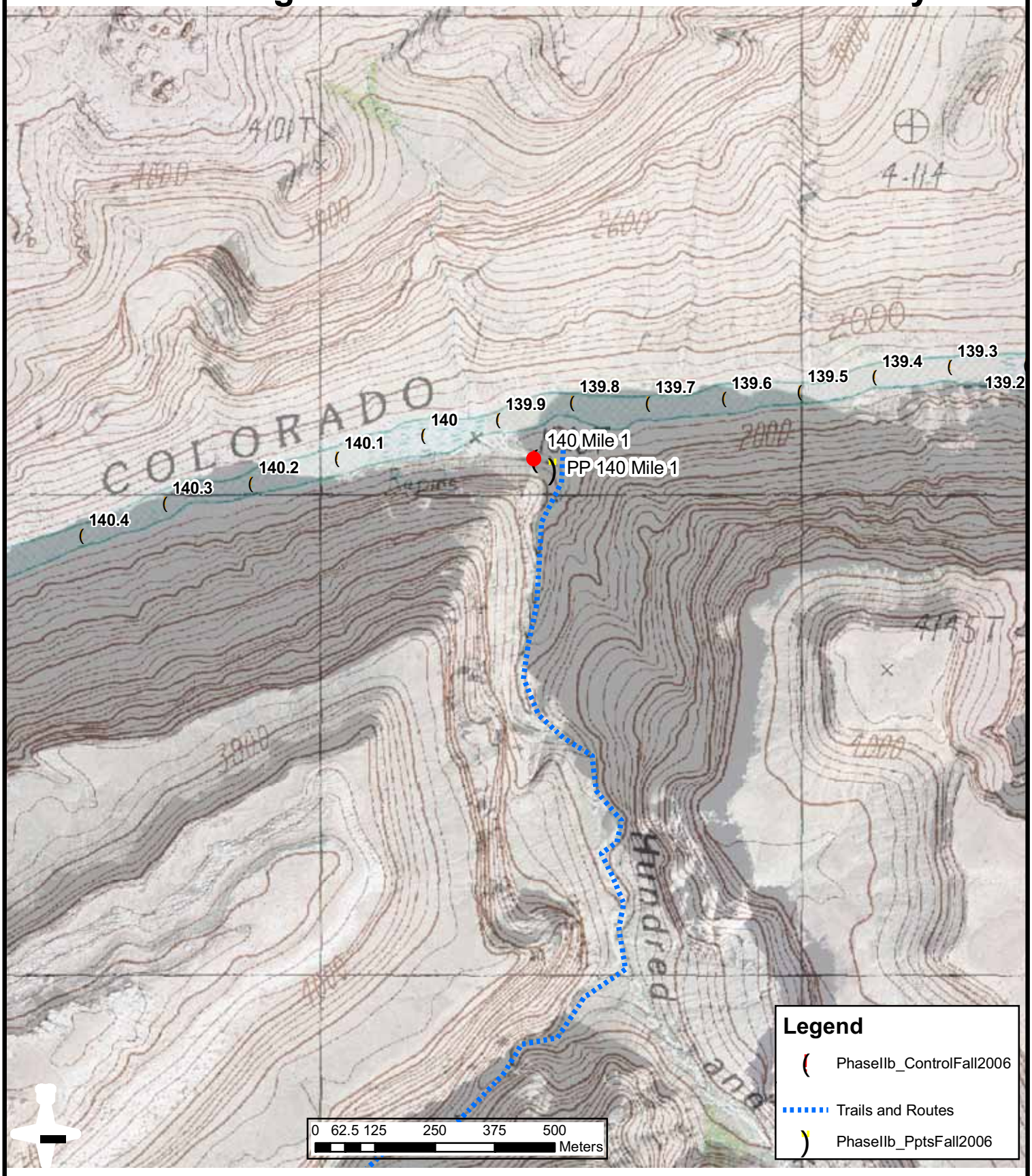

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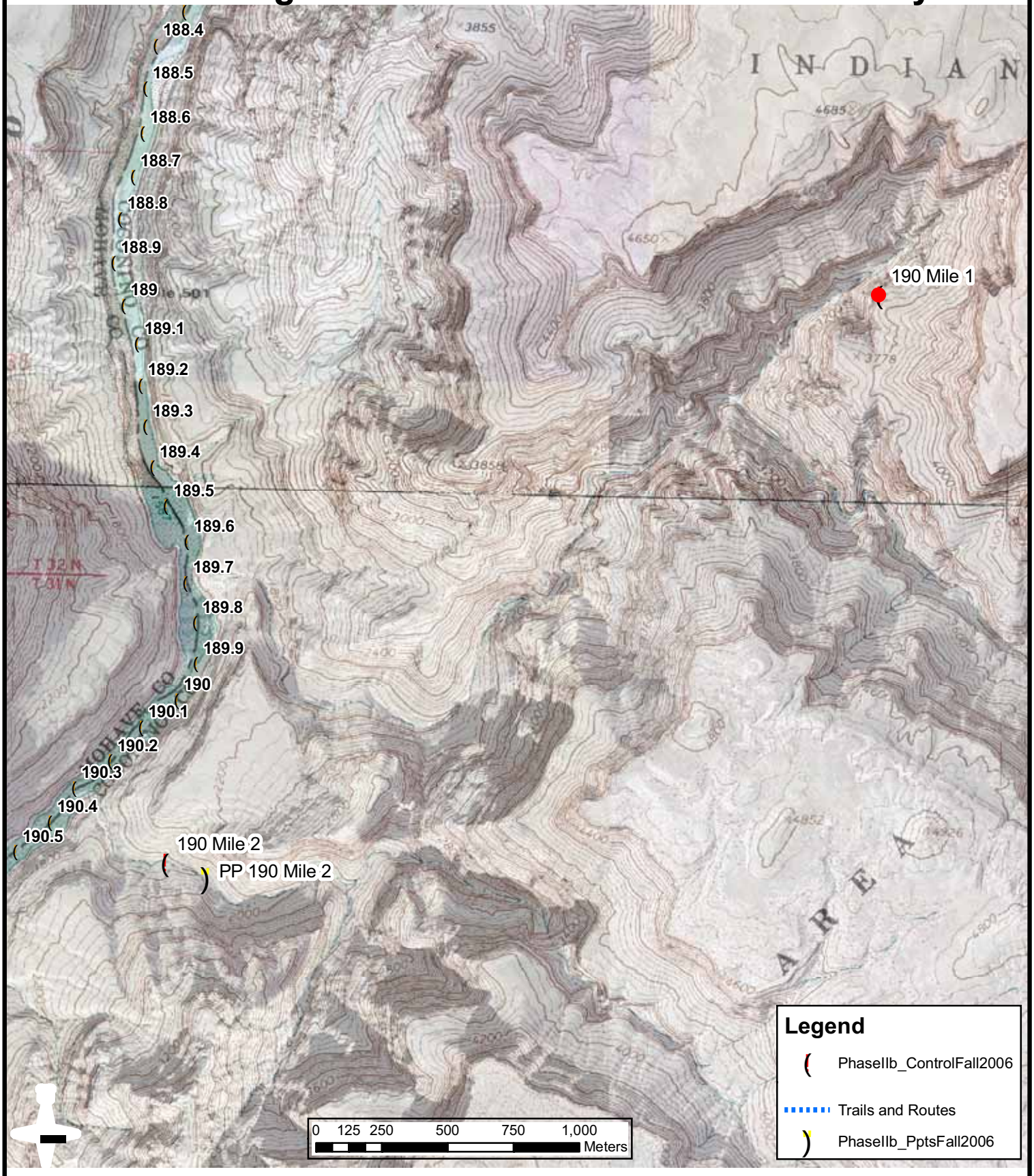

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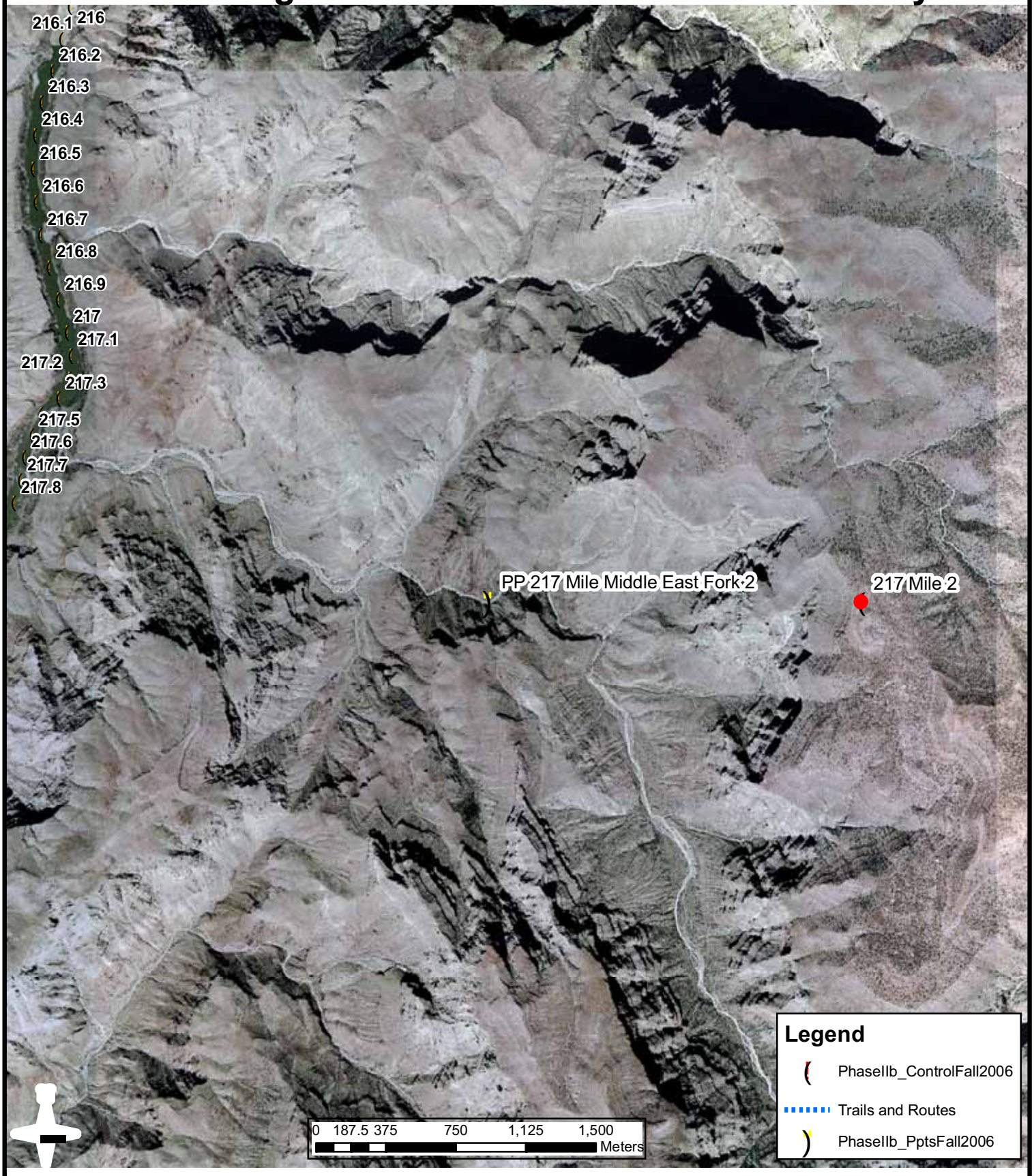

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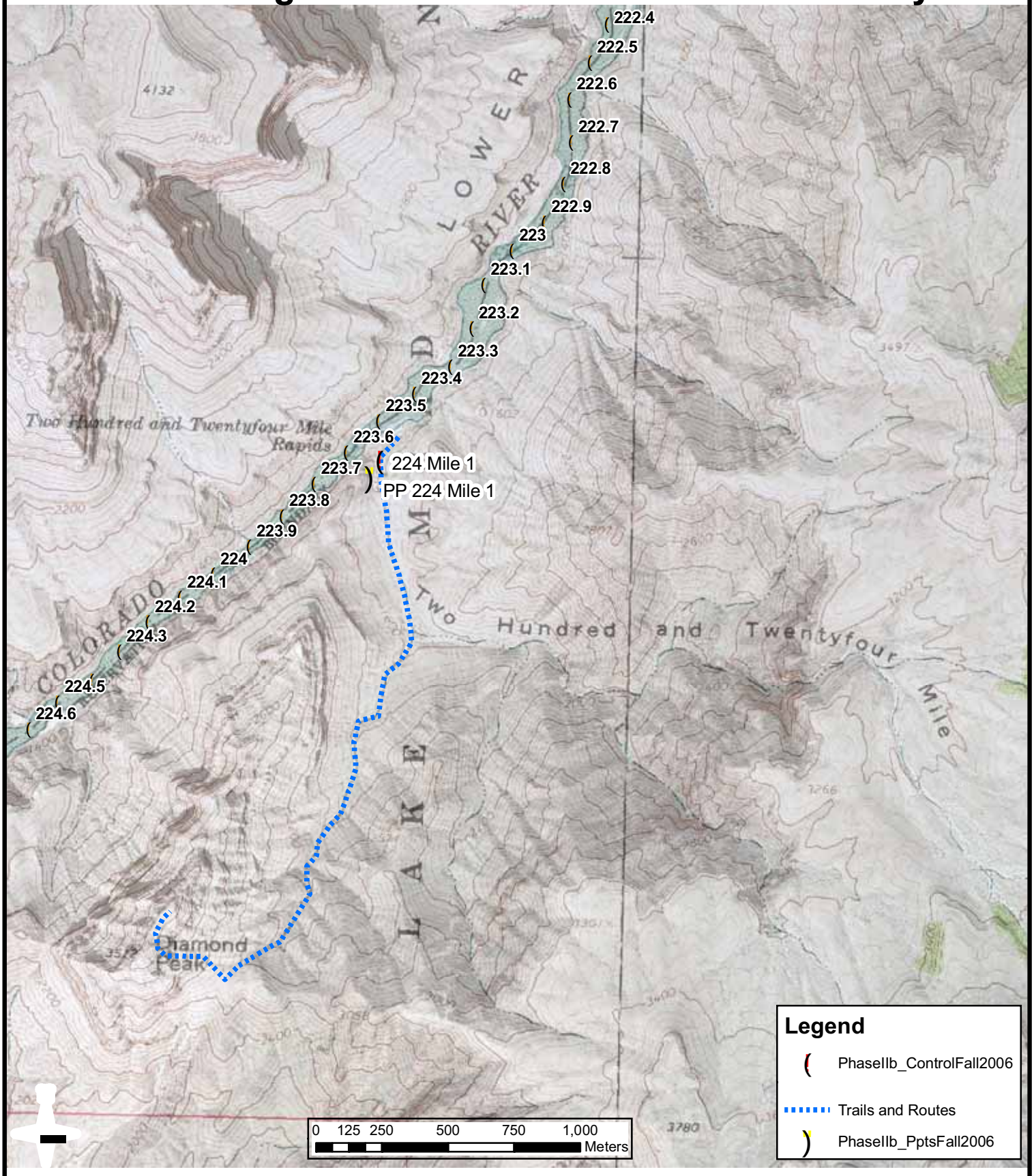

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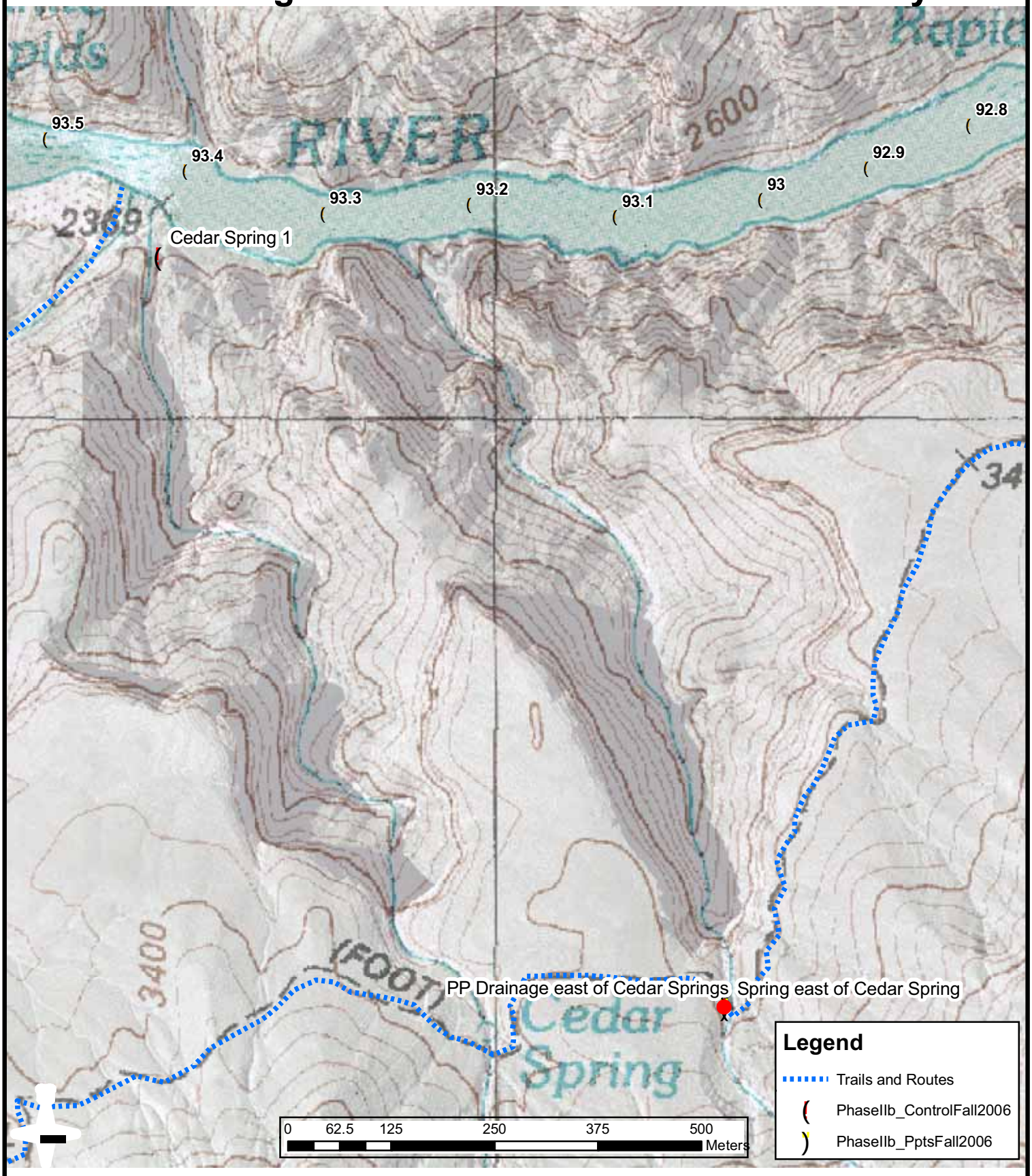

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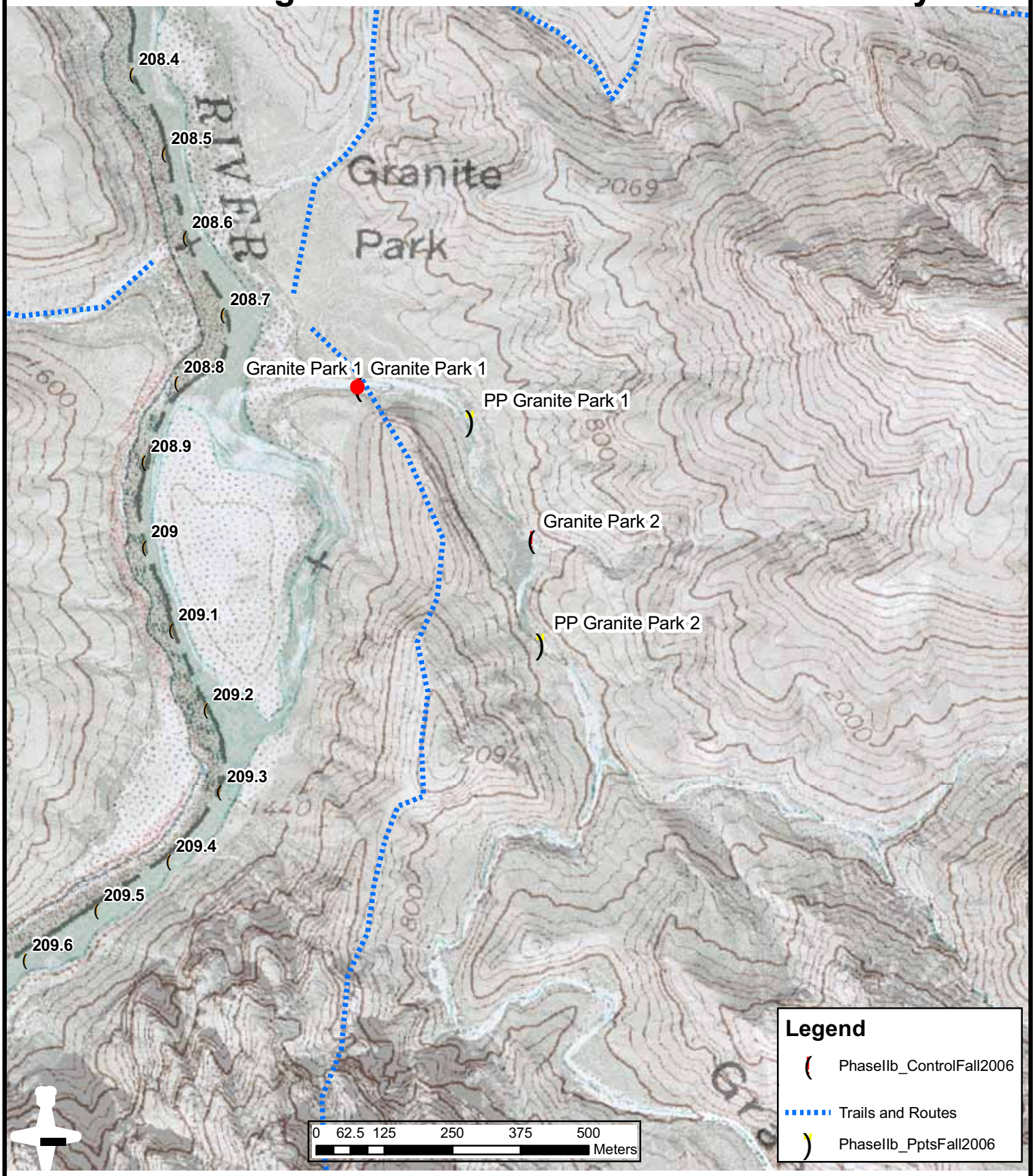

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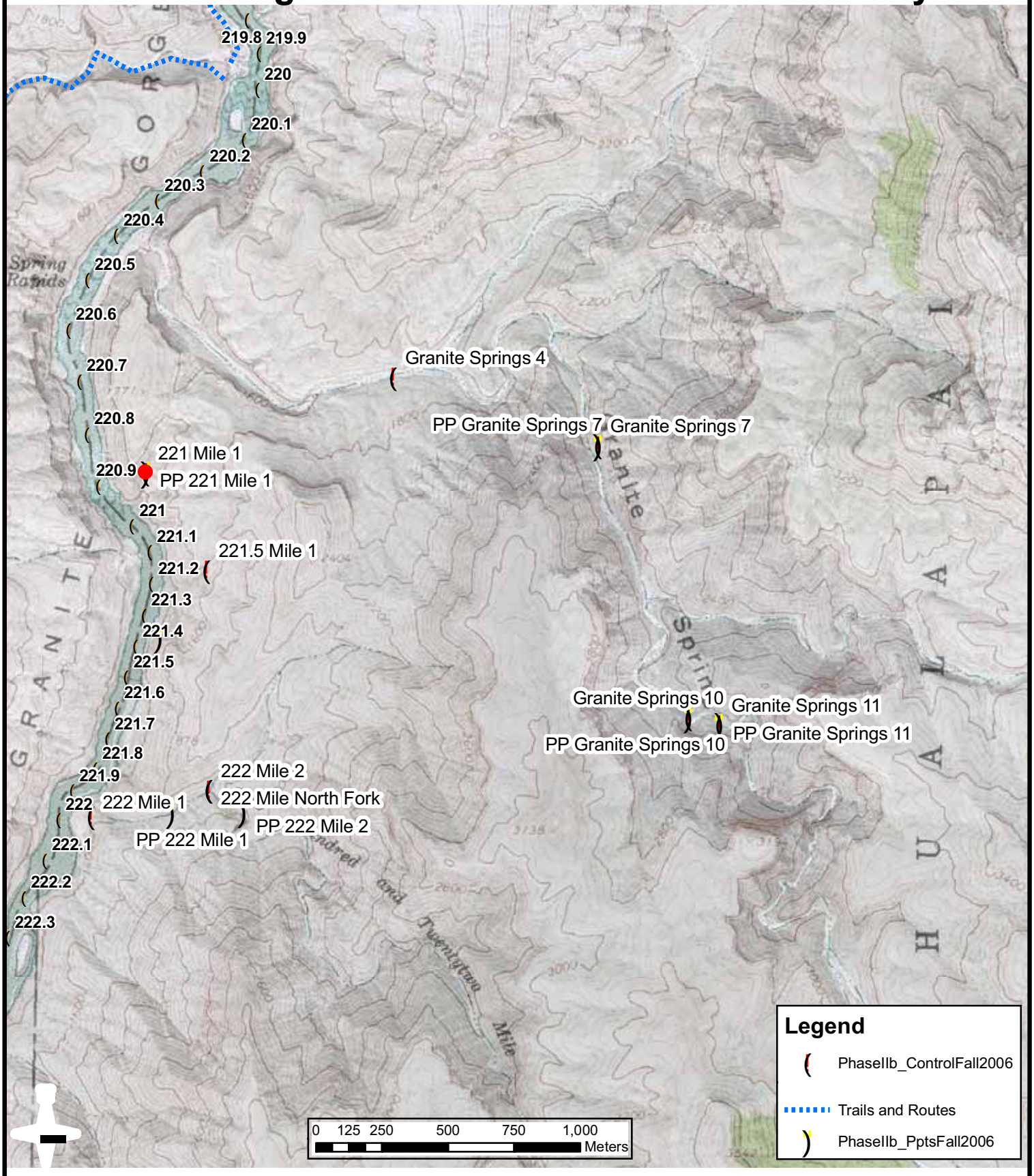

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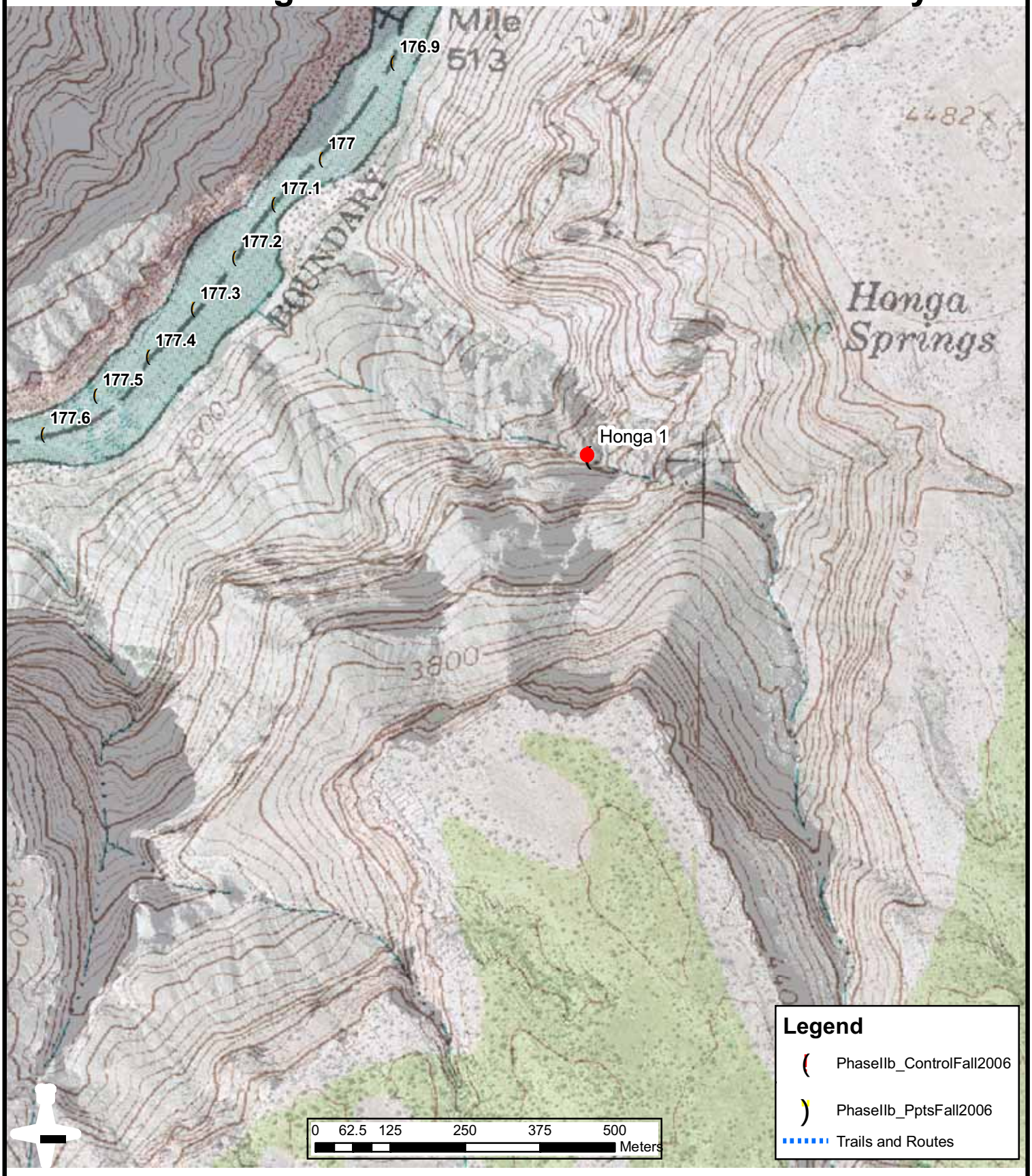

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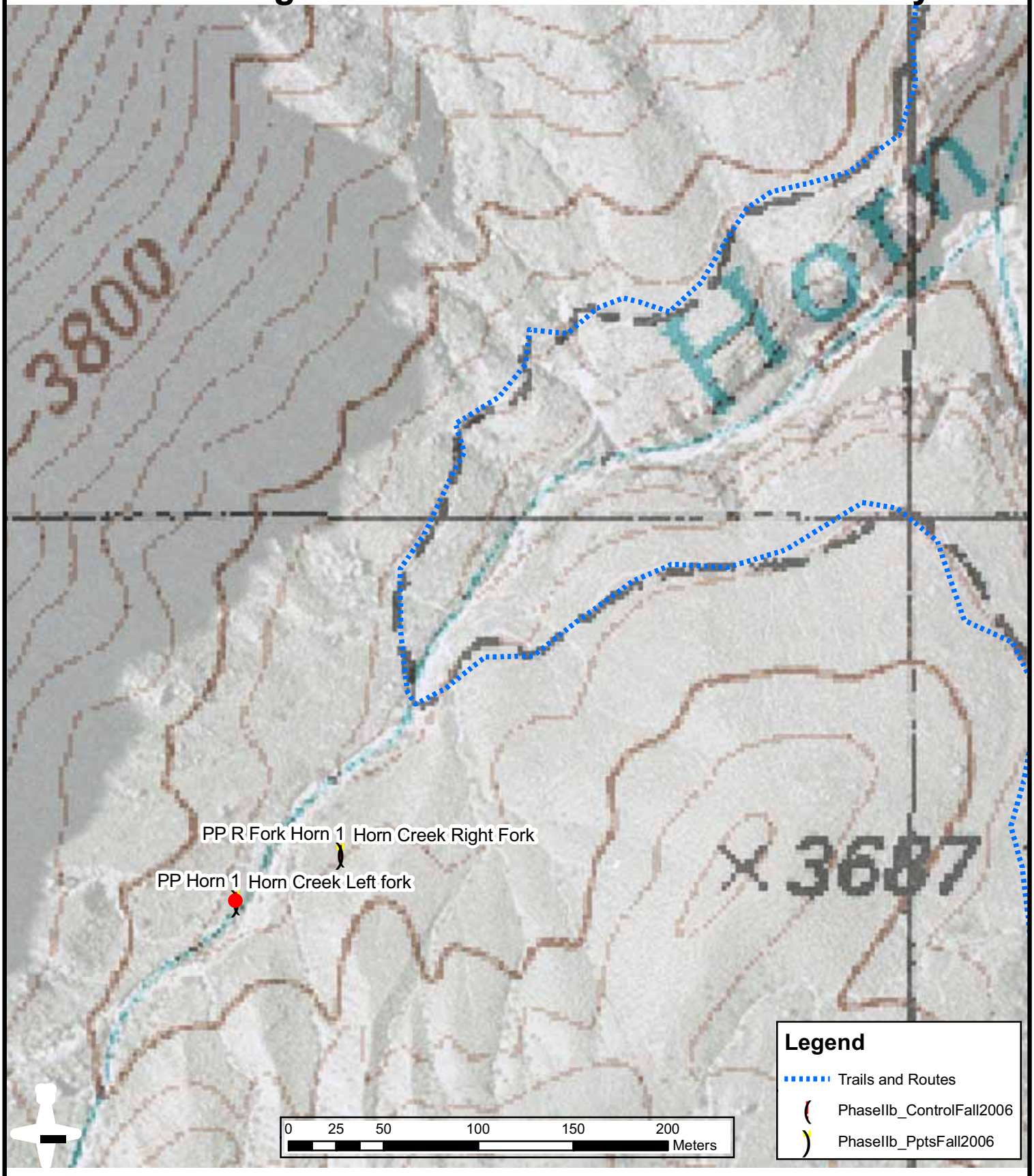

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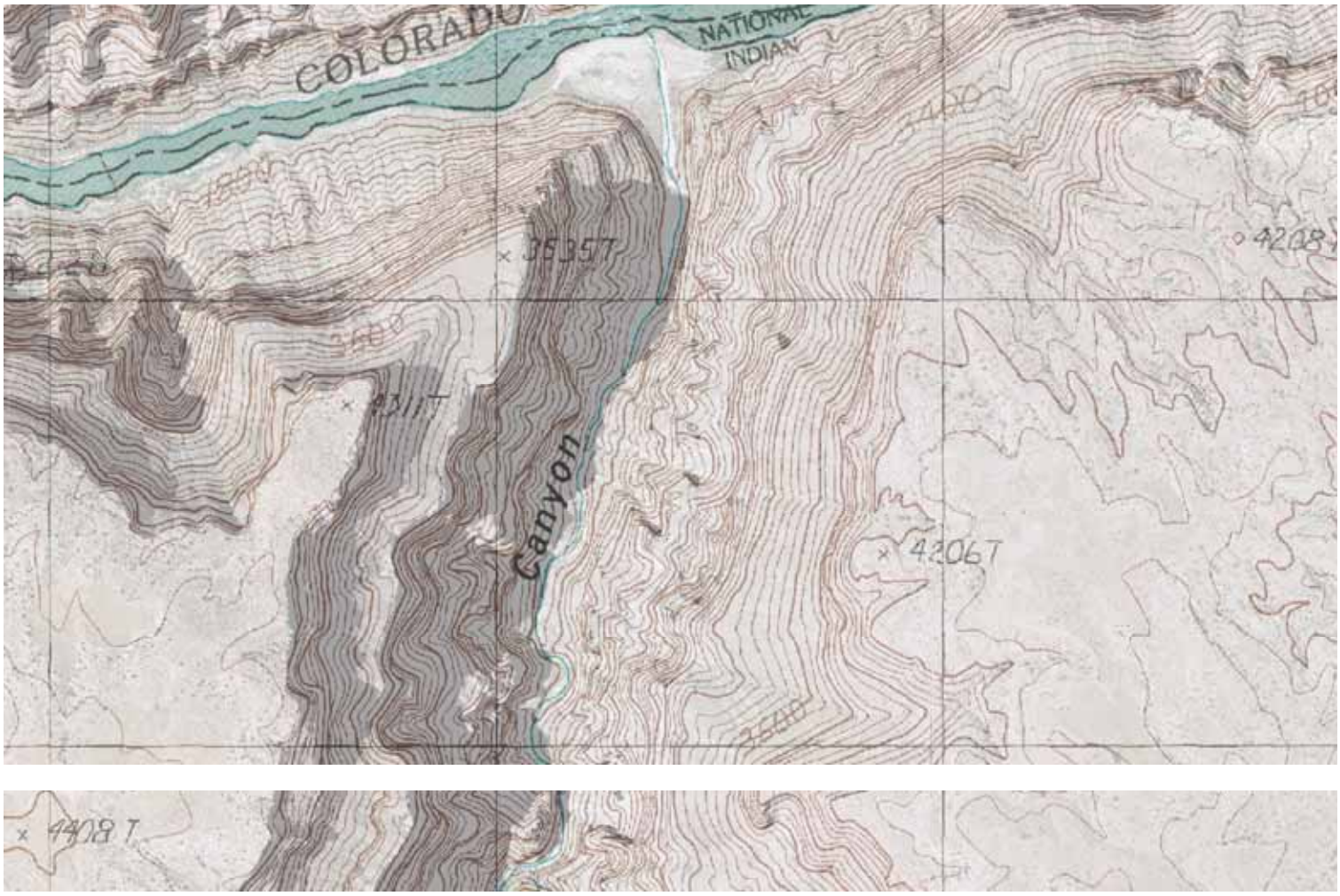
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