Assessment of Juvenile Lamprey Presence/Absence, Habitat Use, and Relative Abundance in the Priest Rapids Project Area

SUBMITTED TO:

Public Utility District No. 2 of Grant County

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EXECUTIVE SUMMARY

A 401 Water Quality Certification was issued by the Washington State Department of Ecology (WDOE) on April 3, 2007, and amended March 6, 2008, for the operation of the Priest Rapids Hydroelectric Project (Project). A new license for the Project was issued by the Federal Energy Regulatory Commission (FERC) on April 17, 2008 (FERC 2008). Under FERC License Article 401(a)(12) and the 401 Certification (6.2 (5)(b)), Public Utility District No. 2 of Grant County (Grant PUD) is required, in consultation with the Priest Rapids Fish Forum (PRFF), to develop and submit for approval a Pacific Lamprey Management Plan (PLMP). On February 19, 2009 Grant PUD filed its PLMP with FERC and received on May 1, 2009 an "order modifying and approving" the PLMP.

The goals and objectives of the PLMP are to be achieved through a series of Protection, Mitigation, and Enhancement (PME) measures. This document proposes to implement a monitoring study in support of the following PME measure as identified in the PLMP:

4.4.1- Juvenile Lamprey Presence/Absence, Habitat Use, and Relative Abundance in the Project Area: use existing aerial photographs, bathymetry, shoreline slope, velocity, and substrate characteristics to segregate habitat types into those areas with high, medium, and low potential for use by juvenile lamprey, and assess presence/absence in areas that may be affected by Project operations using electroshocking sampling.

The objective of this study is to:

1) Assess presence/absence, habitat use, and relative abundance of juvenile lamprey in areas that may be affected by Project operations.

Existing Grant PUD bathymetry data were analyzed using GIS for those areas affected by the Project's operation. This area, known as the operational zone, was layered onto existing aerial photographs and further segregated into Habitat types with high (Type 1), medium (Type 2), and low potential (Type 3) for use by juvenile lamprey. Sample sites will be chosen in Type 1 habitat and water less than 1 m will be sampled using a backpack electroshocker starting in June 2012. Catch per unit effort will be recorded during sampling. Captured lamprey will be measured for length and species and will have a small tissue sample removed from the end of the caudal fin. Presence/absence will be determined for each sample location and CPUE at individual sites will be compared in order to determine relative abundance between sample locations. Mean or median CPUE estimates will be applied to GIS based habitat areas to illustrate relative abundance in the Project area.

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1.0 INTRODUCTION

A 401 Water Quality Certification was issued by the Washington State Department of Ecology (WDOE) on April 3, 2007, and amended March 6, 2008, for the operation of the Priest Rapids Hydroelectric Project (Project). A new license for the Project was issued by the Federal Energy Regulatory Commission (FERC) on April 17, 2008 (FERC 2008). Under FERC License Article 401(a)(12) and the 401 Certification (6.2 (5)(b)), Public Utility District No. 2 of Grant County (Grant PUD) is required, in consultation with the Priest Rapids Fish Forum (PRFF), to develop and submit for approval a Pacific Lamprey Management Plan (PLMP). On February 19, 2009 Grant PUD filed its PLMP with FERC and received on May 1, 2009 an "order modifying and approving" the PLMP.

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1.1 Juvenile Lamprey

Pacific Lamprey (*Lampetra tridentata*) numbers have declined since the 1940's as a result of spawning habitat loss, impediments to migration, changing ocean conditions, and decreased water quality (Close et al. 1995, 2002). Much focus over the past 10 years has been placed on studying migrating adults. Modifications have been made to many dam operations and structures to improve lamprey passage. Little work, however, has been devoted to investigating lamprey while in their juvenile stage.

Pacific lamprey eggs hatch after approximately 19 days (Pletcher 1963 as cited in Close et al. 1995, Lê et al. 2004, Luzier and Silver 2005). Once hatched, larvae drift downstream until encountering a silt/sand substrate and low velocity flow conditions (Pletcher 1963 as cited in Close et al. 2002). At this stage the juveniles are known as ammocoetes. They reside and burrow in fine sediment (Close et al. 2002) filter feeding on diatoms, algae, and detritus (Beamish and Levings 1991) for up to seven years (Beamish and Northcote 1989, Hammond 1979 as cited in Close et al. 1995). During this time they may move down stream during high water flows (Lê et al. 2004). Pacific lamprey then enter a transformation phase characterized by morphological and physiological changes that begin in the latter period of substrate residence and continues into their downstream migration to the ocean. After a parasitic life in the ocean, the Pacific lamprey returns to freshwater to spawn. Both sexes die after spawning.

River (*L. ayresii*) and Western Brook (*L. richardsonii*) lampreys are also present in Columbia River Basin (Wydoski and Whitney 1979). Less research has been conducted on these two species but their life cycles have been observed to be somewhat similar to that of Pacific lamprey. Western Brook lamprey do not migrate to the ocean for the parasitic portion of their life and prefer smaller substrate that Pacific lamprey for spawning. Adults of both species are much smaller than that of Pacific lamprey (Scott and Crossman 1973 as cited in Luzier 2005). River and Western Brook are found at much smaller numbers than Pacific lamprey and Western

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Brook lamprey distribution tends to be associated with coastal streams (Wydoski and Whitney 1979). Juveniles of all three species are difficult to distinguish.

The Priest Rapids Project shoreline is affected by the operation of Priest Rapids and Wanapum dams and is subject to fluctuating water levels. This area, known as the operational zone, contains a variety of habitat types including soft sediment, sand/gravel, or hard rock with the latter two being the most frequent. Depending on shoreline slope, near-shore juvenile lamprey habitat below the ordinary high water mark may be dewatered during low water operations. This reservoir fluctuation has the potential to impact ammocoetes inhabiting the operational zone.

The objective of this study is to:

1) Assess presence/absence, habitat use, and relative abundance of juvenile lamprey in areas that may be affected by Project operations.

1.2 Study Area

Wanapum and Priest Rapids dams, known collectively as the Priest Rapids Project, are operated by Grant PUD and span some 58 miles of the Columbia River. The Wanapum Reservoir is 38 miles long and has a surface area of approximately 14,680 acres. A total of ten tributaries; Johnson, Skookumchuck, Whisky Dick, Sand Hollow, Quilomene, Trinidad, Tarpiscan, Colockum, Douglas, and Brushy creeks enter into the reservoir. The Priest Rapids Reservoir is 18 miles long and has a surface area of approximately 7,725 acres. Two tributaries; Crab, and Hanson creeks, enter into the reservoir.

2.0 JUVENILE LAMPREY DISTRIBUTION AND ABUNDANCE SAMPLING METHODS

2.1 Habitat Mapping

2.1.1 ArcGIS and existing bathymetry data were used to map the shoreline elevations affected by operation of Priest Rapids Project.

2.1.2 This elevations, known as the operational zone, was further segregated into Habitat areas with high (Type 1), medium (Type 2), and low potential (Type 3) for use by juvenile lamprey based on local knowledge of the substrate type in the area.

2.1.3 A final, Geographic Information System (GIS) map was developed outlining the operational zone and habitat types (***Error! Reference source not found.***).

2.1.4 Prior to selecting areas to sample, Type 1 habitats will be visited by boat over the course of a day to confirm the desktop habitat assessment. Sampling methods will also be tested.

2.1.5 Type 1 habitats not consistent with the desktop classification will be redefined as Type 2 or 3 and changed in the GIS data.

2.1.6 Inaccessible sample areas will be noted and not chosen during site selection.

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Table 1. Habitat type description. [1]Close and Aronsuu 2003, [2]Hansen et al 2003.

Habitat Type	Description
Type 1	[1]Mixture of soft sediment particles including silt, clay, fine organic matter, and some sand [2]Preferred larval habitat that usually consists of sand, fine organic matter, and cover (detritus, aquatic vegetation), which is usually formed in areas of deposition
Type 2	[1]Similar to Type I habitat but with a larger component of sand [2]Acceptable, but not preferred, larval habitat that usually consists of shifting sand, gravel, or rubble, and very little or no fine organic matter, but is soft enough for larvae to burrow into
Type 3	[1]Bedrock, hard clay, cobble, or coarse gravel substrates [2]Cannot be penetrated by larvae, so is unacceptable habitat, and usually consists of bedrock or hardpan clay, with rubble and coarse gravel

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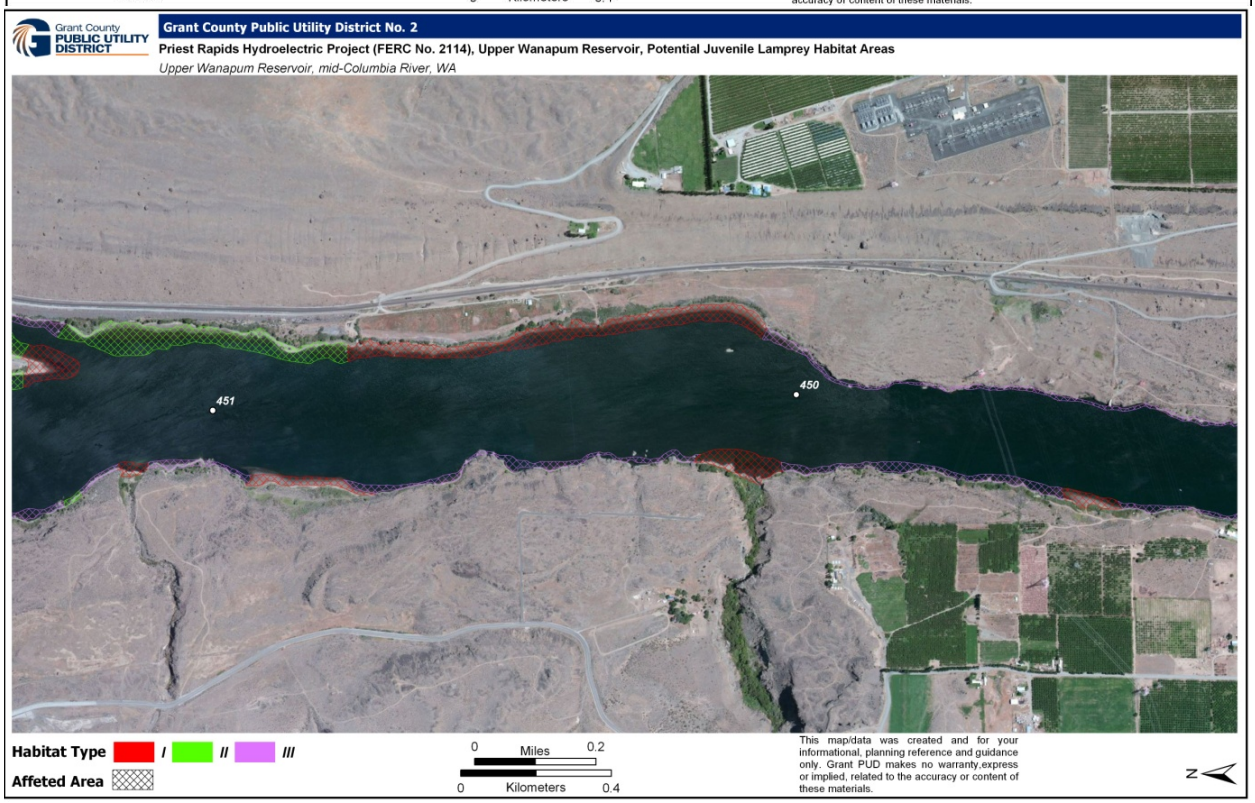

Figure 1. Examples of Habitat types in the Priest rapids project.

2.2 Sampling schedule

2.2.1 Sampling will occur over two seasons with two periods, early June and again late October/ early November, in each season. Exact starting dates will depend on conditions. June was chosen because it occurs after high spring flows and before increased summer macrophyte abundance. October was chosen because the water levels are much lower and macrophyte senescence has occurred.

2.2.2 Each period of sampling will run on the same schedule of 10, 10 hour days. As many sites as possible will be sampled each day within the 10 days.

2.2.3 Sampling will run no longer than 10 days each period regardless of total catch and areas sampled.

2.3 Sample Site Selection

2.3.1 At the beginning of the first period (June 2012), all habitat areas will be grouped according to habitat type and reservoir (PR Type 1, PR Type 2, PR Type 3, WA Type 1, WA Type 2, and WA Type 3). Habit areas in each group will be assigned a unique number ID and a random number generator will be used to assign an order of sampling. Not all areas in each reservoir and habitat group will be sampled in the 10 days but having an order predetermined will provide a non-biased sequence of sites. The overall random sampling design will provide an assessment of distribution throughout habitats types in the Priest Rapids Project

2.3.2 More areas will be sampled in Type 1 habitat than 2 and 3 as this is considered preferred habitat for juvenile lamprey and therefore has the highest probability of capture. A target of 60% of areas sampled will be Type 1 habitat while Type 2 and 3 will each be targeted in 20% of the samples.

2.3.3 Most habitat areas will be too large to sample in their entirety. Specific locations to sample will be chosen in each area. GIS will be used to place points (referred to as locations) five meters apart along the shore line of each habitat area (Figure 2). Each location will be assigned a number ID and a random number generator will we used to select one location within each area. These locations will be the starting point for sampling efforts and are not confined by a sampling boundary. Locations will vary in slope, substrate type, and catch and defining a required coverage could result in uneven effort between sites. Instead, a specific duration of electroshocking will be performed at each location and coverage will vary.

2.3.4 Elevations sampled will not be planned by the sampling crew as reservoir elevation varies throughout the day. As a result, sampling may not occur directly at and around the randomly chosen sample location coordinates. The sampling crew will sample the water closest to the original location.

2.3.5 An effort will be made to sample randomly chosen locations with a large coverage of high water inundation during high waters in June. Conversely, an effort will be made to sample locations with a large

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coverage of low water inundation during low water in October/November. Targeting high and low water habitat will result in a full assessment of the operational zone.

2.3.6 The predefined order of habitat areas will remain for the following three seasons. The order will change when the need exists to sample high and low water inundation locations at opportune times.

2.3.7 A small number of locations which produced high catches in previous season may be sampled again in subsequent seasons and immediately following the first pass to determine catch efficiency. These index sites will increase the likelihood of capture and allow for a thorough assessment of habitat use.

2.3.8 If all habitat areas of a Type are sampled once, the order will repeat and second locations within habit areas will be selected for sampling.

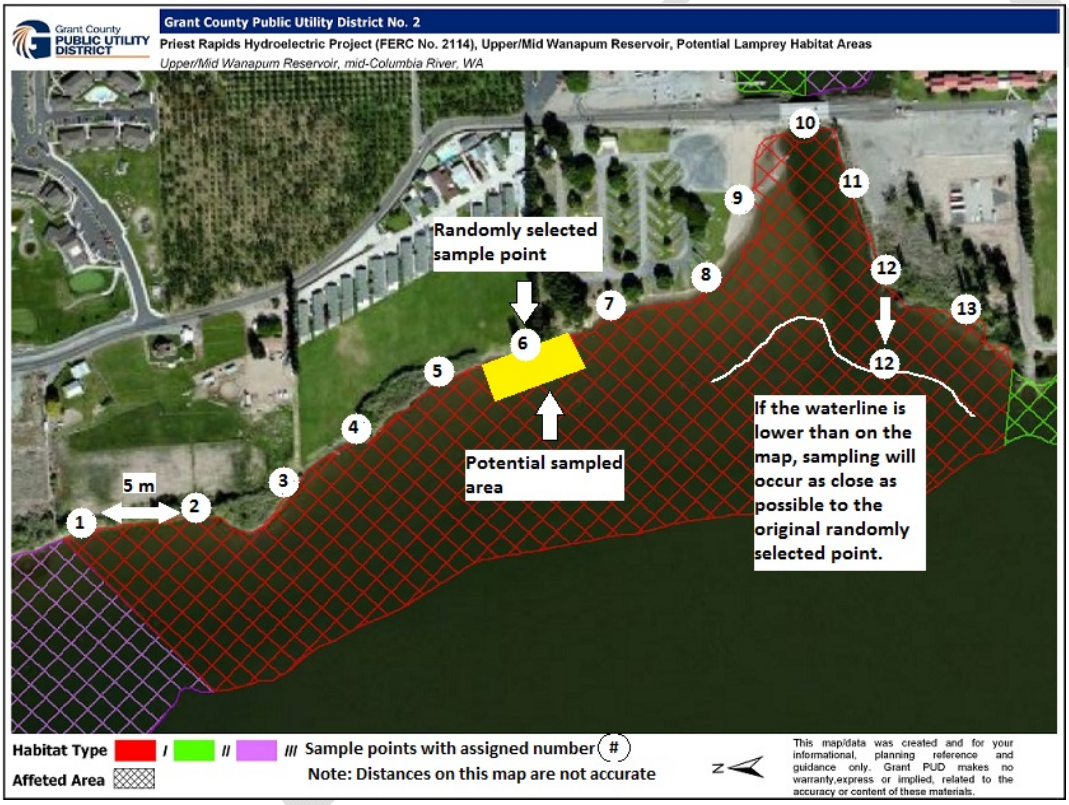

Figure 2. Example of random sampling with in a Type 1 habitat.

2.4 Data collection

2.4.1 Sampling will be conducted by two, two person survey crews. Each crew will use a backpack electroshocker in separate locations and will be ferried from site to site by a designated boat driver. A second boat may be added if one boat proves inefficient (i.e. one crew spends too much time waiting for the boat while it is transferring the other crew).

2.4.2 Sampling will be skipped at locations with non-favorable environmental conditions (i.e. wind, waves). The next location in the sampling order will be sampled and the skipped location will be revisited when conditions improve.

2.4.3 Sampling will occur for 20 minutes (based on electroshocker's operational time) with no sediment electroshocked multiple times. Catch-per-unit-effort (CPUE) will be recorded during sampling to determine relative abundance. Fish per minute will be the constant unit and, therefore, recording area covered is not required nor does it need to be constant between sites (John Crandall, Wild Fish Conservancy, Pers. Comm.).

2.4.4 Other aspects of sampling will be standardized between sites: ABP-2 Backpack Electrofisher settings will be held at 125 volts (DC) with 3 pulses/second, a 25% duty cycle, and a 3:1 pulse train. Passes will occur at a slow walking pace.

2.4.5 Sampling at locations will consist of electroshocking in depths from 0-1 m. Shocking at depth greater than 1 m increase the risk of submerging the backpack components which could result in damaging the equipment and/or electrical shock. Non-submerged and greater than 1 water depths will not be sampled.

2.4.6 Locations producing zero ammocoetes may be shocked for a second pass to confirm absence. Locations producing high number of ammocoetes may be shocked for a second pass to collect more ammocoete data, determine sampling efficiency, and further investigate habitat use. In both scenarios, catch data will be separated by pass number so that first pass data can be compared between locations. Including subsequent passes would be an unfair assessment of relative abundance.

2.4.7 Water elevation, GPS coordinates taken at each corner of the sampled area, date, and beginning and end time of sampling will be recorded for each electroshocking session.

2.4.8 The GPS data can later be imported into ArcGIS to create sampled area polygons. The mean percent of time in a 24 hour period that each sampled area is not submerged can be calculated based on historical reservoir operational data.

2.4.9 Captured lamprey will be placed in a 2 gallon, aerated bucket and anesthetized with MS-222. Ammocoetes will be measured for length and a sterile fingernail clipper will be used to remove a small tissue sample from the end of the caudal fin (Figure 3). All clips taken at a sampling location will be placed in a vial of 100% ethanol (Nelson and Nelle 2007). Lamprey will then be held in a bucket until they have recovered (swimming vigorously), and then released.

2.4.10 Ammocoetes will be identified and enumerated as Pacific, River, or Western Brook species using a U.S. Fish & Wildlife Service key (Figure 4) and characteristics describes in Richards et al. 1982.

2.4.11 Pictures and notes describing features of potential significance, if any, will be taken for each sample location.

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Figure 3. Clipped caudal fin of an ammocoete (Nelson and Nelle 2007).

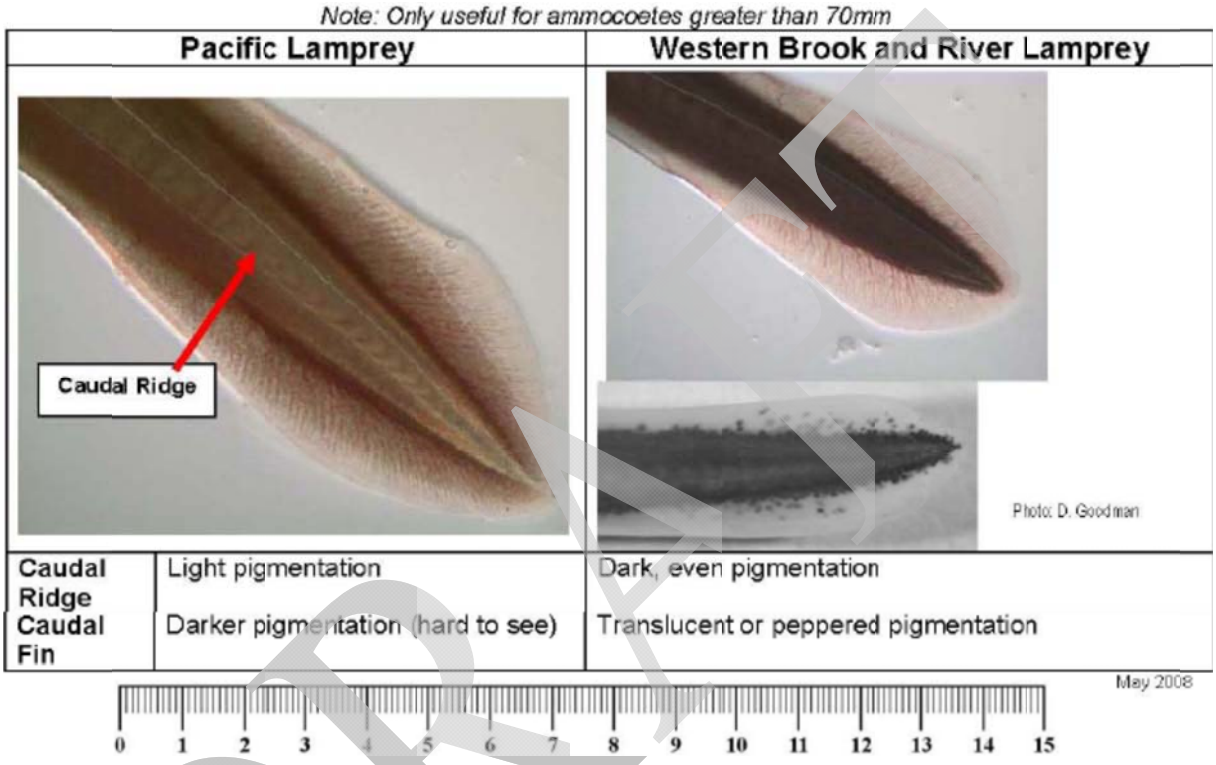

Figure 4. Key to identify ammocoete Pacific, River, and, Western Brook Lamprey ammocoettes (USF&W 2008).

3.0 ANALYSIS

3.1 Presence/absence will be determined for each sample location.

3.2 CPUE at individual sample locations and/or reservoirs will be compared in order to determine relative abundance between sample locations.

3.3 CPUE per habitat types (1, 2, & 3) and/or reservoirs will be graphed. With sufficient data, Analysis of Variance (ANOVA) between mean CPUEs will be conducted to determine if significant habitat preferences exist.

3.4 ANOVAs between mean lamprey lengths in each habitat type (1, 2, & 3) and/or reservoirs will be conducted to determine if habitat quality produced significantly different sized ammocoetes.

3.5 Mean or median CPUE estimates will be applied to GIS based habitat areas to illustrate relative abundance in the Project area.

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3.6 With sufficient data, CPUEs will be correlated with percent of time a sample location is dewatered. This analysis will describe the relationship between presence and abundance of Pacific lamprey in Type 1, 2, and 3 habitats to a corresponding operational elevation.

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