Grant County
PUBLIC UTILITY DISTRICT

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May 25, 2016

Kimberly D. Bose. Secretary
Federal Energy Regulatory Commission
Mail Code: DHAC, PJ-12
888 First Street, N.E.
Washington, D.C. 20426

Re: Priest Rapids Hydroelectric Project No. 2114-211 - Article 401(a)(22) – 2015 Aquatic Invasive Species Control and Prevention Plan (AISP) Annual Report & Request for approval to modify the AISP

Dear Secretary Bose,

Please find enclosed the Public Utility District No. 2 of Grant County, Washington's (Grant PUD) annual report of the 2015 Aquatic Invasive Species Control and Prevention Plan Program (AISP Program) activities consistent with the requirements of the Aquatic Invasive Species Control and Prevention Plan (AISP), Article 401(a)(22) of the Priest Rapids Hydroelectric Project License (P-2114) and associated obligations and mandates, including the Washington Department of Ecology (WDOE) 401 Water Quality Certification. The AISP Program activities for 2015 were conducted in accordance with the management plan titled, *Aquatic Invasive Species Control and Prevention Plan* (Grant PUD 2010), which was developed in consultation with the Priest Rapids Fish Forum (PRFF), the Washington Department of Fish and Wildlife's (WDFW's) Aquatic Invasive Species Program and the WDOE's Freshwater Aquatic Weed Control Program. The AISP was submitted to Federal Energy Regulatory Commission (FERC) on March 3, 2010 and approved on July 7, 2010.

In addition to filing its 2015 AISP Report, Grant PUD is requesting FERC approval to modify the AISP as follows:

- Change the frequency of monitoring the entire Columbia River corridor portion of the Project to the ordinary high water mark for AIS from every other year to every five (5) years, which will result in the next Project-wide monitoring event to occur in 2020 and very five years thereafter. Monitoring at Project boat launches will continue to occur annually.
- Change the frequency of voluntary educational boat inspections from every year to every five (5) years, to match the schedule of the Project-wide AIS surveys and result in the next voluntary educational boat inspection effort to occur in 2020 and every five years thereafter.

These proposed changes are described in more detail Appendix E of the 2015 AISP Report.

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Grant PUD prepared and disseminated a draft summary of the 2015 Aquatic Invasive Species Control and Prevention Program activities for comment on March 1, 2016 to WDOE, WDFW and to members of the PRFF which includes WDOE, WDFW, U.S. Fish & Wildlife Service, Colville Confederated Tribes, Yakama Nation, the Columbia River Inter-Tribal Fish Commission, Bureau of Indian Affairs, the Confederated Tribes of the Umatilla Indian Reservation, and Wanapum Tribe. This consultation draft included the proposed modifications to the AISP. Comments on the draft summary were due April 1, 2016; no comments were received. The annual AISP meeting was held on April 20, 2016 with WDOE, WDFW, and Chelan PUD. In this meeting, Grant PUD proposed the adaptive management changes to the AISP. No objections were noted from the stakeholders in implementing these adaptive management strategies. The AIS management plan update is included as Appendix E in this annual report. The next meeting was scheduled for the spring of 2017 after the implementation of the 2016 monitoring and educational season.

FERC staff with any questions should contact me at 509-753-1468 or email rhendr1@gcpud.org.

Sincerely,

R-Hendrick

Ross Hendrick
License Compliance Manager

CC: Patrick McGuire – WDOE
James Bellatty – WDOE
Patrick Verhey - WDFW

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Priest Rapids Hydroelectric Project (P-2114)

AQUATIC INVASIVE SPECIES CONTROL AND PREVENTION PLAN: 2015 ANNUAL REPORT

License Article 401(a)(22)

By Carson Keeler

Public Utility District No. 2 of Grant County, Washington
Priest Rapids Hydroelectric Project
FERC Project No. 2114

May 2016

Executive Summary

The Aquatic Invasive Species Control and Prevention Program (AISP Program) activities for 2015 were conducted in accordance with the management plan titled, *Aquatic Invasive Species Control and Prevention Plan* (AISP; Grant PUD 2010). The AISP was developed by the Public Utility District No. 2 of Grant County, Washington (Grant PUD) in consultation with the Priest Rapids Fish Forum (PRFF), the Washington Department of Ecology's (WDOE's) Freshwater Aquatic Weed Control Program, the Washington Department of Fish and Wildlife's (WDFW's) Aquatic Invasive Species Program, and in accordance with Section 6.6.4 of the WDOE 401 Water Quality Certification (WQC; WDOE 2007) and Article 401(a)(22) of the Federal Energy Regulatory Commission's (FERC's) license (FERC 2008) for the operation of the Priest Rapids Hydroelectric Project (Project). The AISP was submitted to FERC on March 3, 2010 and approved on July 7, 2010.

Key components of the AISP include education and monitoring that are designed to help manage, regulate, and potentially prevent introduction and/or spread of existing/new aquatic invasive species (AIS) within the Project. Educational activities for 2015 included AIS informational signage at Project boat launches and distribution of outreach material at recreational stores. Monitoring activities for 2015 consisted of zebra/quagga mussel sampling, aquatic plant surveys at Project boat launches, shoreline aquatic plant surveys, and passive-monitoring of riparian/wetland invasive plants along the shorelines of each Project reservoir.

Results from the monitoring efforts in 2015 included no zebra/quagga mussel veliger identified in any samples and no presence of zebra/quagga mussels or other macroinvertebrate AIS including New Zealand mudsnail (NZMS) on any artificial substrates within the Project. Aquatic plant monitoring indicated a total of 549 distinct aquatic vegetation communities separated into three broad categories:

1). dominated by the AIS Eurasian watermilfoil (320 of the 549 patches, or approximately 1,291 acres of the 1,980 acres mapped (~ 65%));
2). dominated by native pondweed species (117 of the 549 patches, or approximately 351 acres of the 1,980 acres mapped (~18%));
3). consisting of an AIS mix of curlyleaf pondweed/Eurasian watermilfoil (112 of the 549 patches, or approximately 338 acres of the 1,980 acres mapped (~17%)).

Shoreline riparian and wetland invasive species passively-monitored included yellowflag iris (127 of 1,174 patches mapped), purple loosestrife (273 of 1,174 patches mapped; 106,368 linear ft. of shoreline), reed canarygrass (399 of 1,174 patches; 44,735 linear ft. of shoreline), common reed (56 of 1,174 patches mapped; 1,356 linear ft. of shoreline)), Himalayan blackberry (307 of 1,174 patches mapped; 1,355 linear ft. of shoreline), and Russian olive (12 of 1,174 patches mapped).

Local and regional coordination activities in 2015 involved participation in the 7th National NZMS conference, presenting at a Washington Invasive Species Council (WISC) quarterly meeting, and hosting Grant PUD's Annual Aquatic Invasive Species meeting.

Grant PUD's annual AIS meeting was held on April 20, 2016. In this meeting, Grant PUD proposed adaptive management actions within the AIS Program related to the frequency of Project-wide surveys (i.e. aerial flights) and volunteer boater surveys, which would be implemented starting in 2016. These proposed changes were based on data collected to date from

2011 through 2015. No objections were noted from the stakeholders in implementing these adaptive management strategies moving forward. The AIS management plan update is included as Appendix E in this annual report.

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Terms and Abbreviations

AIS	Aquatic Invasive Species
AISP	Aquatic Invasive Species Control and Prevention Plan
AISP Program	Aquatic Invasive Species Control and Prevention Program
ASA	Aerial Shoreline Analysis
CDFG	California Department of Fish and Game
FERC	Federal Energy Regulatory Committee
Grant PUD	Public Utility District No. 2 of Grant County, Washington
GeoEngineers	GeoEngineers, Inc.
GIS	Geographic Information Systems
GPS	Global Positioning System
NZMS	New Zealand Mudsnail
OHWM	Ordinary High Water Mark
PRFB	Priest Rapids Fish Bypass
PRFF	Priest Rapids Fish Forum
PRRA	Priest Rapids Recreation Area
Project	Priest Rapids Hydroelectric Project
RM	River Mile
USFWS	United States Fish and Wildlife Service
VMP	Vegetation Management Program
WFB	Wanapum Fish Bypass
WDFW	Washington Department of Fish and Wildlife
WDOE	Washington Department of Ecology
WQC	Water Quality Certification

1.0 Introduction

The Public Utility District No. 2 of Grant County, Washington (Grant PUD) owns and operates the Priest Rapids Hydroelectric Project (Project), located along the mid-Columbia River in central Washington State. The Project is authorized by the Federal Energy Regulatory Commission (FERC) under Project No. 2114[1] and includes the Wanapum and Priest Rapids developments. A 401 Water Quality Certification (WQC) for the operation of the Project was issued by the Washington Department of Ecology (WDOE) on April 3, 2007, amended on March 6, 2008 (WDOE 2007), and directly incorporated into the FERC license to operate the Project issued on April 17, 2008 (FERC 2008).

The Aquatic Invasive Species Control and Prevention Program (AISP Program) activities for 2015 were conducted in accordance with the management plan titled, *Aquatic Invasive Species Control and Prevention Plan* (AISP; Grant PUD 2010). The AISP was developed by Grant PUD in consultation with the Priest Rapids Fish Forum (PRFF), the WDOE's Freshwater Aquatic Weed Control Program, the Washington Department of Fish and Wildlife's (WDFW's) Aquatic Invasive Species Program, and in accordance with Section 6.6.4 of the 401 WQC (WDOE 2007) and Article 401(a)(22) of the FERC license (FERC 2008). The AISP was submitted to FERC on March 3, 2010 and was approved on July 7, 2010.

This annual report summarizes activities conducted in implementation year 2015 under the AISP Program. Additionally, Appendix E of this annual report summarizes adaptive management changes to the AISP.

1.1 Objectives

As identified in the AISP, the primary objective is to address methods to monitor and manage aquatic invasive flora and fauna in the Project. Key components of the AISP include education and monitoring that are designed to help manage, regulate, and potentially prevent introduction and/or spread of new/existing aquatic invasive species (AIS) within the Project.

1.2 Priest Rapids Hydroelectric Project Description

The downstream boundary of the Project is located approximately three miles below Priest Rapids Dam (river mile [RM] 397.1) and extends upriver to the Rock Island Dam tailrace at RM 453.5 (Figure 1).

The Priest Rapids development consists of a 7,725-acre reservoir and a 10,103-foot-long by 179.5-foot-high dam spanning the Columbia River. The dam consists of left and right embankment sections; left and right concrete gravity dam sections; a left and right fish passage structure, each with an upstream fish ladder; a gated spillway; a downstream fish passage structure (the Priest Rapids Fish Bypass (PRFB)); and a powerhouse containing ten vertical shaft integrated Kaplan turbine/generator sets with a total authorized installed capacity of 675 MW (best gate) (Figure 2).

The Wanapum Development consists of a 14,680-acre reservoir and an 8,637-foot-long by 186.5-foot-high dam spanning the Columbia River. The dam consists of left and right embankment sections; left and right concrete gravity dam sections; a left and right fish passage structure, each with an upstream fish ladder; a gated spillway; a downstream fish passage

[1] 123FERC¶61,049

structure (the Wanapum Fish Bypass (WFB)); and a powerhouse containing ten vertical shaft integrated Kaplan turbine/generator sets with a total authorized installed capacity (best gate) of 735 MW (Figure 3).

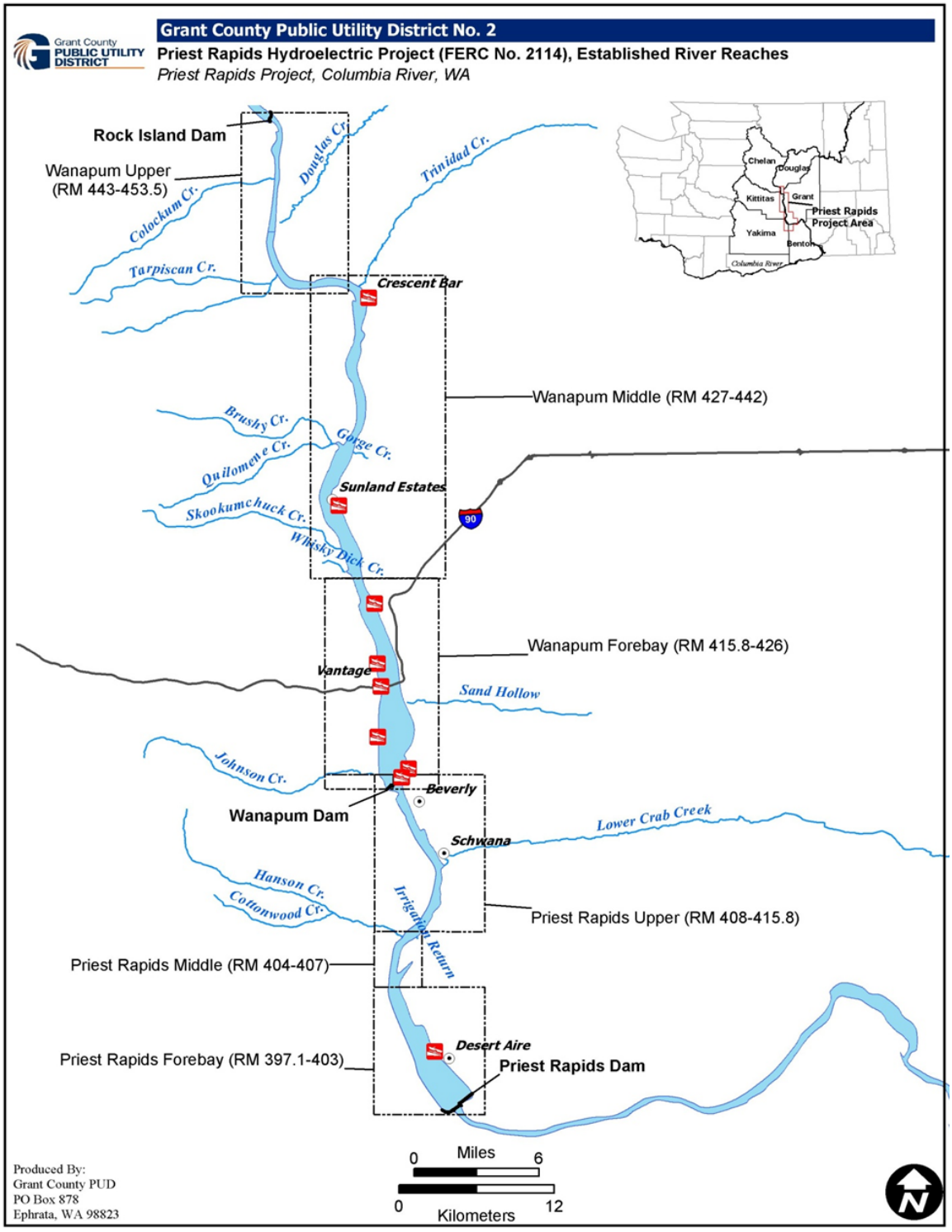

Figure 1 The Priest Rapids Hydroelectric Project and established river reaches presented by river mile (RM), mid-Columbia River, WA.

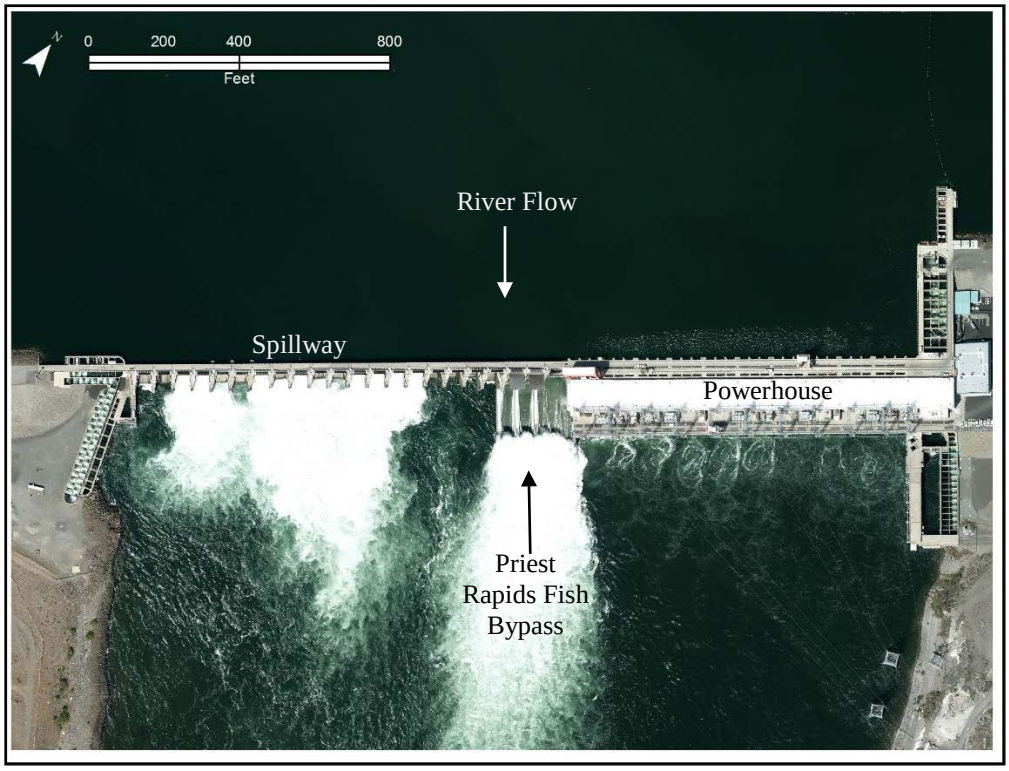

Figure 2 **Aerial photograph of Priest Rapids Dam, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.**

Figure 3 **Aerial photograph of Wanapum Dam, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.**

2.0 Activities

The following sections provide a summary of the activities conducted in 2015 for the AISP, including elements of education, monitoring, and local and regional coordination. Each of these activities are discussed in more detail below.

2.1 Education

The educational activities implemented as part of the AISP for 2015 included educational signage at Project boat launches and outreach material distributed at recreational stores. Voluntary boater surveys were not conducted during the 2015 recreational season due to lack of staff availability. Educational activities are outlined in the following sections.

2.1.1 Educational Signage and Outreach Material

Project boat launches outfitted with informational/educational signage during 2015 included Crescent Bar, Sunland Estates, Frenchman Coulee, Kittitas County (Vantage), Wanapum State Park, and Upper Wanapum on the Wanapum Reservoir, and Lower Wanapum, Huntzinger, Buckshot, and Desert Aire (Priest Rapids Recreation Area (PRRA)) on the Priest Rapids Reservoir. Educational signage included the WDFW's AIS poster (WDFW 2011) and the WDOE advisory poster for Eurasian watermilfoil (WDOE 2011) (see Figure 4). Outreach material distributed at select recreational stores consisted of the 100th Meridian Initiative's *Zap the Zebra* brochure (100th Meridian Initiative 2011; Appendix A).

It is important to note that all Grant PUD Project boat launches, including newly developed launches that are in the process of being updated and/or constructed, will be outfitted with kiosks that will contain information about boater safety, boater regulations, recreational opportunities, wildlife, and AIS in the Project. All Project boat launches during 2015 consisted of the approximate configuration of informational and educational signage as the example displayed in Figure 4 below.

Figure 4 Informational/Educational signage configuration at the Upper Wanapum boat launch, Wanapum Reservoir, Priest Rapids Hydroelectric Project, mid-Columbia River ,WA.

2.2 Monitoring

The monitoring activities implemented as part of the AISP for 2015 included zebra/quagga mussel sampling and aquatic plant surveys. Descriptions of the monitoring activities applied during 2015 are presented in the following sections.

2.2.1 Zebra/Quagga Mussel Sampling

Zebra/quagga mussels were monitored throughout the Project by use of a plankton tow net and deployment of artificial substrates. Each of these monitoring methods is covered in the following sections.

2.2.1.1 Plankton Tow Net

Horizontal and vertical plankton tow net samples were collected throughout the Project. Samples were collected at Crescent Bar, Sunland Estates, Wanapum forebay/tailrace, Crab Creek, and Lake Geneva. Samples were collected three times throughout the monitoring season (once in July, August, and September respectively).

Sample methods included the use of a Wisconsin plankton net (363µ mesh net) drifted for a distance of 40-100 ft. at a depth of approximately 20 ft. for each location. The plankton tow net was thoroughly rinsed and all sample materials were transferred to a 250 ml Teflon bottle and preserved with 70% isopropyl alcohol. A label was affixed to the sample bottle and appropriately filled out. Methods for collecting vertical tow samples were almost identical to the horizontal tow sampling method as described above, except that samples were taken from one meter above the bottom of the river up through the entire water column without drifting. The sampling procedures followed protocols developed by WDFW (Jesse Schultz, WDFW, pers. com).

After collection, samples were cataloged and shipped to Cameron Lange, a Senior Environmental Scientist located in the Great Lakes region of the United States familiar with the identification of zebra/quagga mussel veliger, for analysis. Results and more information of these analyses are presented in Section 3.1.1 and Appendix B.

2.2.1.2 Artificial Substrates

Grant PUD deployed artificial substrates at some high-traffic Project boat launch areas as an additional monitoring technique during 2015 to monitor for zebra and quagga mussels (and other AIS) near areas with high boater traffic. Boat launches selected for substrate deployment included Desert Aire (PRRA) in the Priest Rapids Reservoir and Kittitas County (Vantage), Sunland Estates, and Crescent Bar in the Wanapum Reservoir. Grant PUD followed the artificial substrate monitoring protocols as established by the California Department of Fish and Game (CDFG 2008) and provided by the WDFW (Jesse Schultz, WDFW, pers. com). One substrate was deployed at each site. The substrates were kept at least one meter above the bottom of the river and were examined on the same schedule as the plankton tow net samples. Results from the artificial substrate monitoring are presented in Section 3.1.2.

2.2.2 Aquatic Plant Surveys

Aquatic plant surveys were conducted along the entire Columbia River corridor of the Project and at Project boat launches looking specifically for submergent and emergent aquatic vegetation listed on the Washington State Noxious Weed List, along with native submergent plant species. Table 1 presents the submergent AIS plants that were identified as focal species during survey

efforts as established by the AISP (Grant PUD 2010). Native species presence was also noted as part of these survey efforts.

Table 1 Focal Submergent/Emergent Aquatic Invasive Species Plants noted for Survey Efforts.

Common Name	*Scientific Name*	Listing Status[1]	Known Presence in Project?[2]
flowering rush	*Butomus umbellatus*	Class A	No
fanwort	*Cabomba caroliniana*	Class B	No
Brazilian elodea	*Egeria densa*	Class B	No
Hydrilla	*Hydrilla verticillata*	Class A	No
water primrose	*Ludwigia peploides*	Class B	No
floating primrose-willow	*L. peploides*	Class A	No
parrotfeather	*Myriophyllum aquaticum*	Class B	No
variable-leaf watermilfoil	*M. heterophyllum*	Class A	No
Eurasian watermilfoil	*M. spicatum*	Class B	Yes
fragrant waterlily	*Nymphaea odorata*	Class C	No
yellow floatingheart	*N. peltat*	Class B	No
curlyleaf pondweed	*Potamogenton crispus*	Class C	Yes

Notes:
[1]As specified by the Washington State Noxious Weed List (2015).
[2]Known presence determined from a combination of sources, including Grant PUD (2010, 2014), Washington Department of Ecology Aquatic Invasive Species information sheets (WDOE 2011a), and the Washington State Noxious Weed Control Board species information sheets (2015a).

Additionally, although not required as part of the AISP, passive-monitoring was conducted for existing and/or new terrestrial, wetland, and/or riparian zone emergent AIS plants listed on the Washington State Noxious Weed List. This effort was intended to support Grant PUD's non-aquatic vegetation management efforts; note that terrestrial, wetland, and/or riparian zone AIS plants are currently monitored, managed, and controlled as part of Grant PUD's Vegetation Management Program (VMP; Grant PUD 2014).

Table 2 lists terrestrial, wetland, and/or riparian zone emergent AIS plants that were identified to concentrate on during passive-monitoring efforts based on known presence in the Project and/or potential infestation risk.

Table 2 Focal Terrestrial, Wetland, and/or Riparian Zone AIS Emergent Plants noted for Survey Efforts.

Common Name	*Scientific Name*	Listing Status[1]	Known Presence in Project?[2]
hairy willowherb	*Epilobiaum hirsutum*	Class B	No
yellowflag iris	*Iris pseudacorus*	Class C	Yes
purple loosestrife	*Lythrum salicaria*	Class B	Yes
reed canarygrass	*Phalaris arundinacea*	Class C	Yes
common reed	*Phragmites australis*	Class B	Yes
Himalayan blackberry	*Rubus armeniacus*	Class C	Yes

Notes:
[1]As specified by the Washington State Noxious Weed List (2015).
[2]Known presence determined from a combination of sources, including Grant PUD (2010, 2014), Washington Department of Ecology Aquatic Invasive Species information sheets (WDOE 2011a), and the Washington State Noxious Weed Control Board species information sheets (2015a).

To accomplish the tasks of mapping/monitoring and tracking aquatic plant species throughout the Project, Grant PUD contracted GeoEngineers, Inc. (GeoEngineers) and Aquatechnex™. A preliminary set of AIS base maps for the Project was developed previously based on surveys conducted in 2011 and 2013. Survey methods for 2015 repeated methods used in 2011/2013, which included:

1). Conduct an Aerial Shoreline Analysis (ASA) following protocols developed by Aquatechnex™ for recording aquatic plant distribution; and
2). Complete boat-based surveys to:
   a. verify aquatic plant distribution mapped during the ASA;
   b. collect species composition information;
   c. establish transects at Project boat launches,
   d. map aquatic plant distribution, composition and density at Project boat launches, and
   e. passively-monitor shoreline invasive species.

These methods are discussed in more detail in the following sections.

2.2.2.1 Preliminary Mapping

Preliminary mapping methods were described in detail in the 2011 Annual Report (Keeler, 2012). In summary, the preliminary maps were developed using a Geographic Information System (GIS; ESRI ArcGIS 10 software) with available geospatial data. The geospatial data layers were compiled into a geodatabase, which included: the Project boundary, high-resolution aerial imagery, bathymetric data, road information, and Project boat launch locations. Bathymetric data was originally used to identify the "threat zone," which was defined as those areas with potential habitat for submergent aquatic vegetation and was, therefore, limited to the

littoral portions of the Project reservoirs (open waters up to 20 feet deep) based on light availability. The threat zone was included on the GIS-based preliminary maps, which were used in the field to help focus AIS survey efforts, as well as to assist in locating Project boat launches.

2.2.2.2 Aerial Shoreline Analysis

Aerial shoreline analysis (ASA) methods were also described in more detail in the 2011 Annual Report (Keeler, 2012). In summary, the ASA protocol utilizes digital photographic and Global Positioning Systems (GPS) technologies, flight parameters, and techniques that maximize visual resolution of features below the water surface. High-resolution image data is linked to GPS positions and images are georeferenced and loaded into a GIS for further analysis. The primary benefit of ASA protocol surveys is that, when done correctly, submerged aquatic plant communities are very evident in the image data. To ensure visual resolution of plant communities, flight protocols must be conducted such that water penetration of ambient light is maximized. This enables mapping the location, shape and extent of aquatic vegetation with a high degree of accuracy.

An aerial flight for the ASA was conducted on September 4, 2015, using a small fixed-wing aircraft. Once within the Project, the aircraft maintained a vertical position approximately 1,000 feet above the water surface and a horizontal offset of approximately 1,000 feet from the shoreline to provide a photographic angle of approximately 45 degrees, based primarily on solar angle, for capture of oblique imagery. However, prohibited airspace over the U.S. Army Joint Base Lewis-McChord Yakima Training Center required the flight path to be modified somewhat in the southern portion of the Project because the aircraft was required to stay over the river and was not permitted to fly over the western shore in this area. Consequently, imagery was captured at a slightly different angle for much of the eastern shoreline. This deviation from the standard ASA protocol was determined not to adversely affect image quality and mapping results.

The aerial imagery collected during the flight was downloaded, post-processed and analyzed using GIS software. Distribution of aquatic plant communities visible in the aerial imagery were digitized as polygons. These polygons were then transferred onto a field computer for use during boat-based surveys for verification or modification based on direct field observations and sampling.

2.2.2.3 Boat-Based Surveys

To complete the AIS mapping objective for the Project, boat-based surveys were conducted in 2015 on the following dates: August 6 (boat launches); and September 8-11 and October 7-9 (shoreline surveys). Survey dates were scheduled to be generally consistent with surveys from prior years. These survey efforts together fulfilled the following objectives:

1). Examining shorelines of the Project to verify and/or modify the AIS polygons resulting from the ASA.
2). Collecting species composition data to determine dominant AIS species within map polygons.
3). Passively-monitoring riparian and/or wetland invasive species present along the shoreline.
4). Establishing transects at Project boat launches and collecting sample data for AIS along these transects.

Boat-based survey methods employed during 2015 were consistent with methods used in prior years, as described in detail in the 2011 and 2013 Annual Reports (Keeler 2012 and 2014). In summary, these surveys were conducted using a small field crew of biologists travelling in a motorized vessel along the Project shoreline and within the threat zone, as previously defined. The field crew visited areas with aquatic vegetation to verify approximate location, extent and species composition of AIS. Modifications to the polygons developed from the ASA were then digitized to produce maps illustrating the final AIS polygons. Distribution of shoreline riparian and wetland invasive plant species was also observed and recorded during the boat-based surveys. For the 2015 surveys, methods for identification and classification of riparian and wetland invasive plants, such as classification of patch sizes (small, medium, large) and identification of "areas of extensive distribution" were consistent with methods employed in 2013, as described in the 2013 Annual Report (Keeler, 2014).

Boat launch transect locations previously established within the Project in 2011 were re-surveyed in 2012 – 2015. Transect methodology generally followed the same protocol in 2015 as was completed during 2012 – 2014, which was modified slightly from the original protocol in 2011 (Keeler 2012 – 2015), but consistent with AISP requirements (Grant PUD 2010). In general, three transects were completed at each boat launch; however, four transects were completed at the Desert Aire (PRRA) boat launch due to its reconfiguration between the 2012 and 2013 surveys. Other boat launches have been re-constructed since surveys began (Frenchman Coulee, Vantage, Wanapum State Park, Wanapum Forebay, and Huntzinger) but not substantially reconfigured; therefore, transect locations were not modified at these boat launches. During surveys, aquatic vegetation was sampled periodically along each transect, and dominance or occurrence of invasive species (e.g., Eurasian watermilfoil or curlyleaf pondweed), native species or no vegetation were recorded at each sample point.

2.3 Local and Regional Coordination

Local and regional coordination activities in 2015 involved participation in the 7th National NZMS conference, presenting at a Washington Invasive Species Council (WISC) quarterly meeting, and hosting Grant PUD's Annual Aquatic Invasive Species meeting.

2.3.1 7th National New Zealand Mudsnail Conference

Grant PUD attended the 7th National NZMS conference held in Seattle, Washington on June 16-17, 2015 at the USGS Western Fisheries Research Center. Topics of NZMS discussion included: an overview of current NZMS policies, various case studies, updated research, and various discussions on coordinated management and research gaps and priorities.

2.3.2 Washington Invasive Species Council Quarterly Meeting

Grant PUD was invited to attend and present at the September 2015 quarterly meeting for the WISC held at the Discovery Center in Wenatchee, WA. Presentation from other mid-Columbia PUD's (i.e. Chelan and Douglas) on various AIS topics were also a part of the meeting.

2.3.3 Annual Aquatic Invasive Species Meeting

On April 20, 2016 and in accordance with the AISP, Grant PUD hosted its annual AIS meeting at its Hydro Office Building (HOB). Per the AISP, the purpose of this meeting were to discuss the upcoming monitoring and educational season, any needed/warranted changes to AIS education, monitoring, and/or control methods or other changes to the AISP based on results from the previous year, new technologies, new AIS threats and/or introductions, new AIS

pathways, etc. Attendees included Carson Keeler and Ross Hendrick (Grant PUD), Patrick Verhey (WDFW), David Conlin (GeoEngineers, Inc.), Patrick McGuire (WDOE), and Marcie Steinmetz (Chelan PUD). A PowerPoint was presented by Grant PUD on the results from the 2015 season along with a brief overview of the AISP activities to date followed by proposed changes to the AISP for 2016 onward.. These proposed changes will be addressed in Appendix E of this annual report. The next meeting was scheduled for the spring of 2017 after the implementation of the 2016 monitoring and educational season.

3.0 Results

The following sections provide results from activities conducted as part of the AISP in 2015, which includes outcomes from the zebra/quagga mussel sampling (both plankton tows and artificial substrate), Project shoreline aquatic emergent/submergent plant surveys, and boat launch transect surveys.

3.1 Zebra/Quagga Mussel Monitoring

As stated above in Section 2.2.1, zebra/quagga mussels were monitored by use of plankton tow nets and artificial substrates throughout the Project. Results from each method are discussed in the following sections.

3.1.1 Plankton Tow Net Results

A total of 18 samples were collected from July – September, cataloged, and sent to Cameron Lange, a Senior Environmental Scientist located in the Great Lakes region of the United States whom is familiar with the identification of zebra/quagga mussel veliger and is recognized as an expert by WDFW (Jesse Schultz, WDFW, pers. com), for analysis. The 18 samples were analyzed using standardized techniques that are accepted for zebra mussel analyses. These techniques included the use of a dissecting style microscope fitted with polarizing filters used to examine the samples under 40x-120x magnification. Since zebra mussels have not previously been found at the sample locations within the Project, the entire settled contents of each sample were examined. If samples contained a lot of phytoplankton or plankton, they were prescreened through a 425-micron mesh sieve (Lange 2015).

No zebra mussels were found in any of the samples analyzed. A copy of each analysis was sent via email to WDFW during the 2015 season. See Appendix B of this annual report for results from samples analyzed during 2015.

3.1.2 Artificial Substrate Results

During the same timeframe as the plankton tow samples were collected (July - September), artificial substrates were checked for presence/absence of zebra/quagga mussels or other AIS macroinvertebrate. A standard form were supplied by WDFW to check for presence/absence of mussels (WDFW 2010). No presences of zebra/quagga mussels on any other macroinvertebrate AIS during the 2015 season were detected. Results were cataloged, scanned and sent via email to WDFW.

3.2 Aquatic Plant Survey Results

Results from the survey efforts put forth for mapping and tracking AIS plants within the Project are depicted in the following sections. These sections include aquatic (submergent) plant communities, shoreline (emergent) invasive species, and boat launch transects.

3.2.1 Aquatic (Submergent) Plant Communities

The threat zone covers approximately 6,013 acres, or 18 percent, of the 33,324-acre Project. Approximately 1,979.7 acres, or 32.9 percent, of the threat zone was mapped as having aquatic vegetation beds. A breakdown by patch type for 2015 and prior year surveys is included in Table 3, and discussed below.

A total of 549 distinct patches of aquatic vegetation were mapped during the 2015 ASA and boat-based survey efforts, as shown in Figures C1 – C9 in Appendix C of this final report and as summarized in Table 3. For the 2015 surveys, vegetation communities were divided into three distinct types: Eurasian watermilfoil-dominated, native-dominated, and curlyleaf pondweed-Eurasian watermilfoil mix. Survey results from prior years (2011 and 2013) did not include a curlyleaf pondweed-Eurasian watermilfoil mix category, indicating the composition of aquatic vegetation beds at the time of the 2015 survey has shifted since 2013.

The most prevalent aquatic plant community for 2015 was Eurasian watermilfoil-dominated. Patches of this type were either monocultures or domiinnated by more than 75% of the species. Curlyleaf pondweed was a secondary co-dominant species in many of these patches and was found at lower densities within the Eurasian watermilfoil beds. The two other types of communities (native-dominated and curlyleaf pondweed-Eurasian watermilfoil mix) were found in approximately equal proportion. Native-dominated patches included areas with dense aquatic plant growth dominated by more than 75% native pondweed species (primarily *Potamogeton* spp.). There was limited amounts of Eurasian watermilfoil and/or curlyleaf pondweed in these beds, but these species were not dominant compared to the native pondweed species. Curlyleaf pondweed-Eurasian watermilfoil mix patches contained more or less equal proportions of the two species, with neither dominating the other by more than 75%.

Table 3 Summary Results for Aquatic Vegetation Communities 2011, 2013, and 2015 within the Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

Year	Eurasian Watermilfoil				Native Species				Curlyleaf-Watermilfoil Mix[2]				Total			
	# Patches	Average Patch Size[1]	Total Cover[1]	% of Threat Zone	# Patches	Average Patch Size[1]	Total Cover[1]	% of Threat Zone	# Patches	Average Patch Size[1]	Total Cover[1]	% of Threat Zone	# Patches	Average Patch Size[1]	Total Cover[1]	% of Threat Zone
2011	313	3.7	1159.5	19.3	25	17.6	439.9	7.3					338	4.7	1599.4	26.6
2013	280	5.0	1394.3	23.2	58	10.4	603.2	10.0					338	5.9	1997.5	33.2
2015	320	4.0	1290.9	21.5	117	3.0	350.9	5.8	112	3.0	337.9	5.6	549	3.6	1979.7	32.9

Notes:
[1] Average patch size and total cover are depicted in acres.
[2] Curlyleaf-watermilfoil mix patches were not identified in 2011 or 2013.

As noted in Table 3, the total number of aquatic vegetation patches mapped in 2015 was greater than those mapped in 2011 and 2013. However, the average patch size was smaller and there was an overall reduction in total aquatic vegetation acreage relative to prior years.

During 2014, the Wanapum Reservoir was drawn down more than 20 feet below its normal minimum operating level (and up to 26 feet below its normal operating level) for repairs to be made to the spillway sections of Wanapum Dam (a fracture was discovered in February of 2014 and the reservoir behind Wanapum Dam (Wanapum Reservoir) was lowered to prevent further damage). This drawdown temporarily affected the extent and location of the littoral zone (i.e. threat zone) and appears to have affected the extent of aquatic (and/or riparian) vegetation near the shoreline of the Wanapum Reservoir. The drawdown did not substantively affect water surface elevations within the Priest Rapids Reservoir. To evaluate the impact of the drawdown on aquatic vegetation effects in the Wanapum Reservoir, the data results for total cover of each vegetation community were separated by reservoir (see Table 4). The drawdown occurred between the data collection efforts in 2013 and 2015. As displayed in Table 4, there was a net reduction of aquatic vegetation cover in the Wanapum Reservoir over the two-year span, and a net increase in aquatic vegetation cover in the Priest Rapids Reservoir. Grouping the Eurasian watermilfoil patch type with the curlyleaf-watermilfoil mix patch type (the latter of which was not identified in 2013) to compare 2015 data against results from 2013 indicates that there was an overall reduction in Eurasian watermilfoil cover in the Wanapum Reservoir after the drawdown. Native species cover also declined from 2013 to 2015 in the Wanapum Reservoir. In contrast, for the Priest Rapids reservoir, there was an increase in Eurasian watermilfoil and a decrease in native species from 2013 to 2015.

Table 4 Comparison of Total Cover (acres) of Aquatic Vegetation Types between Reservoirs within the Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

Year	Eurasian Watermilfoil		Native Species		Curlyleaf-Watermilfoil Mix[1]		Total for All Species	
	Wanapum	Priest Rapids	Wanapum	Priest Rapids	Wanapum	Priest Rapids	Wanapum	Priest Rapids
2011	791.4	368.1	377.7	62.2			1169.1	430.2
2013	961.3	433.0	332.7	270.6			1293.9	703.6
2015	490.1	800.8	238.4	112.5	307.6	30.4	1036.0	943.7

Note:
[1] Curlyleaf-watermilfoil mix patches were not identified in 2011 or 2013.

3.2.2 Shoreline Aquatic Invasive Species

Shoreline riparian and wetland invasive species are summarized in Table 5 and indicated on Figures C1 – C9 in Appendix C as point locations and/or "areas of extensive distribution." Point locations were classified by patch size as small, medium or large, as illustrated on Figures C1-C9 in Appendix C as well. Details regarding methods for patch size classification were provided in the 2013 annual report (Keeler 2014). The "areas of extensive distribution" are represented by lines along the shoreline. These areas include locations where a single species was distributed frequently along a length of shoreline, thus making it impractical to collect single GPS points.

Table 5 Summary Results for Shoreline Invasive Species Passive-Monitoring 2011, 2013 and 2015 within the Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

Year	Yellowflag iris		Purple loosestrife		Reed canarygrass		Common reed		Himalayan blackberry		Russian olive		Total	
	# Patches[1]	Length of Shoreline[2]	# Patches[1]	Length of Shoreline[2]	# Patches[1]	Length of Shoreline[2]	# Patches[1]	Length of Shoreline[2]	# Patches[1]	Length of Shoreline[2]	# Patches[1]	Length of Shoreline[2]	# Patches[1]	Length of Shoreline[2]
2011	178	0	58	42,798	89	13,780	11	7,888	136	13,565	0	0	472	78,031
2013	243	0	359	94,686	245	36,285	63	1,813	144	0	1	0	1,055	132,784
2015	127	0	273	106,368	399	44,735	56	1,356	307	1,355	12	0	1,174	153,814

Notes:
[1] Number of patches for each species are summed regardless of patch size.
[2] Linear length of shoreline is represented in feet for those areas where individual patches were not discerned due to presence of invasive species spanning broad areas continuously along the shoreline.

The total number of riparian invasive species patches mapped in 2015 was slightly higher than those mapped in 2013. Areas of extensive distribution were also generally greater in 2015 than in 2013. For individual species, the following trends were noted:

- Yellowflag iris: the number of patches decreased for this species in 2015. It was particularly noted observationally that there were very few patches in the Wanapum Reservoir, which is hypothesized to be a result of the drawdown that occurred during 2014. It is likely that a lowered water table at the shoreline resulted in conditions that did not support yellowflag iris and that this species has not yet had the opportunity to recolonize since the drawdown.
- Purple loosestrife: the individual patches recorded in 2015 were fewer than those recorded in 2013, whereas the amount of shoreline with extensive distribution increased. It is quite likely that this trend is at least partially explained as a substitution, whereas some of the data recorded as extensive distribution in 2015 replaced data that were recorded as individual points in 2013. Another factor may have been survey timing. Although surveys were completed during approximately the same time of year as they were previously, it was noted during the October 2015 boat-based shoreline survey, which was in the Priest Rapids Reservoir, that this species was already senescing and may have been more difficult to spot from the boat.
- Reed canarygrass: the number of observed patches and length of shoreline with extensive distribution increased again in 2015.
- Common reed: the number of patches and length of shoreline with extensive distribution both declined slightly in 2015. Common reed occurs predominantly in the Priest Rapids pool, which was not affected by the drawdown; therefore, the reason for this decline is not known, but the magnitude of the decline is small and may be within an expected range of error given the methods employed and size of the survey area.
- Himalayan blackberry: the number of patches increased substantially in 2015, more than doubling, and the length of shoreline with extensive distribution also increased relative to 2013. This species is predominantly located along the Wanapum pool shoreline; therefore, it is likely that its proliferation over the past year was related to the pool drawdown, which may have created somewhat drier conditions under which Himalayan blackberry can thrive but many other riparian species may not.
- Russian olive: this species was not a focal species prior to the 2015 survey. Survey effort for this species was increased during 2015 in response to a comment received during the review process for 2014 survey results. Prior to 2015, only one patch was noted during our surveys; for 2015, we recorded 12 patches along the Project shorelines. It should also be noted that this species can occur set back from the shoreline and therefore, may occur in places not immediately apparent from a boat travelling on the water.

The most striking differences between 2015 and 2013 data occur for yellowflag iris and Himalayan blackberry, which exhibited inverse relationships to one another. It is hypothesized that a decline in yellowflag iris and increase in Himalayan blackberry are both related to the Wanapum drawdown that occurred during 2014 between the survey efforts. Effects of reservoir water level fluctuations in regulated systems—which may favor certain species over others, reduce species richness or other measures of diversity, and/or reduce plant density and cover—

have been previously documented (e.g., Wood et al. 2008; Boehringer 2014). Tuttle (2012) documented low invasion by Himalayan blackberry after several years in a constructed riparian wetland within the drawdown zone of a reservoir on Vancouver Island, British Columbia. Other studies that identified shifts in the prevalence of yellowflag iris or Himalayan blackberry on the shorelines of a reservoir following a drawdown as what occurred in the Wanapum Reservoir could not be documented. The drawdown likely lowered the water table along the shoreline, which appears to have favored Himalayan blackberry and inhibited yellowflag iris. However, these two species occupy different types of microhabitats. Yellowflag iris is most frequently observed on gravel bars and mudflats right down at the water's edge and often within the range of typical water surface fluctuations. Himalayan blackberry, on the other hand, is usually distributed above the waterline on the bank or adjacent cliffs and talus slopes. Therefore, it is not believed that Himalayan blackberry is displacing yellowflag iris, nor is the decline of yellowflag iris permitting the expansion of Himalayan blackberry. The observed inverse relationship is likely correlative, not causal.

Reed canarygrass was also observed in substantially larger numbers than it was in prior years. This result could be due to: an actual increase in distribution of this species; an improvement in the ability of the survey crew to spot and identify this species; expansion of this species following the drawdown as a result of dormant seeds becoming exposed to conditions suitable for germination; or some combination of the all of the above. Reed canarygrass seeds can remain viable in the soil for several years (Wisconsin Reed Canary Grass Management Working Group 2009). Reed canarygrass also reportedly survives drought well (Tu 2004), so the drawdown was unlikely to have negatively impacted its abundance.

3.2.3 Boat-Launch Transects

Figures D1 – D9 in Appendix D of this final report illustrate results of aquatic vegetation mapping along transects established at each Project boat launch. Table 7 includes a summary of results for each boat launch. Each GPS point location along these transects represents a single sampling location where dominance, presence and/or absence of AIS and native aquatic vegetation were recorded based on visual observations and/or rake sampling within an approximate 4 meter by 2 meter plot located at the front of the boat. Where multiple species were present, the dominant species was recorded and additional species were noted as sub-dominant. In some cases, transects were terminated early as a result of loss of contact with aquatic vegetation, which was often correlated with a water depth greater than 20 feet, and therefore beyond the threat zone. This is consistent with the protocol for these surveys described in the AISP (Grant PUD 2010). Results presented in Table 7 are summarized as presence or absence of each species at each boat launch.

Table 6 Summary Results for Boat Launch Transect Monitoring, Priest Rapids Hydroelectric Project, mid-Columbia River, WA

	Crescent Bar			Sunland			Frenchman Coulee			Vantage			Wanapum State Park			Upper Wanapum			Lower Wanapum			Huntzinger			Buckshot			Desert Aire (PRRA)		
Year	EM	CP	NS	EM	CP	NS	EM	CP	NS	EM	CP	NS	EM	CP	NS	EM	CP	NS	EM	CP	NS	EM	CP	NS	EM	CP	NS	EM	CP	NS
2011	x	x		x			x	x		x	x		x	x		x	x								x			x		
2012	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x							x	x	x	x	x	x
2013	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x							x	x	x	x	x	x
2014																						x	x	x	x		x	x	x	x
2015			x	x	x	x						x		x	x			x				x		x	x	x	x	x	x	x

Notes:
EM = Eurasian watermilfoil; CP = curlyleaf pondweed; NS = native species.
Native species were not recorded in 2011.
The following boat launches were not surveyed in 2014 due to the Wanapum drawdown: Crescent Bar, Sunland, Frenchman Coulee, Vantage, Wanapum State Park and Upper Wanapum.
Huntinger boat launch was formally established between the 2013 and 2014 survey seasons and was therefore not sampled prior to 2014.

As illustrated in Table 7, data results for boat launches within the Priest Rapids Reservoir were generally consistent with data results from prior years. Data results for boat launches in the Wanapum Reservoir, however, varied widely. The Wanapum boat launches were not surveyed during 2014 due to the drawdown. The littoral zones at these boat launches were exposed during the drawdown and the aboveground portion of aquatic bed vegetation likely died off during this time. Re-growth and/or recolonization of some vegetation has occurred at most boat launches since the drawdown, although the amount of aquatic vegetation is much lower than prior years. The ability of Eurasian watermilfoil to re-sprout from surviving root crowns following drawdown has been previously documented (e.g., Geiger 1983). It should also be noted that during the drawdown, two of the boat launches (Frenchman Coulee and Vantage) were completely rebuilt and dredged. As of the 2015 surveys, Eurasian watermilfoil had only recolonized one of the Wanapum boat launches (Sunland) and curlyleaf pondweed had only recolonized two of these boat launches (Sunland and Wanapum State Park). For both of these launches, invasive species were only observed at one transect point. Native species were observed at all boat launches except Frenchman Coulee, which completely lacked vegetation during the 2015 survey.

4.0 Conclusion/Summary

Educational activities for 2015 included placement of outreach materials and signage at Project boat launches and placement of outreach material at major recreational outlet stores.

Monitoring activities during 2015 consisted of zebra/quagga mussel sampling, invasive aquatic plant surveys at Project boat launches, shoreline aquatic plant surveys, and passive-monitoring of riparian/wetland invasive plants along the shorelines.

Results from the monitoring efforts in 2015 reported no zebra/quagga mussel veliger identified in any samples and no presence of zebra/quagga mussels or other macroinvertebrate AIS including New Zealand mudsnail (NZMS) on any artificial substrates within the Project.

Aquatic vegetation monitoring indicated a total of 549 distinct aquatic vegetation patches divided into three general categories: one dominated by the AIS Eurasian watermilfoil (320 of the 549 patches, or approximately 1,291 acres of the 1,980 acres mapped (~ 65%)), another type dominated by native pondweed species (117 of the 549 patches, or approximately 351 acres of the 1,980 acres mapped (~18%)) and the last type consisting of an AIS mix of curlyleaf pondweed/Eurasian watermilfoil (112 of the 549 patches, or approximately 338 acres of the 1,980 acres mapped (~17%)).

Shoreline riparian and wetland invasive species passively-monitored included yellowflag iris (127 of 1,174 patches mapped), purple loosestrife (273 of 1,174 patches mapped; 106,368 linear ft. of shoreline), reed canarygrass (399 of 1,174 patches; 44,735 linear ft. of shoreline), common reed (56 of 1,174 patches mapped; 1,356 linear ft. of shoreline)), Himalayan blackberry (307 of 1,174 patches mapped; 1,355 linear ft. of shoreline), and Russian olive (12 of 1,174 patches mapped).

Local and regional coordination activities in 2015 involved participation in the 7th National NZMS conference, presenting at the Washington Invasive Species Council (WISC) quarterly meeting, and hosting Grant PUD's Annual Aquatic Invasive Species meeting.

Based on the data collected to date from 2011 through 2015 and after discussions with the AISP stakeholders, Grant PUD is proposing adaptive management actions within the AIS Program

related to the frequency of Project-wide surveys (i.e. aerial flights) and volunteer boater surveys, which would be implemented starting in 2016. No objections were noted from the stakeholders in implementing these adaptive management strategies moving forward. The proposed AISP update is included as Appendix E in this annual report.

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Appendix A
100th Meridian Institute's *Zap the Zebra* Brochure

STOP AQUATIC HITCHHIKERS!

www.ProtectYourWaters.net

Follow these simple steps:

☑ Clean

Remove all plants, animals, mud and thoroughly wash everything, especially all crevices and other hidden areas.

☑ Drain

Eliminate all water before leaving the area, including wells, ballast, and engine cooling water.

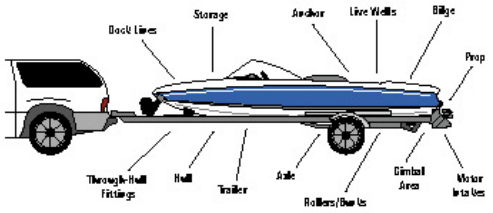
☑ Dry

Allow sufficient time for your boat to completely dry before launching in other waters.

If your boat has been in infested waters for an extended period of time, or if you cannot perform the required steps above, you should have your boat *professionally* cleaned with high-pressure scalding hot water (>140 °F) before transporting to any body of water.

Before launching and before leaving...

Inspect everything!



Invasive Mussels: Expensive Damage!

When zebra and/or quagga mussels invade our local waters they clog power-plant and public-water intakes and pipes. Routine treatment is necessary and very expensive. This leads to increased utility bills. If you use water and electricity, you do not want these mussels.

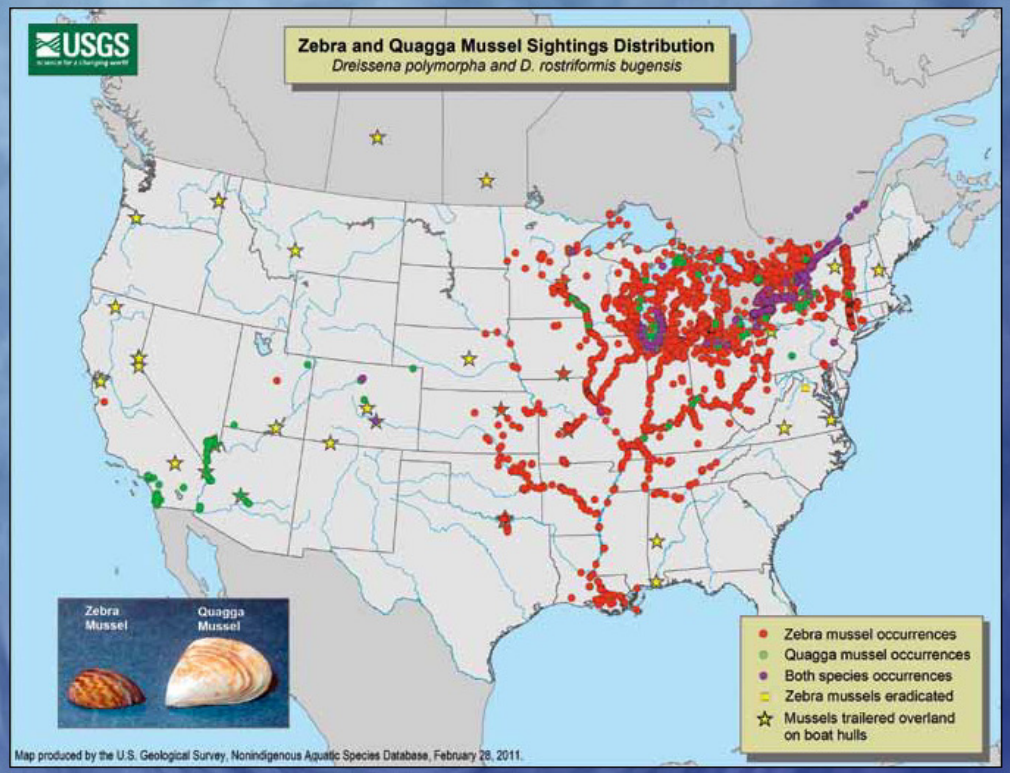
Zebra mussels in a cut-away pipe

Zebra mussels blocking a pipe

Zebra/Quagga Mussels May Use Your Boat to Invade Additional Waters!

Once a boat has been in infested waters, it could carry invasive mussels. These mussels can spread to new habitats on boats trailered by commercial haulers or the public. Zebra and quagga mussels attach to boats and aquatic plants carried by boats. These mussels also commonly attach to bait buckets and other aquatic recreational equipment. An adult female zebra mussel can release up to a million eggs in a year. Please take precautions outlined in this brochure to help reduce the chance that zebra or quagga mussels will spread from your boat or equipment to uninfested areas.

Before zebra mussels *After zebra mussels*



Zebra/Quagga Mussels Harm Native Aquatic Life

Zebra mussels on a crayfish

Zebra mussels on a native mussel

Zebra/Quagga Mussels Encrust Any Hard Surface

Zebra mussels on a beer can

Zebra mussels on a fishing lure

Zebra Mussels / Quagga Mussels

What are they?

Both are closely related, invasive, freshwater bivalve (mollusk) species that encrust hard surfaces.

Where do they come from?

These species came from the Black and Caspian Sea Drainages in Eurasia.

What size are they?

Larvae are microscopic and adults may be up to two inches long. They are usually found in clusters.

Why "Zebra" mussels?

Both species are sometimes referred to as "zebra" mussels because they both have light and dark alternating stripes. Quagga mussels are actually a distinct (but similar) species named after an extinct animal related to zebras.

Appendix B
Zebra/Quagga Mussel veliger sample results during 2015, Priest Rapids Hydroelectric Project, mid-Columbia River, WA

Date	Reservoir	Location	Zebra Mussels	*Corbicula*	Prescreened	Comments
7/7/15	Wanapum	CB	No	Some	No	Heavy Phytoplankton
7/7/15	Wanapum	SE	No	No	No	Many Cladocerans
7/7/15	Wanapum	WF	No	No	No	Very Little Material
7/7/15	Priest Rapids	WT	No	No	No	Very Little Material
7/7/15	Priest Rapids	CC	No	Some	No	
7/7/15	Priest Rapids	LG	No	No	No	
8/29/15	Wanapum	WF	No	No	No	
8/29/15	Wanapum	SE	No	No	No	
8/29/15	Wanapum	CB	No	No	No	
8/29/15	Priest Rapids	CC	No	No	No	
8/29/15	Priest Rapids	WT	No	No	No	Few Copepods
8/29/15	Priest Rapids	LG	No	No	No	Many Rotifers
9/30/15	Wanapum	WF	No	No	No	
9/30/15	Wanapum	SE	No	No	No	Some Copepods
9/30/15	Wanapum	CB	No	No	No	Many Rotifers
9/30/15	Priest Rapids	WT	No	Few	No	
9/30/15	Priest Rapids	CC	No	Few	No	Many Diatoms
9/30/15	Priest Rapids	LG	No	Few	No	Many Diatoms

Notes:
CB=Crescent Bar, SE=Sunland Estates, WF=Wanapum Forebay, WT=Wanapum Tailrace, CC=Crab Creek, LG=Lake Geneva

Appendix C
Shoreline Survey Map Series for 2015

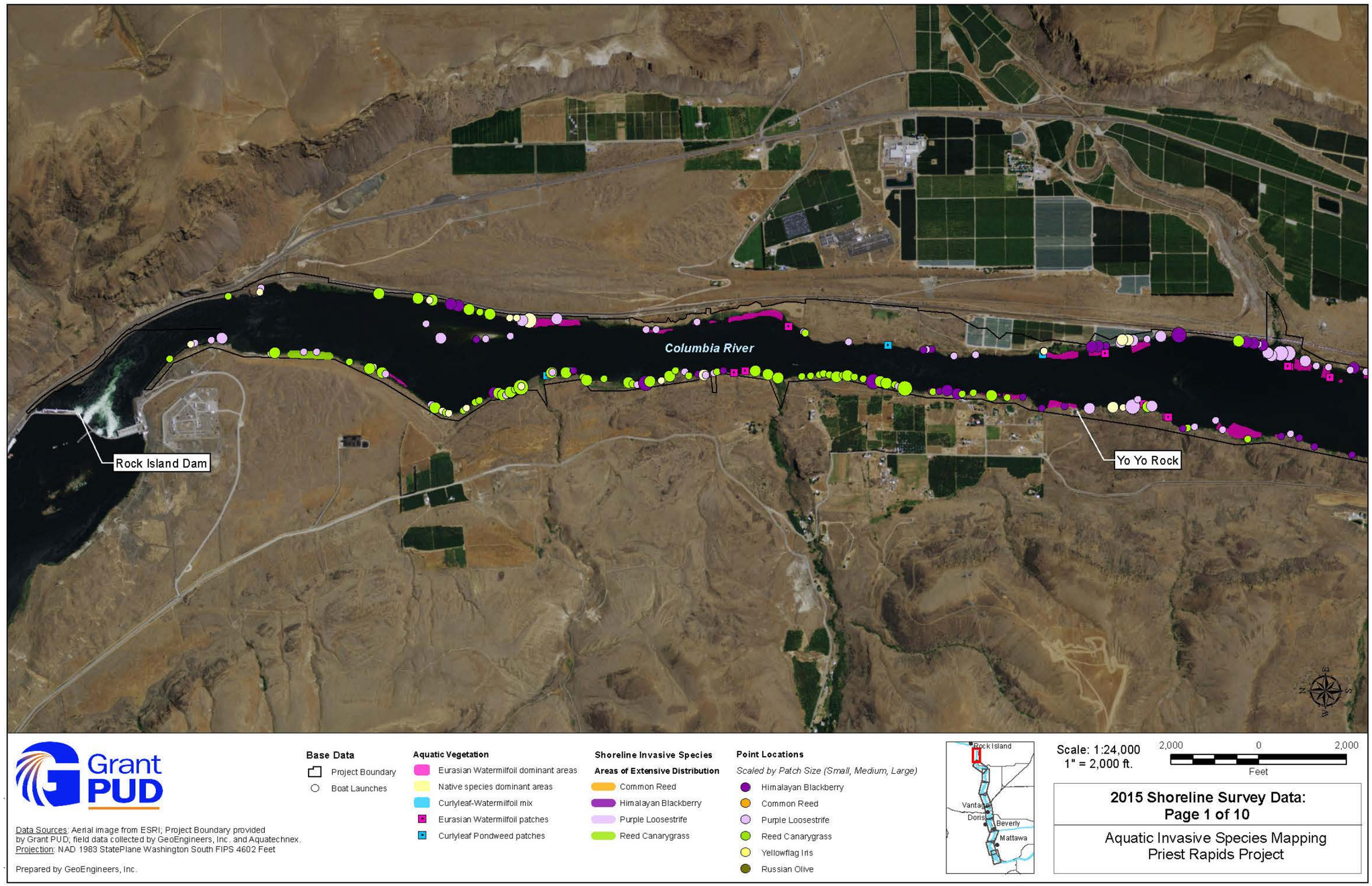


Figure C-1 Upper Wanapum Reservoir (~RM 452-448) Shoreline Survey Data, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

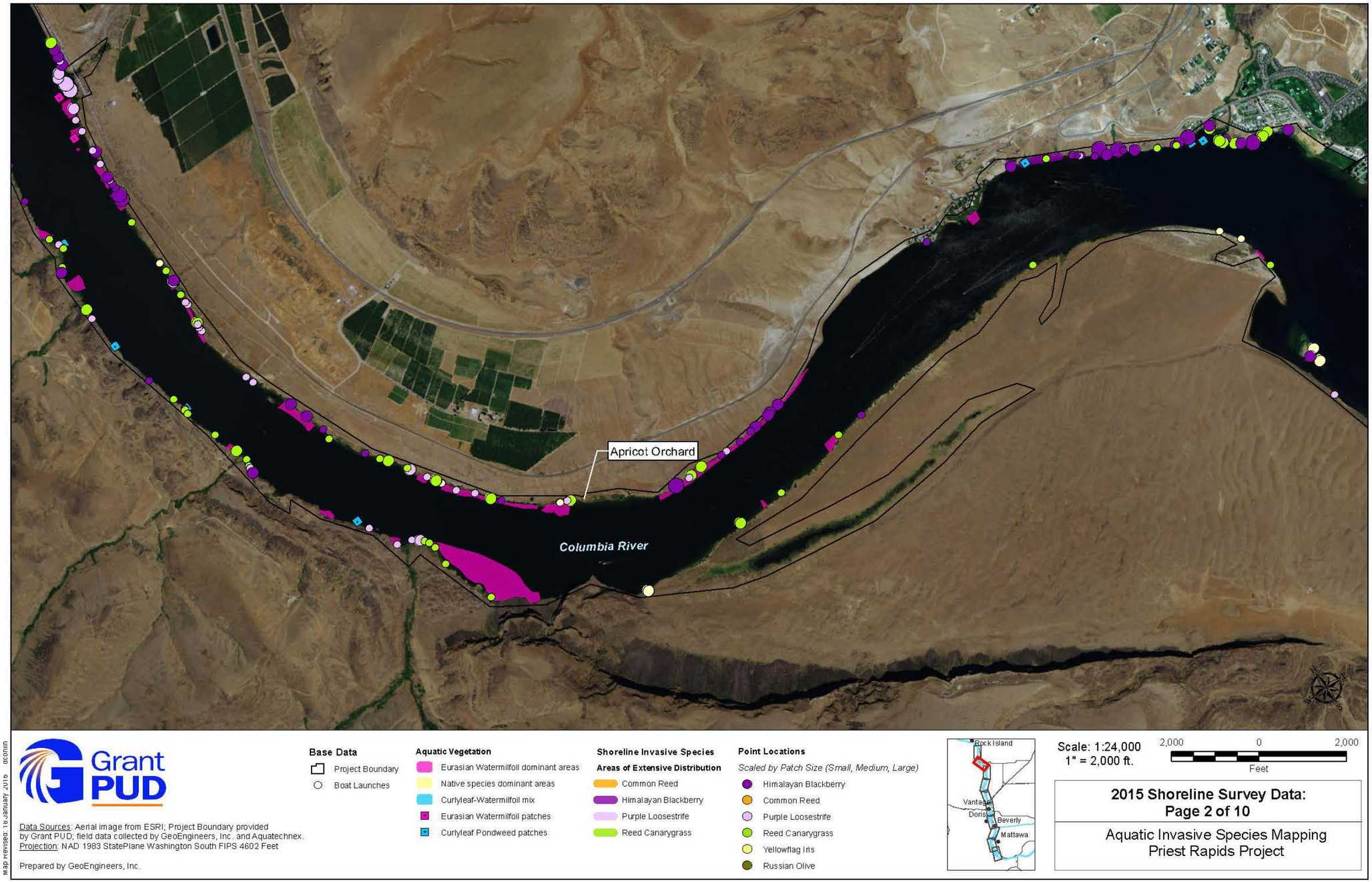


Figure C-2 Upper Wanapum Reservoir (~RM 448-441) Shoreline Survey Data, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

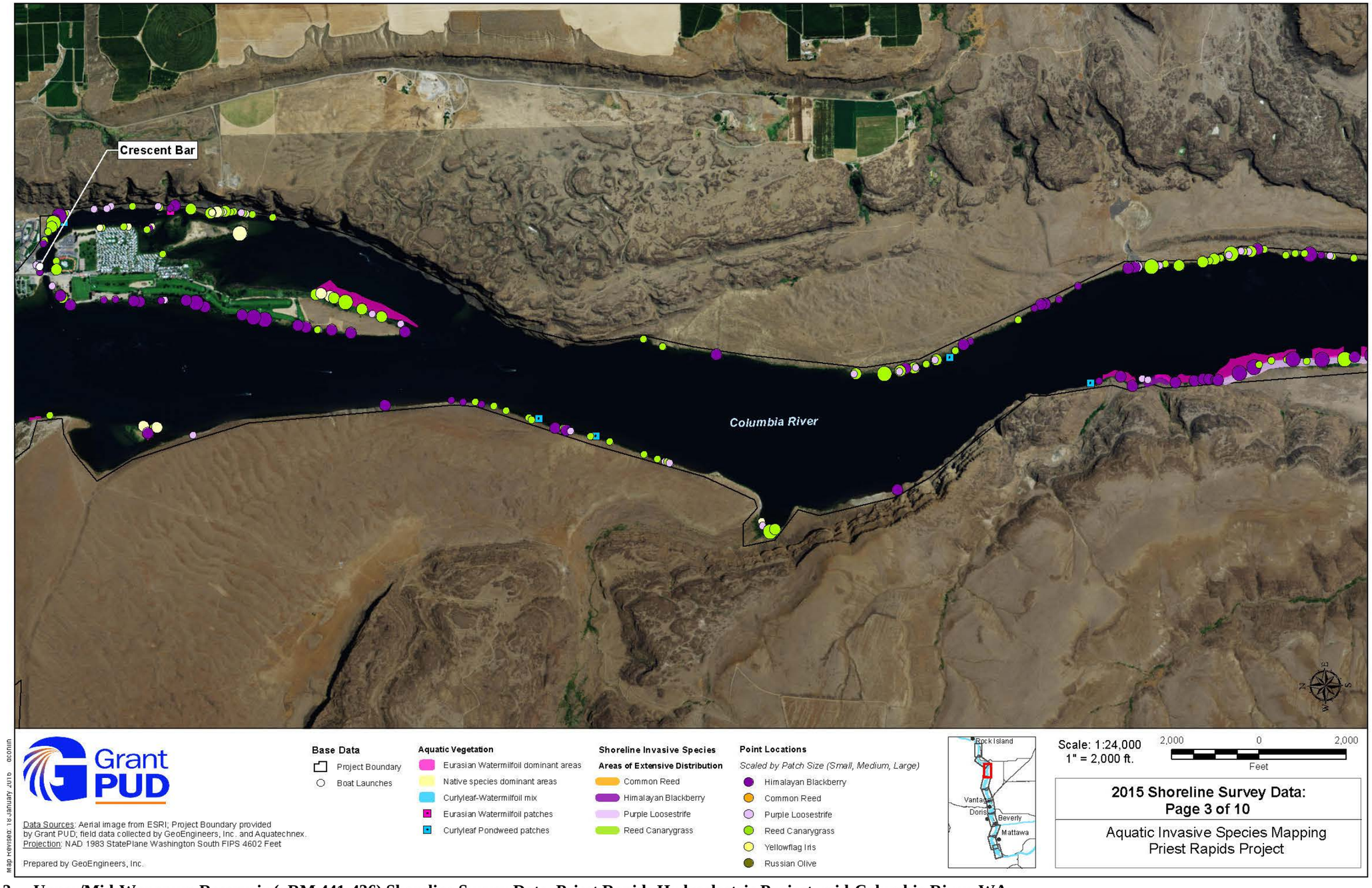


Figure G-3 Upper/Mid-Wanapum Reservoir (~RM 441-436) Shoreline Survey Data, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

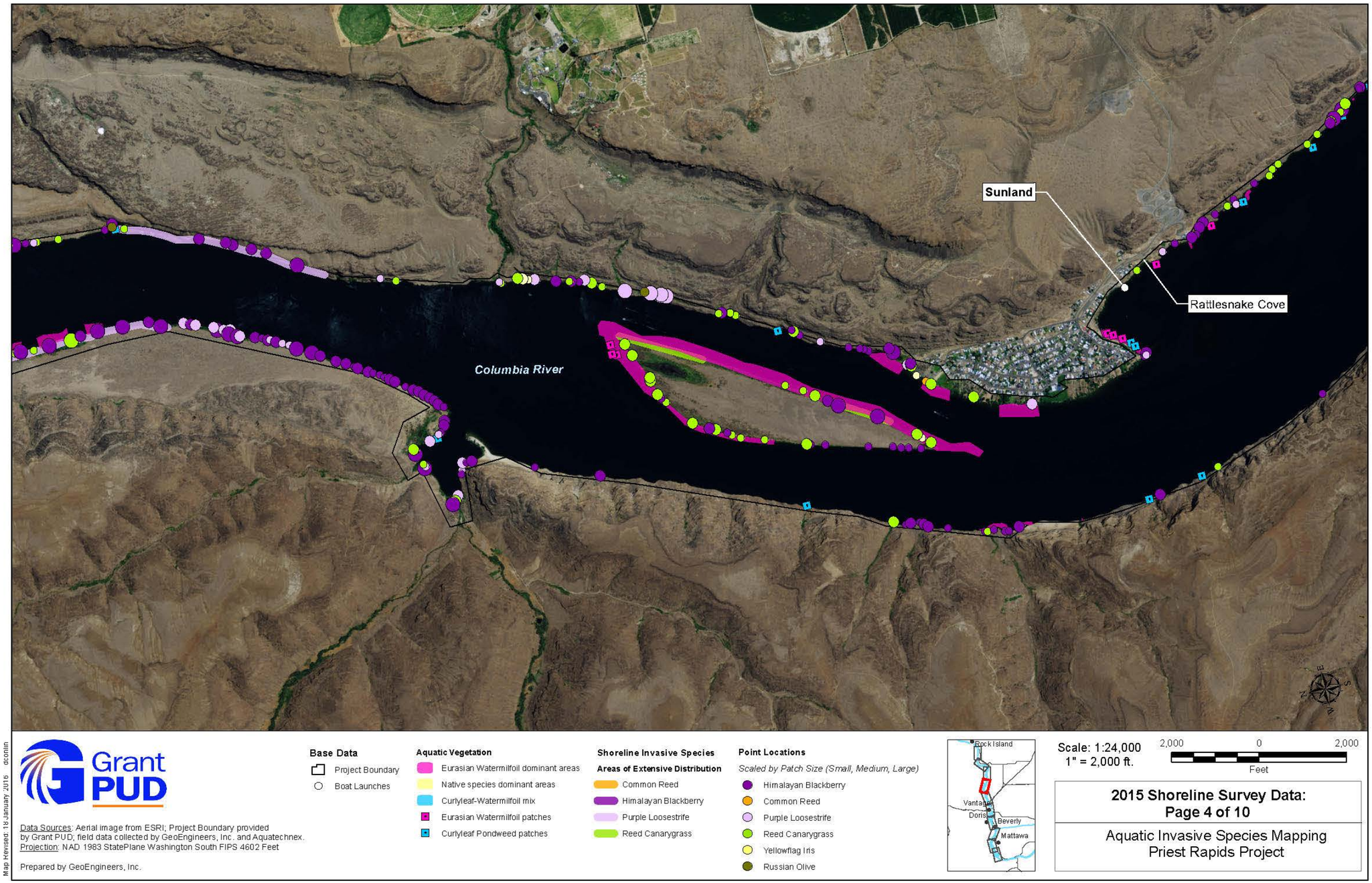


Figure C-4 Mid-Wanapum Reservoir (~RM 436-430) Shoreline Survey Data, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

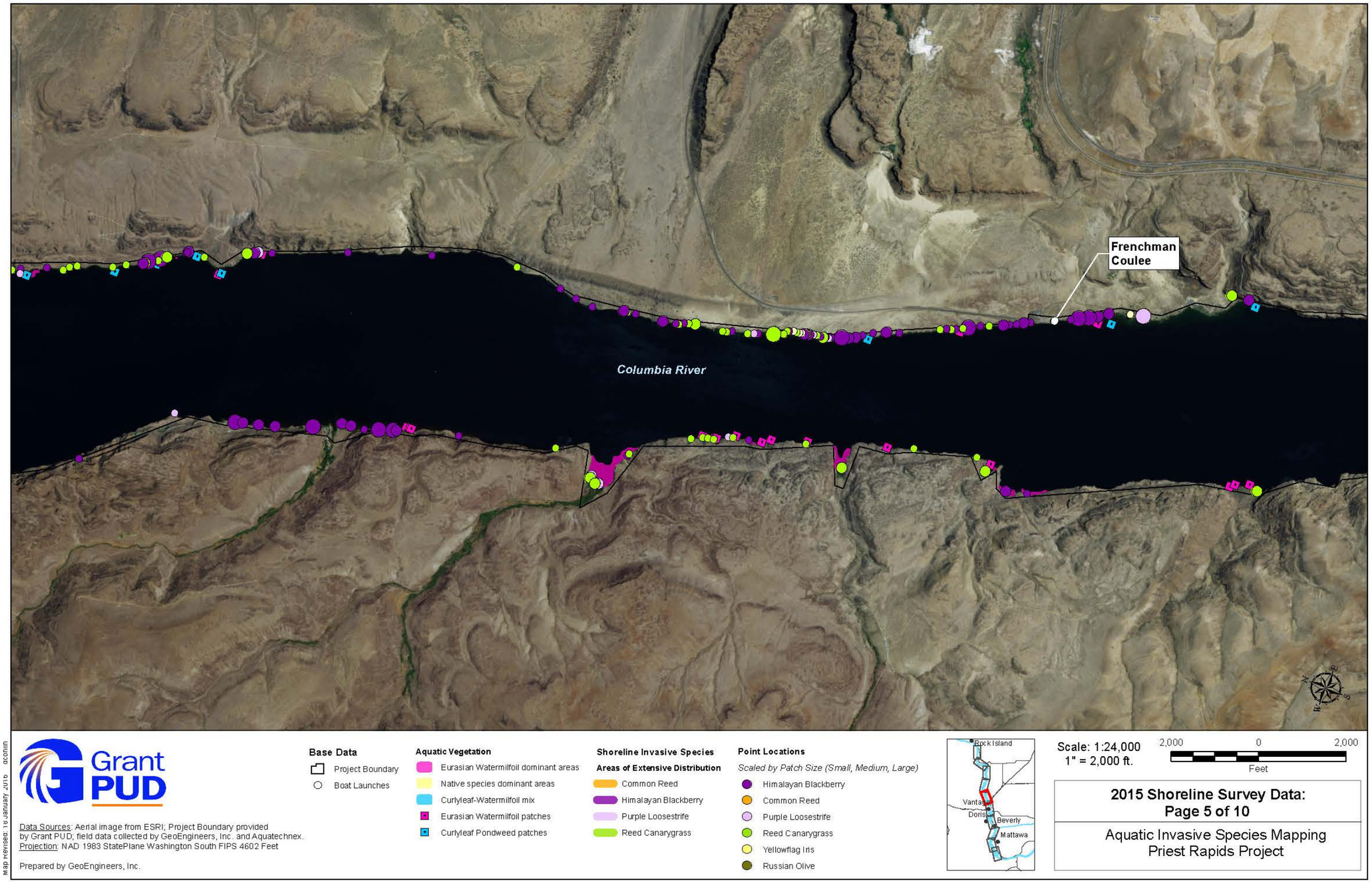


Figure C-5 Mid-Wanapum Reservoir (~RM 430-424) Shoreline Survey Data, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

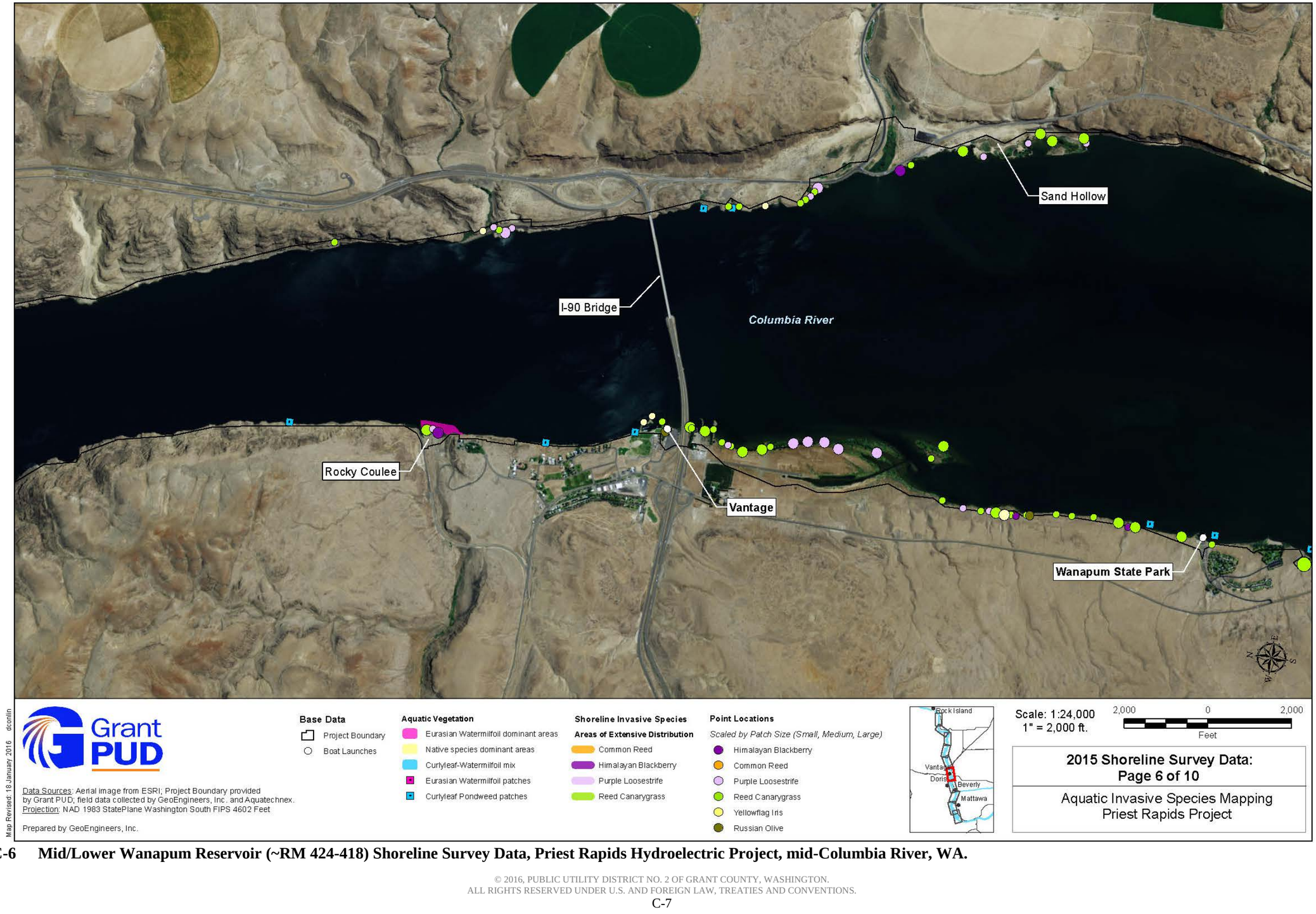


Figure C-6 Mid/Lower Wanapum Reservoir (~RM 424-418) Shoreline Survey Data, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

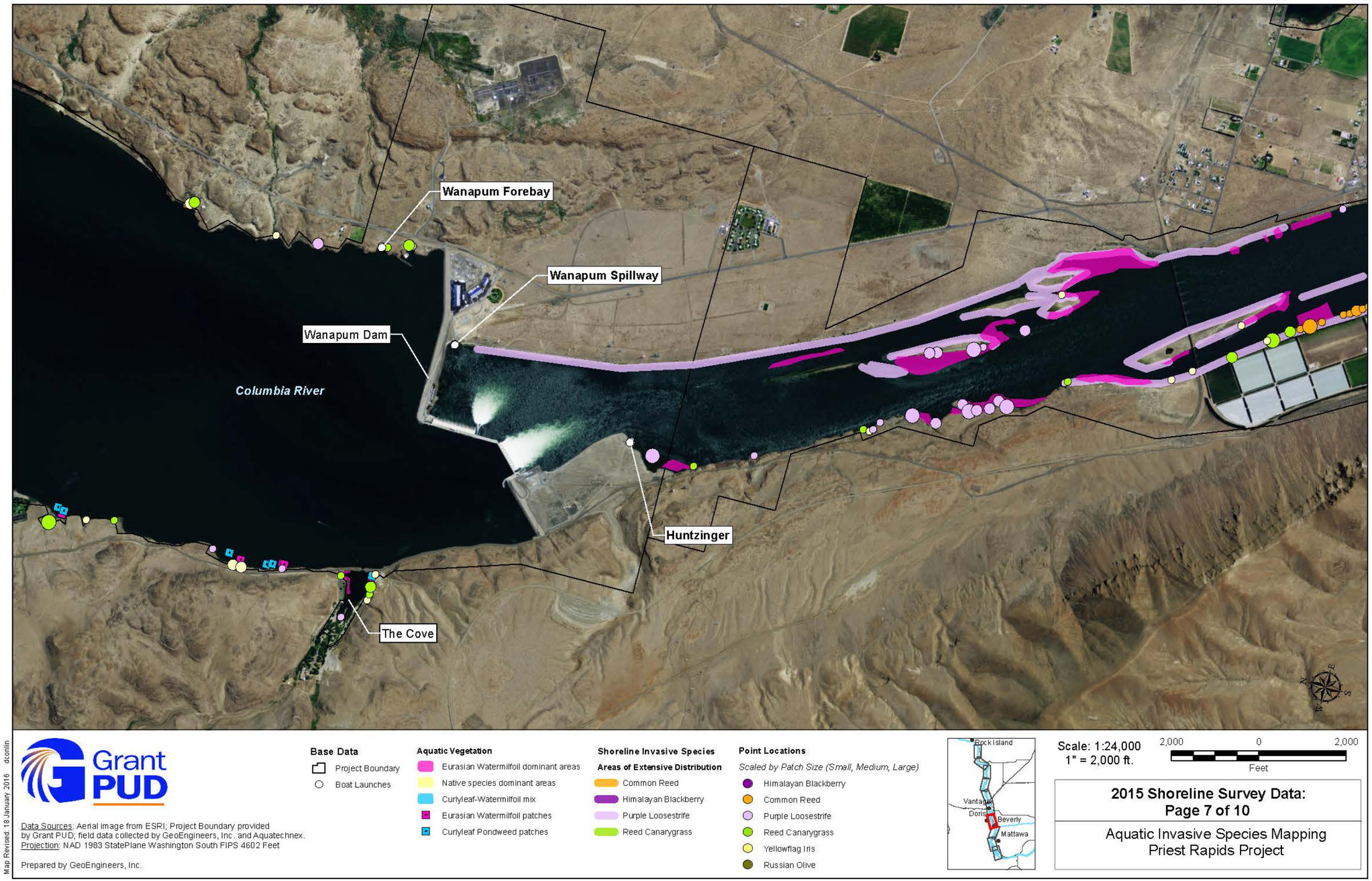


Figure C-7 Lower Wanapum and Upper Priest Rapids Reservoirs (~RM 418-412) Shoreline Survey Data, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

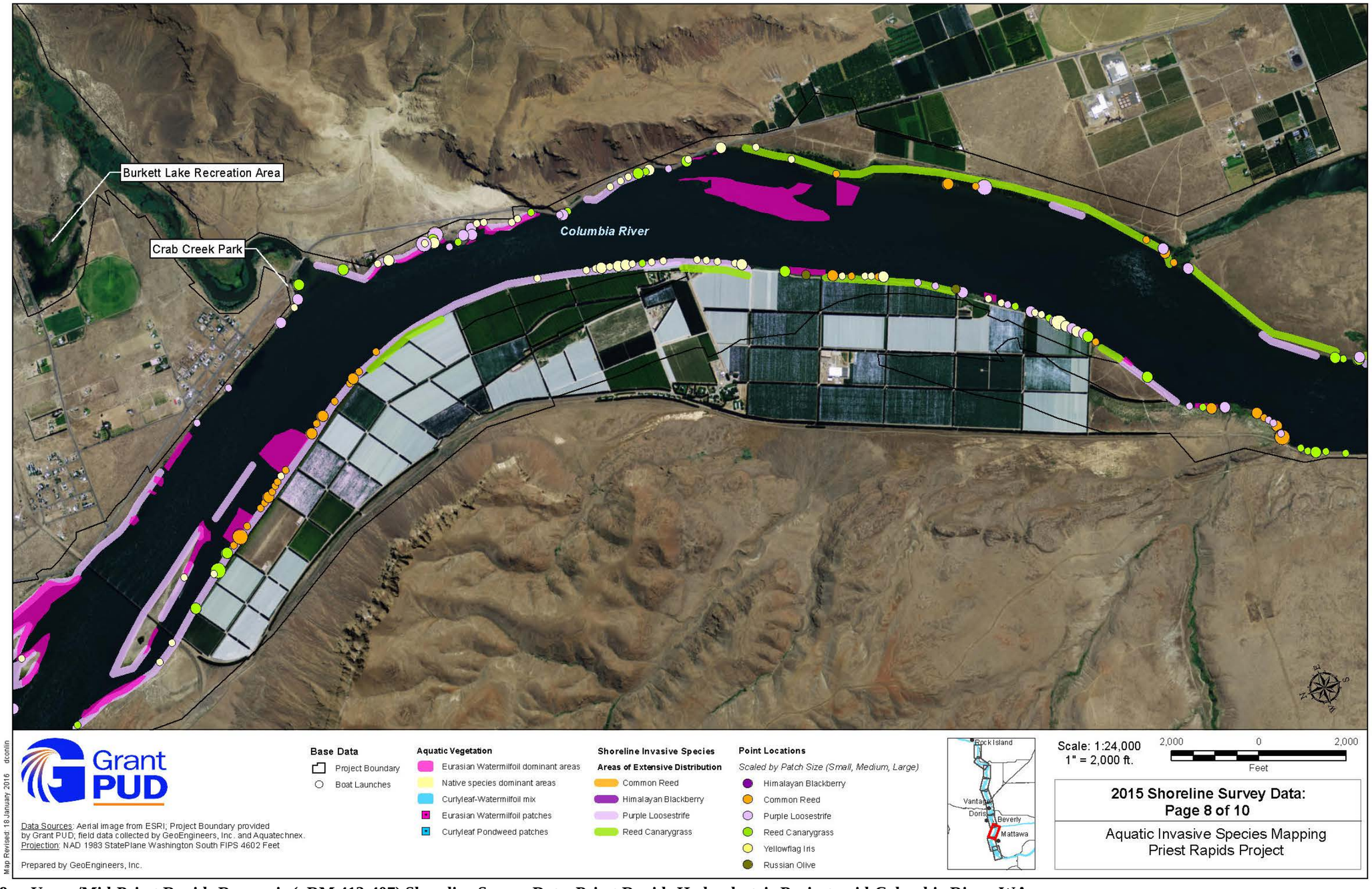


Figure C-8 Upper/Mid-Priest Rapids Reservoir (~RM 412-407) Shoreline Survey Data, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

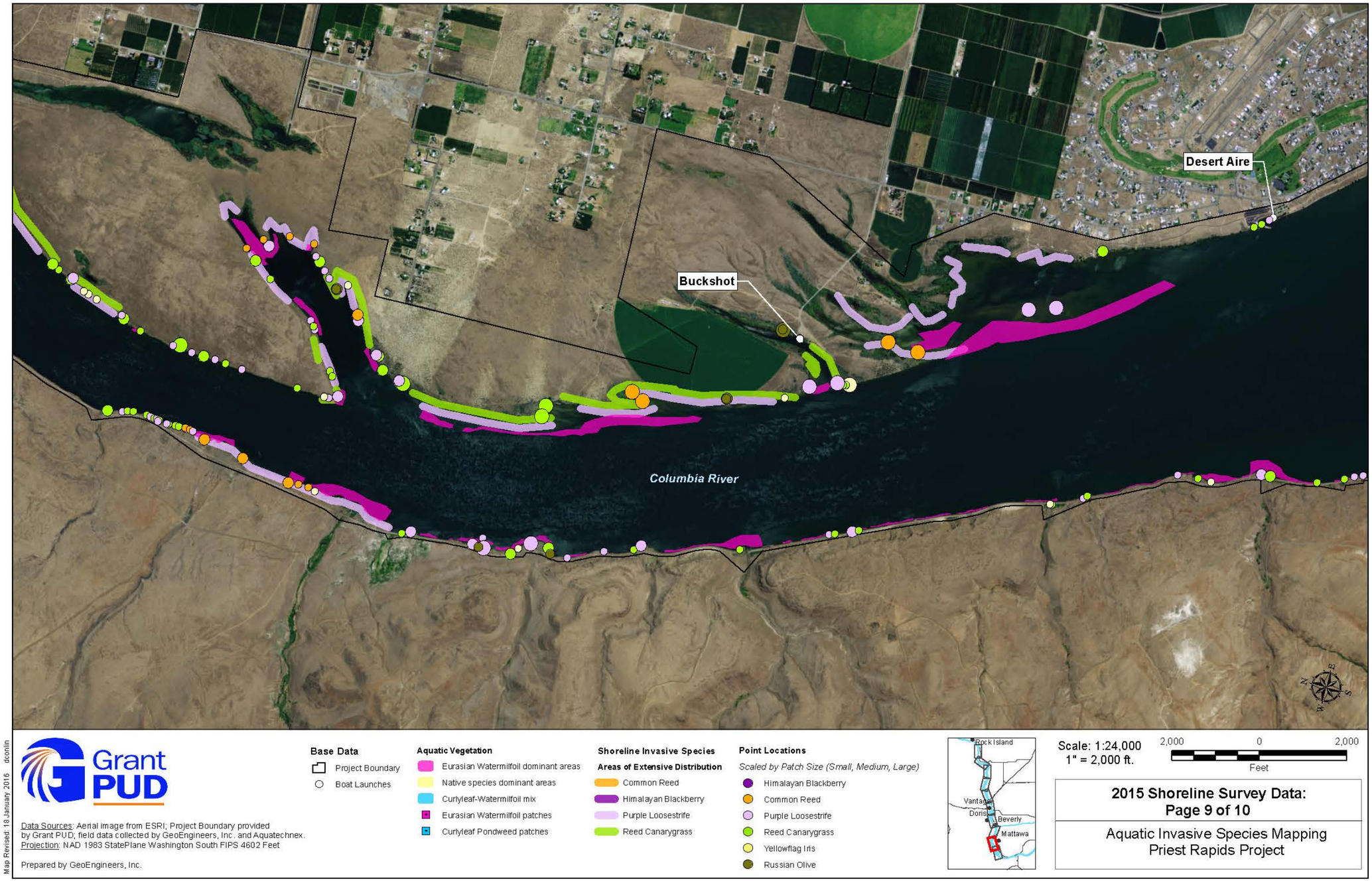


Figure C-9 Mid/Lower Priest Rapids Reservoir (~RM 407-400) Shoreline Survey Data, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

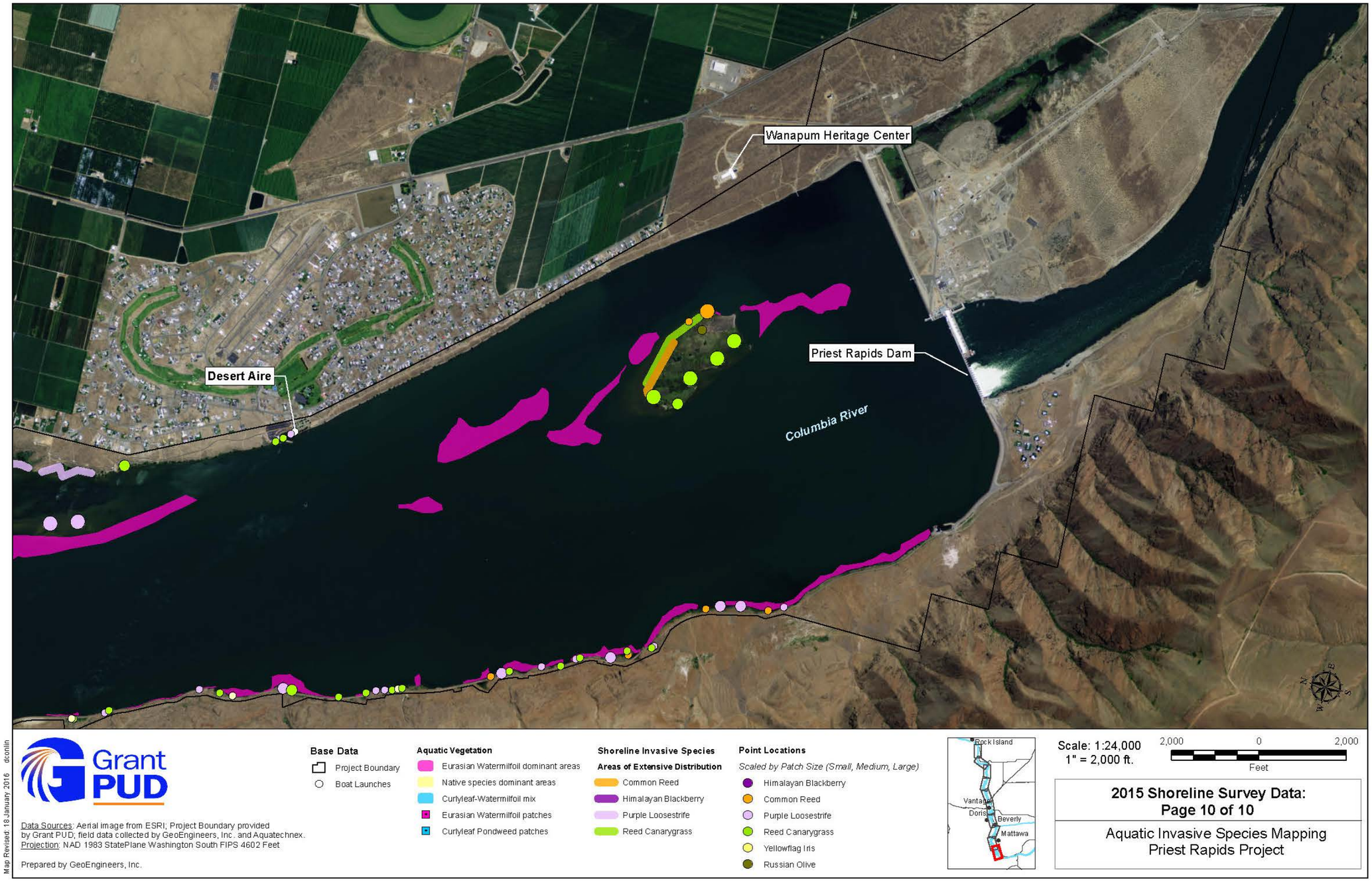


Figure C-10 Lower Priest Rapids Reservoir (~RM 400-397) Shoreline Survey Data, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

Appendix D
Boat Launch Transect Maps for 2015

Transect Data:
Occurence of Aquatic Vegetation Species

NS*	EM*	CP*
NS*, CP	EM*, CP	CP*, EM
NS*, EM	EM*, NS	CP*, NS
NS*, CP, EM	EM*, NS, CP	CP*, EM, NS
		No Vegetation

NS = native species

EM = Eurasian watermilfoil

CP = curlyleaf pondweed

* indicates dominant species

200 0 200
Feet

Grant PUD

Data Sources: Aerial image from ESRI; field data collected by GeoEngineers, Inc. and Aquatechnex.
Projection: NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet

Prepared by GeoEngineers, Inc. GeoEngineers

Map Revised: 21 January 2016 dconlin

2015 Boat Launch Transects:
Crescent Bar

Aquatic Invasive Species Mapping
Priest Rapids Project

Figure D-1 Crescent Bar Boat Launch Transects, Wanapum Reservoir, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

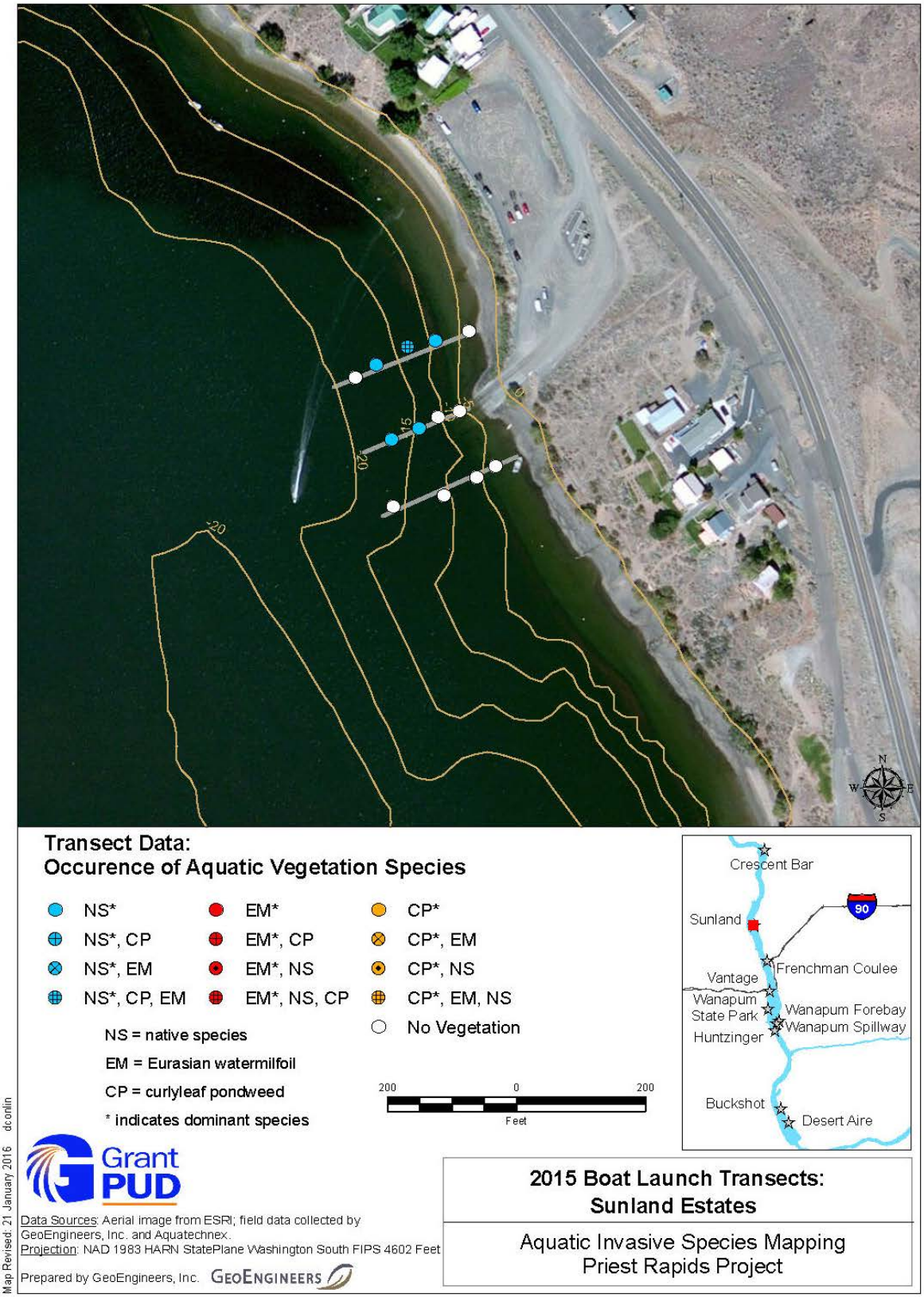


Figure D-2 Sunland Estates Boat Launch Transects, Wanapum Reservoir, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

Transect Data:
Occurence of Aquatic Vegetation Species

NS*	EM*	CP*
NS*, CP	EM*, CP	CP*, EM
NS*, EM	EM*, NS	CP*, NS
NS*, CP, EM	EM*, NS, CP	CP*, EM, NS
		No Vegetation

NS = native species
EM = Eurasian watermilfoil
CP = curlyleaf pondweed
* indicates dominant species

200 0 200
Feet

Grant PUD

Data Sources: Aerial image from ESRI; field data collected by GeoEngineers, Inc. and Aquatechnex.
Projection: NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet

Prepared by GeoEngineers, Inc. GeoEngineers

Map Revised: 21 January 2016 dconlin

2015 Boat Launch Transects:
Frenchman Coulee

Aquatic Invasive Species Mapping
Priest Rapids Project

Figure D-3 Frenchman Coulee Boat Launch Transects, Wanapum Reservoir, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

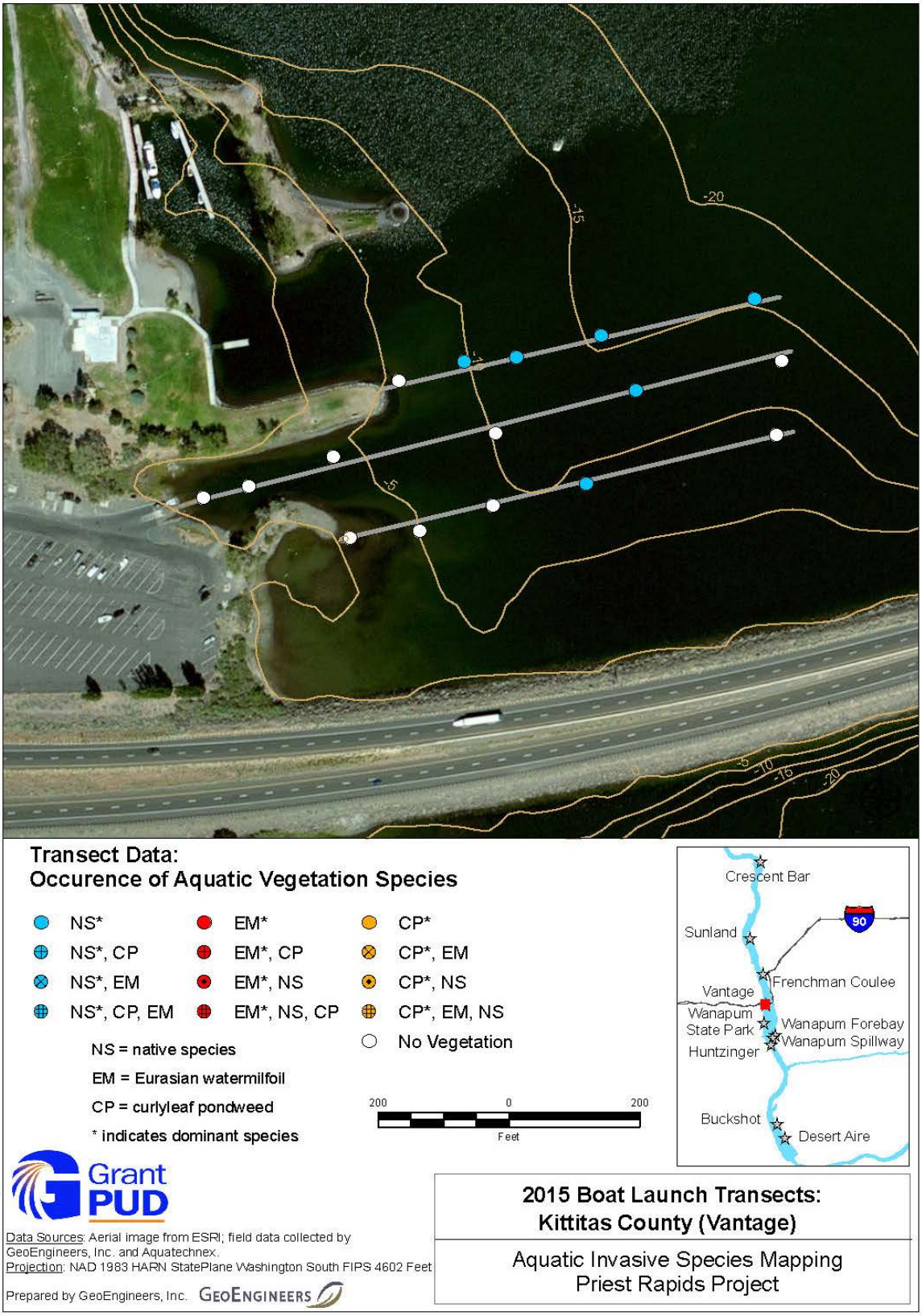


Figure D-4 Kittitas County (Vantage) Boat Launch Transects, Wanapum Reservoir, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

Figure D-5 Wanapum State Park Boat Launch Transects, Wanapum Reservoir, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

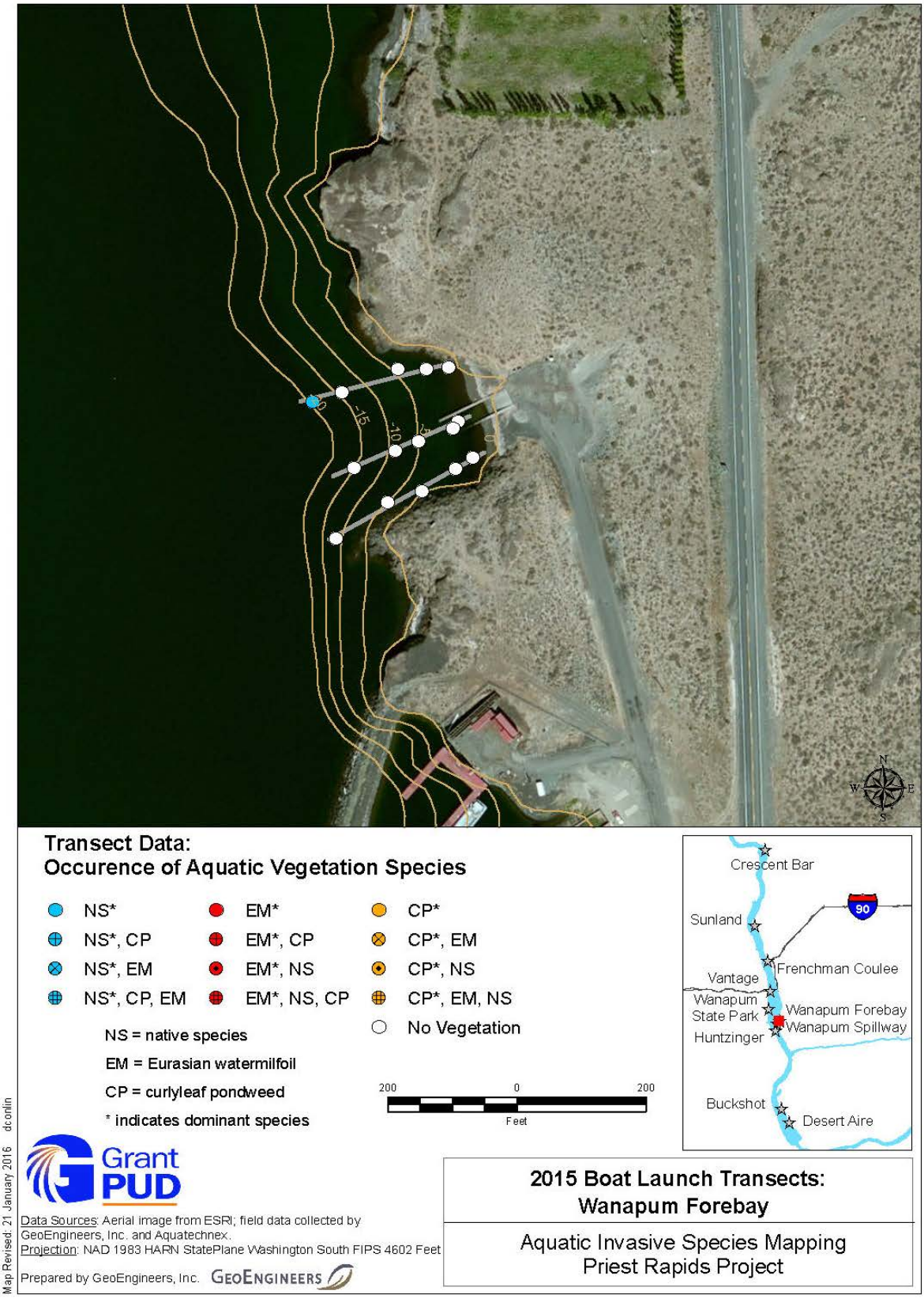


Figure D-6 Upper Wanapum Boat Launch Transects, Wanapum Reservoir, Priest Rapids Project, mid-Columbia River, WA.

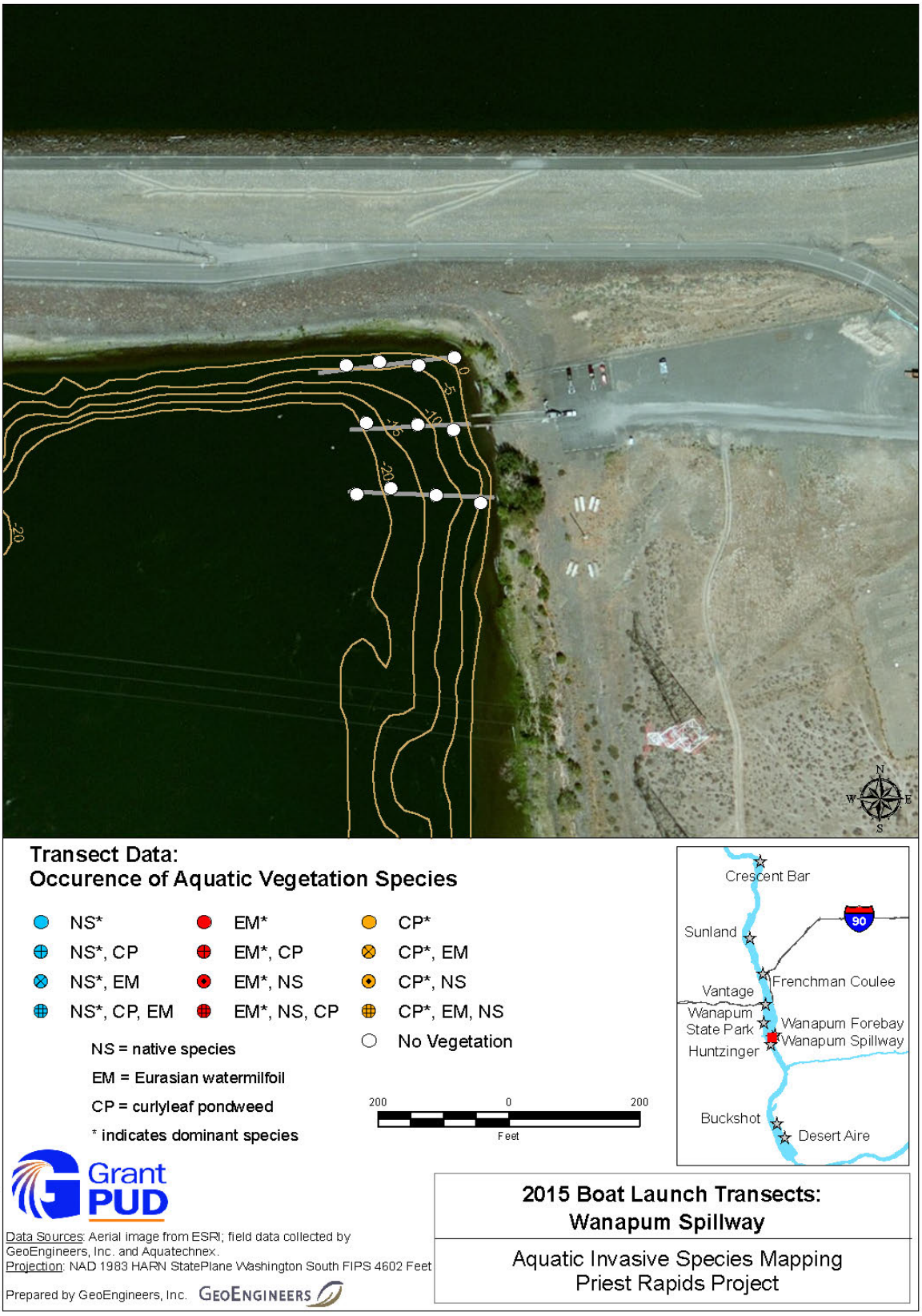


Figure D-7 Lower Wanapum Boat Launch Transects, Priest Rapids Reservoir, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

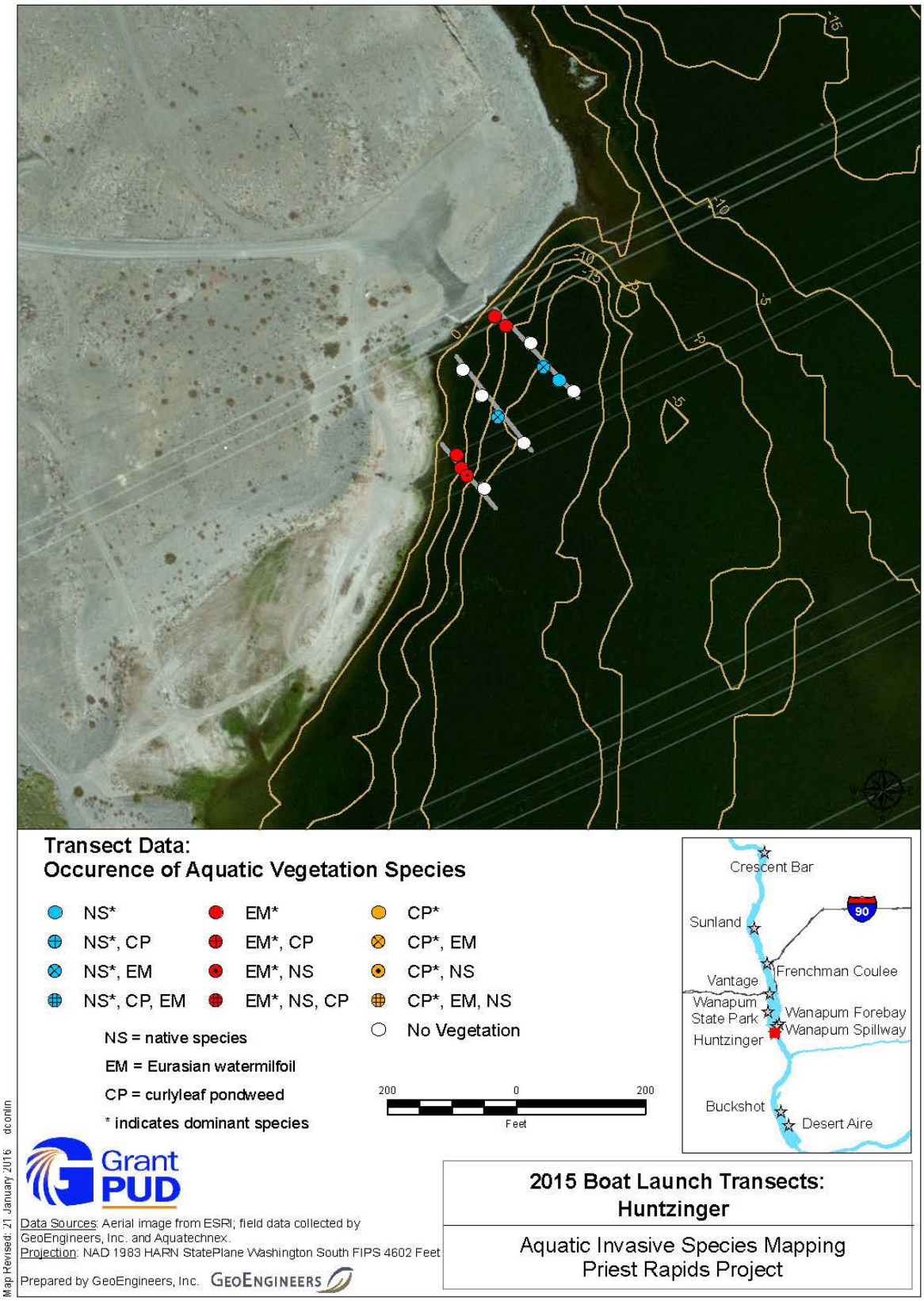


Figure D-8 Huntzinger Boat Launch Transects, Priest Rapids Reservoir, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

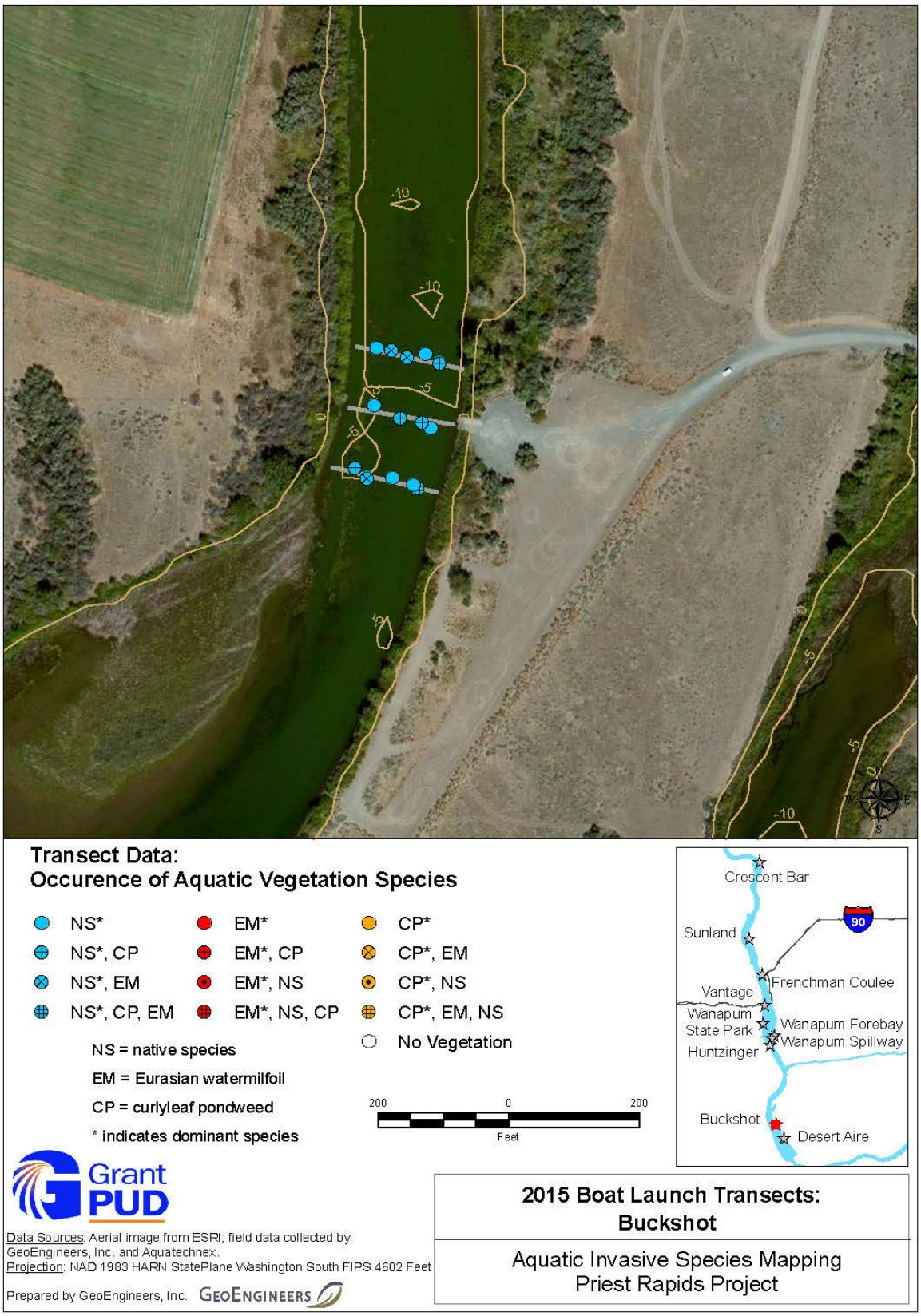


Figure D-9 Buckshot Boat Launch Transects, Priest Rapids Reservoir, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

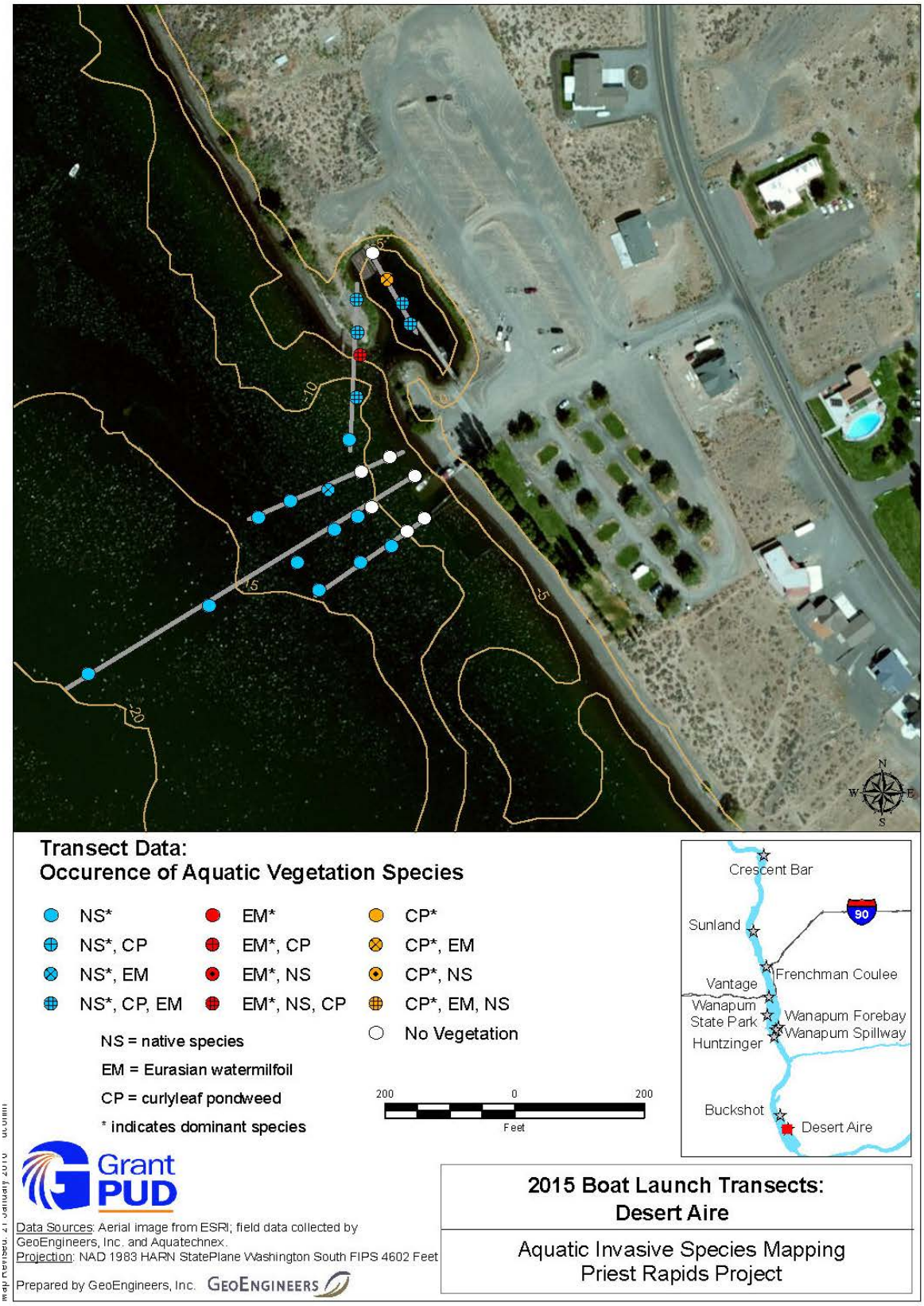


Figure D-10 Desert Aire (PRRA) Boat Launch Transects, Priest Rapids Reservoir, Priest Rapids Hydroelectric Project, mid-Columbia River, WA.

Appendix E
Grant PUD's Aquatic Invasive Species Program: Management Plan Update

1.0 Management Plan Update

Within the initial five-years of the AISP Program (2011-2015), Grant PUD implemented vigorous and extensive survey methods (including aerial and boat based) to map, track, and monitor aquatic and shoreline/riparian AIS within the Project. These intensive surveys and data gathering exercises have provided an abundant baseline of information for the AIS Program. In general, the AIS survey data over the timeframe (2011-2015) had slight variations in size or amount of the aquatic weed beds. The only disparity between the survey years was the dominant species trends within the weed beds (milfoil vs. native pondweeds). The differences in dominance was attributed to the timing of the surveys (ranging from late August to early October), with Eurasian watermilfoil tending to be more dominant the later in the season the survey was conducted. Lastly, and most importantly, there were no additional AIS species noted within the Project that hadn't been previously documented (both Eurasian watermilfoil and curlyleaf pondweed had previously been documented).

Based on this information, the following modifications will be introduced to the AISP Program:

1). Project-wide shoreline/riparian and aquatic AIS surveys will be on a quinquennial (every 5 year) schedule, as opposed to an every other year schedule.
    a. Project boat launches will continue to be monitored annually, including new areas-of-interest (i.e. new boat launches, swim beaches and/or other public recreation areas) to monitor the extent and/or changes in aquatic vegetation in these areas and to potentially help treat/control specific areas. This monitoring will allow for any new AIS species to be noted within high-use recreation areas.
    b. If a new AIS threat is found, Grant PUD will re-consult with the stakeholders on potentially initiating more intensive monitoring.
2). Voluntary boater surveys will be performed every 5 years to match the schedule of the Project-wide AIS surveys.

These proposed AISP changes were documented in the draft 2015 AISP Report that was sent on March 1, 2016 to Washington Department of Ecology (WDOE), Washington Department of Fish and Wildlife (WDFW), and members of the Priest Rapids Fish Form (PRFF) which includes WDOE, WDFW, U.S. Fish & Wildlife Service, Colville Confederated Tribes, Yakama Nation, the Columbia River Inter-Tribal Fish Commission, Bureau of Indian Affairs, the Confederated Tribes of the Umatilla Indian Reservation, and the Wanapum Tribe. In addition, these proposed changes were presented and discussed during the annual AIS stakeholder meeting (which included representatives from WDOE and WDFW) on April 20, 2016. There were no comments or no objections to Grant PUD's proposed changes to the AISP during the draft report consultation period or during the annual AIS stakeholder meeting.

Grant PUD will next complete Project-wide AIS surveys and voluntary boater surveys in implementation year 2020 within the AISP Program.