

GALES CREEK LARGE WOODY DEBRIS INVENTORY REPORT



Submitted to

Tualatin River Watershed Council

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TABLE OF CONTENTS

TABLE OF CONTENTS.....	2
INTRODUCTION	3
WATERSHED OVERVIEW.....	4
METHODS	5
RESULTS	6
GL02	7
GL05	7
GL06	8
GL08	8
GL09	9
DISCUSSION.....	9
REFERENCES	13
FIGURES	16
TABLES	29

INTRODUCTION

In 1998, the Tualatin River Watershed Council (TRWC) produced a Watershed Assessment for Gales Creek (Breuner 1998) that provided detailed information on the past and present condition of the watershed and pointed the TRWC in the direction of sustainable watershed management. This document cited several fisheries-related concerns, including fish habitat, fish migration barriers, riparian condition, channel modifications, water quality and water use issues and sedimentation (Breuner 1998). More specifically, the document identified needs for salmonid spawning, rearing and overwintering habitat, and a general call for increasing habitat diversity within the creek. The document cited the need for an assessment of existing large woody debris (LWD) to better understand current patterns in stream structure and habitat complexity within the Gales Creek watershed.

Towards these ends, in 2003, the TRWC completed the Lower Gales Creek Habitat Enhancement Plan with the purpose of identifying priority areas and sites for improving anadromous fish habitat over a five-year period. Through a review of the physical, biological and land use characteristics of Gales Creek, a four-mile stretch from Prickett Creek to Clear Creek was identified as a priority area for enhancement (TRWC 2003). The Enhancement Plan was developed for this area of Gales Creek in response to a U.S. Bureau of Reclamation (BOR) request to identify factors limiting winter steelhead (*Oncorhynchus mykiss*) and other salmonid production and to plan habitat enhancement activities with these species in mind and in response to the fisheries needs identified in the 1998 Gales Creek Watershed Assessment.

Nine habitat enhancement projects identified in the Enhancement Plan require further information in order to proceed with design, permitting and project implementation steps. Five of these projects require information on existing numbers of LWD for project planning. ABR, Inc. conducted LWD inventories in Gales Creek on September 28 and October 4, 2005. The objective of the inventories was to evaluate the current levels of large wood in Lower Gales Creek. Surveys identified existing LWD, log jams and areas prone to recruitment of LWD from the riparian zone. This report documents the results of the LWD surveys on Gales Creek.

WATERSHED OVERVIEW

The Gales Creek watershed is a 49,481-acre sub-basin of the Tualatin River watershed and is located primarily within northwestern Washington County, Oregon. Elevations within the Gales Creek watershed range from 159 ft at the confluence with the Tualatin River to a maximum of 3,154 ft (TRWC 2003). The mainstem of Gales Creek is 23.5 miles long, and flows in a southeasterly direction through primarily rural areas before entering the Tualatin River south of the City of Forest Grove.

Vegetation and land use within the Gales Creek watershed varies from intensely managed Douglas fir forests in the uplands, to pasturelands, vineyards, tree farms and orchards in the foothills. Lowland flood plains are primarily dedicated as agricultural lands. Almost two-thirds of the watershed is privately owned as industrial forestland (26%) or agricultural and rural residential lands (38%). The Oregon Department of Forestry (ODF) owns and manages 28% of the watershed; the City of Forest Grove owns the remaining eight percent of public lands (TRWC 2003). A variety of invasive plant species such as Japanese knotweed, Himalayan blackberry, reed canary grass, English ivy and Scots broom are present in the lower reaches of the watershed.

Salmonids such as cutthroat trout (*Oncorhynchus clarki*), steelhead trout (*O. mykiss*) and coho salmon (*O. kisutch*) exist within the Gales Creek watershed. Cutthroat trout and steelhead salmon are native to these waters, while coho salmon populated the watershed after a fish ladder was constructed at Willamette Falls in the late 1800s (TRWC 2003). Coho were also stocked in Gales Creek from 1936 to 1987 and now some natural spawning occurs (TRWC 2003). Statewide decreases in salmonid populations are forcing natural resource managers to focus on spawning and rearing habitats for salmonids in restoration activities. The TRWC hopes to re-create these vital habitats through the current Enhancement Plan.

METHODS

LWD surveys in five reaches of Gales Creek were conducted using methods developed for habitat restoration by the California Department of Fish and Game (Flosi et al. 1998). Selected survey reaches were divided into 200-ft intervals and one thousand feet of each reach were surveyed for LWD, except for GL06 which was only 900 ft in length and GL09 where 1,100 ft were surveyed (Table 1; Figure 1). In reaches greater than 1,000 ft (GL02, GL08 and GL09), a minimum of five intervals were randomly selected for sampling (Table 1; Figure 1). This design allows for comparison of each 200 ft section of stream as a replicate, and the surveyed segments of each reach can be combined to make generalizations about each reach. Every linear foot of each reach was not surveyed, thus LWD, debris jams, weirs and other observations within the reaches may have not been counted in these surveys. These items were counted within the surveyed 200 ft segments only. Data were tallied and averaged for each reach individually and combined for an overall analysis of wood in the surveyed reaches.

Surveyors traveled upstream through each reach with a hip chain, marking habitat units (pools, riffles and glides) and tallying all LWD pieces. Each piece of wood ≥ 1 foot in diameter and ≥ 6 feet in length and root wads ≥ 1 foot were tallied. Wood pieces and trees within the recruitment zone were also tallied and characterized as live or dead. Live trees were further characterized as being coniferous or deciduous. Debris jams, defined as aggregations of three or more pieces of wood, were located, photographed and noted. Other observations such as the occurrence of beaver dams were also recorded.

In addition to the methods outlined in Flosi et al. (1998), steps were taken to better support the objectives of this study and the Gales Creek watershed. Crews recorded habitat units where debris jams occurred and noted if the jam marked a change in habitat type. Habitat units were defined according to ODFW's Methods for Stream Habitat Surveys (Leader 2002). The recruitment zone for live trees was defined as 50 feet from the bankfull edge for the survey. Water and air temperature were taken at the beginning of each survey with a handheld thermometer.

Crews recorded the location of the downstream and upstream end of reach and any debris jams by averaging the location on a Garmin 12 handheld GPS unit. Field workers took photos

facing into the reach from the downstream and upstream ends and also photographed any notable features (beaver dams, diversions, etc.) throughout the sampled reaches.

Waypoints from the handheld GPS units were overlain on a 2003 color aerial photo of the study area, provided by April Olbrich of the TRWC, in ArcMap 9.1. Point data were joined with a database of the results of the LWD census to create maps for this report.

RESULTS

All of the surveyed reaches contained pieces of LWD within the stream's bankfull width and in the recruitment zone (Table 2). The 200-ft segments averaged 15 pieces of LWD instream and in the recruitment zone, combined (n = 26; 8 pieces LWD per 100 ft). All segments averaged 2 pieces of instream LWD (n= 26; 1 pieces LWD per 100 ft) and 14 pieces of recruitment zone LWD (n= 26; 7 pieces LWD per 100 ft). Recall that the recruitment zone for this study was defined as 50 ft from the stream's bankfull mark. Instream numbers reflect wood counted within the stream's bankfull mark. There were no live, qualifying, coniferous trees observed within the survey.

Reach GL05 contained the highest total number of instream and recruitment zone LWD. The greatest number of perched or dead trees within the recruitment zone occurred in reach GL08 (Table 2). The majority of LWD within all reaches (82.5 %) fell into the 1-2 ft diameter class (Table 3). Debris jams were found infrequently throughout the surveys, with a total of five found throughout the 5,000 ft of stream sampled. When these debris jams did occur, 40% demarcated a break in habitat types, from pool to riffle or glide (Table 4). This may be viewed as the ability of LWD jams to create habitat heterogeneity in Gales Creek.

Habitats encountered within the reaches were glides, pools and riffles. Stream temperatures ranged from 10 to 15 °C throughout the surveys; air temperatures ranged from 6 to 18 °C. Land use in the surveyed portion of Gales Creek is primarily agricultural with some forested and rural residential lands. A synopsis of the LWD survey in each reach follows.

GL02

Reach GL02 begins at the confluence of Gales and Kelly Creeks and extends upstream approximately 3,100 ft (Figure 2). Habitat types in GL02 include riffles, glides and pools with a mean gradient of 1% (Figure 3).

The air temperature and water temperature at GL02 were 8 °C and 10 °C, respectively. On average, GL02 had 16.0 pieces LWD per 200-ft reach. A total of 80 pieces of qualifying wood were observed within the survey, with one piece observed within the stream. The remaining 79 pieces were observed within the recruitment zone of the creek. Within the recruitment zone, 11 pieces were dead or perched for recruitment while 68 were live trees (Table 2). The majority (87.5%) of the LWD surveyed within the reach fell within the 1-2 ft diameter class (Table 3). No large debris jams or notable wood features were observed within the surveyed reach segments on GL02.

GL05

Reach GL05 begins where Roderick Road crosses Gales Creek and extends upstream approximately 1000 ft (Figure 4). Habitat types within GL05 include riffles, glides and pools with a mean gradient of 2% (Figure 5).

The air temperature and water temperature in GL05 were 9 °C and 11 °C, respectively. On average, GL05 had 25.4 pieces LWD per 200-ft reach. One hundred twenty-seven pieces of qualifying wood were observed within the survey area, with 13 pieces observed within the bankfull width of the Gales Creek. The remaining 114 pieces were observed within the recruitment zone. Of these pieces for potential introduction, eight were dead or perched for recruitment; 106 were live trees (Table 2). The majority (89.8%) of the LWD surveyed within the reach fell into the 1-2 ft diameter class (Table 3). Two large debris jams were observed within the survey segments (Figures 4 and 6). The jams contained five and four pieces of qualifying wood and distinguished no habitat changes (Table 4).

GL06

Reach GL06 begins 900 ft downstream of the Roderick Road crossing of Gales Creek and extends upstream, ending at this crossing (Figure 4). Habitat types encountered included glides and pools with a mean gradient of 1% (Figure 7).

The air temperature and water temperature were 5.5 °C and 11 °C, respectively. On average, GL06 had 16.0 pieces LWD per 200-ft reach. A total of 72 pieces of qualifying wood were observed during the survey, with five pieces observed within bankfull width of the stream. The remaining 67 pieces were observed within the recruitment zone outside of either bankfull of the creek. Of these pieces for potential introduction, nine were dead or perched for recruitment while the remaining 58 were live trees (Table 2). The majority (59.7%) of the LWD surveyed within the reach sized within the 1-2 ft diameter class (Table 3). One large debris jam was observed within the survey segments (Figures 4 and 8). This debris jam contained three pieces of qualifying wood and marked a change in habitat type from pool above the jam to riffle below (Table 4).

GL08

Reach GL08 begins approximately 2,500 ft above the Springtown Road crossing and extends upstream 1,600 ft (Figure 9). Habitat types in GL08 include riffles, glides and pools with a mean gradient of 1% (Figure 10).

The air temperature and water temperature were 18 °C and 15 °C, respectively. On average, GL08 had 12.4 pieces LWD per 200-ft reach. Sixty-two pieces of qualifying wood were observed within the survey; four of these pieces were lying within the stream's bankfull width. The remaining 58 pieces were observed within the recruitment zone on either bank. Within the recruitment zone, twelve pieces of LWD were dead or perched for recruitment. Forty-six trees were live (Table 2). The majority (85.5%) of the LWD surveyed within the reach sized within the 1-2 ft diameter class (Table 3). One large debris jam, containing four pieces of qualifying wood, and two beaver dams were observed within the survey segments (Figures 9 and 11). The beaver dams contained no qualifying wood pieces, but marked changes from pool to riffle habitat types (Figure 11).

GL09

Reach GL09 begins approximately 930 ft above the Springtown Road crossing of Gales Creek and extends upstream 1,700 ft (Figure 9). Habitat types in GL09 include riffles, glides and pools with a mean gradient of 1% (Figure 12).

On the survey date, the air temperature and water temperature at GL09 were 18 °C and 15 °C, respectively. On average, GL09 had 9.8 pieces LWD per 200 ft reach. Of the fifty-four pieces of qualifying wood observed within GL09, 11 pieces were within the stream's bankfull width. The remaining 43 pieces were observed within the recruitment zone on either side of the creek. Six pieces within the recruitment zone were dead or perched for recruitment, while 37 pieces were live (Table 2). The majority (83.3%) of the LWD surveyed within the reach sized within the 1-2 ft diameter class (Table 3). One large debris jam was observed within the survey segments (Figures 9 and 13). This jam contained five pieces of qualifying wood, and marked no change in habitat type (Table 4).

DISCUSSION

Historically, Gales Creek likely would have been in a forested watershed with opportunities to receive LWD input from the upper watershed and the recruitment zone throughout its length. In autumn of 2005, we observed very few pieces of LWD or debris jams within the surveyed portions of the creek. While the recruitment zones of these reaches possessed greater numbers of wood than the channel, the likelihood of the wood to reach the creek is greatly diminished due to the primarily agricultural land use in the area. We found an average of 0.08 pieces of wood per ft and 0.001 debris jams per foot on our surveys. While direct comparisons with historic LWD abundance in rivers in the Pacific Northwest are difficult to make, Sedell and Froggatt report that in the Willamette basin between 1879 and 1950, an average of 1.8 snags per foot were removed from rivers (1984). Each snag may have had one or more pieces of LWD within it, but even if each snag was only one piece of wood, the historic numbers across the Willamette valley are two

orders of magnitude higher than those found in Gales Creek during these surveys. Collins et al. (2002) cite the description of Puget Lowland rivers by an early army general:

...the channels are strewn with immense trunks, often two hundred feet long, with roots, tops, and all ...[forming] jams, which frequently block the channels altogether [Major Hiram Chittenden, 1907].

This reveals the great occurrence of LWD and corresponding root wads and branches in the pre-settled Pacific Northwest. In our surveys we found only one root wad, defined as meeting the minimum criteria for diameter (1-2 ft) but less than 6 ft long. When root wads were part of pieces of LWD longer than 6 ft, they were not recorded as such.

Large woody debris counted within the Gales Creek survey reaches were primarily in the 1-2 ft diameter range. Compared with historic records of tree sizes within Pacific Northwest, these are small pieces of wood for a stream like Gales Creek. For Puget Lowland rivers, Collins et al. (2002) report information from the U. S. War Department records showing that between 1889 and 1909 the annual maximum diameter of wood in rivers ranged from 11.8 to 17.4 ft.

Temperatures within Gales Creek on our survey dates ranged from 10 to 15 °C. These are below the recently-published upper limit of the realized thermal niche for cutthroat trout, 16.2 °C (Huff et al. 2005). However, these numbers are the result of a single sampling, and temperature within the planned restoration reaches should be monitored throughout the restoration process. High temperatures have been previously cited for Gales Creek (Breuner 1998) and are linked to processes other than the occurrence of LWD within streams such as riparian vegetation and stream shading (Cederholm et al 1997).

The lack of wood within Gales Creek can likely be attributed to land use changes such as forestry and agriculture, as is noted in other systems of the Pacific Northwest (Bisson et al. 1987; Hicks et al. 1991, Bilby and Ward 1991; Collins et al. 2002). The relationship between habitat needs of salmonids and LWD in fresh water systems has been often described (Bustard and Narver 1975; House and Boehne 1986; Bisson et al 1987; Cederholm et al. 1997). Therefore when resource managers are tasked with mitigating habitat for dwindling salmonid stocks, installation of LWD pieces and jams is frequently employed.

Due to the small numbers of LWD and the lack of debris jams within Gales Creek, LWD structures could be constructed throughout to diversify habitats, supplement food supply and

create refugia for salmonids. The TWRC has already proposed to place LWD structures in the surveyed reaches. The placement of instream structures on a small scale, such as proposed for Gales Creek, has been implicated as good technique for providing short-term improvements in habitats for certain species (Roni et al. 2001).

For example in the Alsea and Nestucca basins, Oregon, placement of wood in created alcoves and dammed pools increased the overwinter survival of cutthroat trout and steelhead salmon (Solazzi et al. 2000). Flossi et al. (1998) named log debris accumulations as the preferred summer habitat for young-of-year steelhead. These fish may overwinter along the margins of streams containing pieces of wood or boulders while root wads provide both summer and winter habitat for steelhead (Flossi et al. 1998).

To focus on improving habitat for steelhead in Gales Creek, the types of LWD structures appropriate for enhancement would be: root wads, single pieces of wood along the channel margins and LWD accumulations. Each can serve a separate purpose. For example, log weirs are usually employed across the channel; material collects on the upstream side of the weir and a scour pool eventually forms on the downstream side. The placement of debris jams can be directed to create scour pools, refugia and food resources within or along side channels. Side-channel LWD placement can create refugia for juvenile salmonids in the fragile early stages of their lives. Single pieces of wood may be within or above a stream's bankfull width to create riffles, slow water eddies or pools, depending on the orientation of the piece. There are engineering concerns with each type of structure that should be adequately addressed by a restoration designer.

However, placement of single structures in sites scattered throughout a watershed may be viewed as part of a watershed-wide approach to promoting quality habitat (Cederholm et al. 1997). This technique is often successful as a temporary fix for threatened species (House and Boehne 1986; Cederholm et al. 1997; Roni et al. 2001) but will not persist if the reasons for the lack of woody structure in the stream are not addressed. It is best to view the placement of LWD within the identified reaches in Gales Creek as a temporary measure that may need maintenance and will promote long-term quality habitat only with corresponding watershed management. For long-term restoration, researchers suggest a watershed-wide program that includes protection of existing quality habitat in the watershed, conducting a watershed assessment to identify

restoration needs and subsequently focusing on re-connecting habitats isolated by disturbance such as culverts or dikes (Roni et al. 2001). Management should also focus on accelerating the development of desired vegetation in the riparian zone (Cederholm et al. 1997). While the development of a mature conifer forest along Gales Creek will occur on a long (decades to a century) timescale, LWD placement as a restoration technique can promote desired habitat in the meantime.

Biological monitoring of restoration sites, especially over the long term, is not frequently conducted (Roni et al 2001; Koehler and Garono 2005). While we have a great deal of knowledge on coho salmon response to LWD placement, there are fewer studies revealing a response of steelhead, or cutthroat trout to such enhancement. Biological monitoring of such projects is necessary to promote further enhancement activities, increase the involvement of stakeholders and community support and to further restoration ecology. Biological monitoring may be more easily conducted if it is part of the restoration plan from the start of the project, and Gales Creek is a suitable place to conduct such monitoring.

Placement of LWD structures is a good way to begin mitigation for fish habitat loss. However, fish habitat must be addressed alongside watershed wide concerns such as connectivity, water quality, water use and sedimentation. Because the TRWC has already conducted a watershed assessment and enhancement plan and is building trust with local landowners, the Gales Creek watershed managers are well on the way to a more sustainable watershed.

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FIGURES

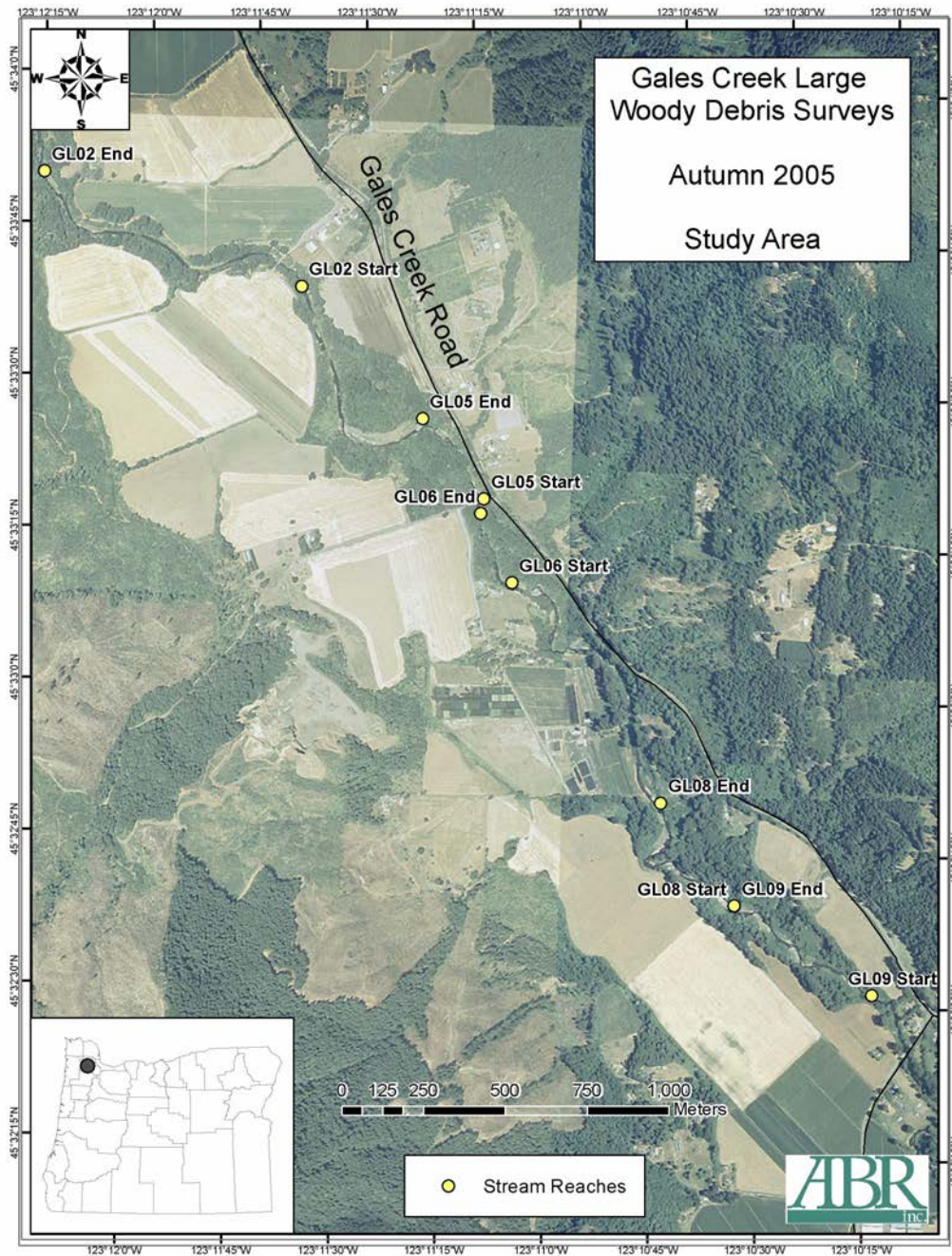


Figure 1. Study area showing the identification, start and end of each surveyed reach.

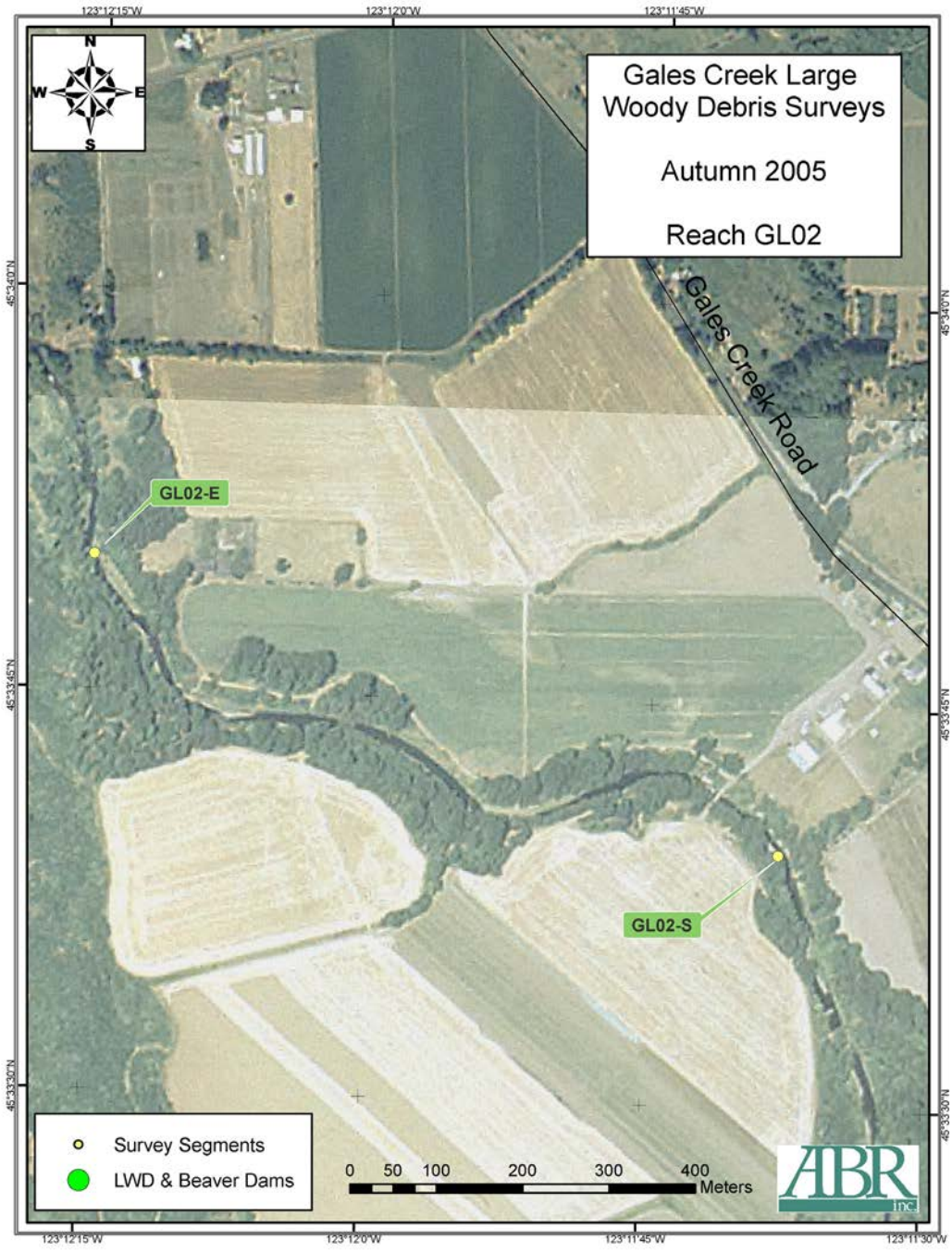


Figure 2. Map of reach GL02, showing the start (-S) and end (-E) of the reach. No debris accumulations were observed within the GL02 surveyed reach.



Figure 3. Photos of GL02 facing into the start of the reach (upper) and the end of the reach (lower). These photos show pool, glide and riffle habitats encountered within the reach GL02.

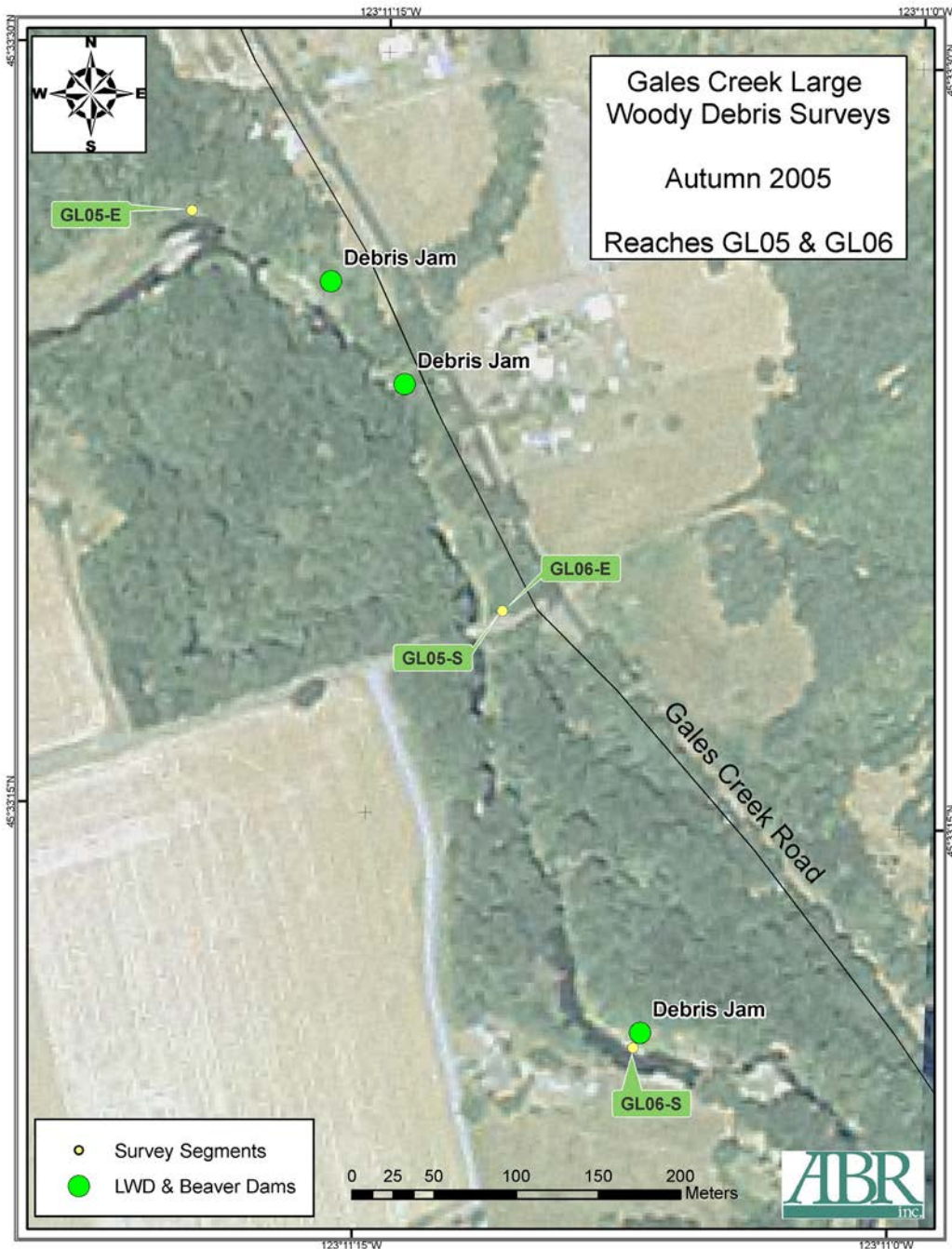


Figure 4. Map of reach GL05 and GL06, showing the start (-S) and end (-E) of each reach, and LWD debris jams within the surveyed portion of the reaches.



Figure 5. Photos of GL05 facing into the start of the reach (upper) and the end of the reach (lower). These photos show pool, glide and riffle habitats encountered within the reach.



Figure 6. Debris jams in GL05: left bank (upper photo) and gravel bar, mid-channel (lower photo).



Figure 7. Photos of GL06 facing into the start of the reach (upper) and the end of the reach (lower). These photos show glide and pool habitats encountered within the reach.



Figure 8. Photo of the large debris jam, spanning the wetted channel, in GL06.

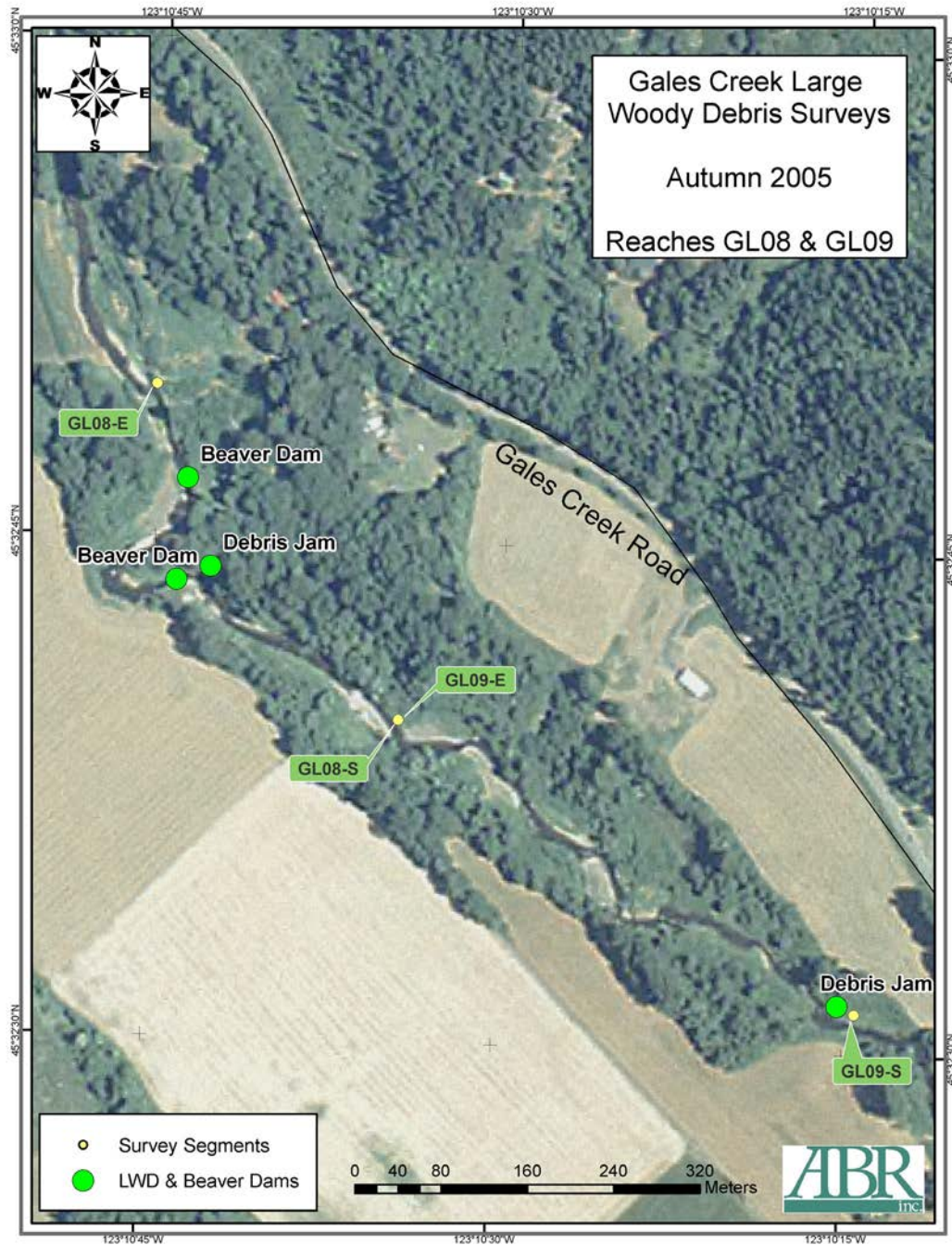


Figure 9. Map of reach GL08 and GL09, showing the start (-S) and end (-E) of each reach, and LWD debris jams or other noted features within the surveyed portion of the reaches.



Figure 10. Photos of reach GL08 facing into the start of the reach (upper) and the end of the reach (lower). These photos reveal glide and pool habitats encountered within the reach; riffle habitats were also observed in GL08.



Figure 11. Debris jam, located mid-channel, within a pool (upper photo) and two beaver dams (middle and lower photos), spanning the wetted channel in GL08.



Figure 12. Photos of reach GL09 into the start of the reach (upper) and the end of the reach (lower). These photos show pool, glide and riffle habitats encountered within the reach.



Figure 13. Large debris jam on left bank in reach GL09.

TABLES

Table 1. Gales Creek reach information including planned enhancement activities, site and survey length (see TRWC 2003 for more information on proposed enhancement activities).

Reach	GL02	GL05	GL06	GL08	GL09
Proposed Enhancement Activities	LWD placement	LWD placement	Bank enhancement, channel modification	Channel modification	Restrict vehicular access to stream
Site Length (ft)	3,100	1,000	900	1,600	1,700
Survey Length (ft)	1,000	1,000	900	1,000	1,100

Table 2. Large woody debris tallies observed in total, instream and on the recruitment zone, in terms of dead/perched LWD and live trees, in each surveyed reach.

Reach	Total Sample Length (ft)	Total		Instream			Recruitment Zone		
		Total LWD	Average pieces LWD (per 200 ft)	Total LWD	Dead/perched LWD	Live trees	Total LWD	Dead/perched LWD	Live trees
GL02	1,000	80	16.0	1	1	0	79	11	68
GL05	1,000	127	25.4	13	8	5	114	8	106
GL06	900	72	16.0	5	3	2	67	9	58
GL08	1,000	62	12.4	4	3	1	58	12	46
GL09	1,100	54	9.8	11	11	0	43	6	37
Total	5,000	395	15.8	34	26	8	361	46	315

Table 3. Percent of trees and total number of pieces instream and in the recruitment zones in Gales Creek surveyed reaches, autumn 2005.

Reach	1 - 2 ft dia (%)	2 - 3 ft dia (%)	3 - 4 ft dia (%)	>4 ft dia (%)	Total number of pieces
GL02	87.5	11.3	0.0	0.0	80
GL05	89.8	7.1	3.1	0.0	127
GL06	59.7	34.7	5.6	0.0	72
GL08	85.5	9.7	4.8	0.0	62
GL09	83.3	5.6	11.1	0.0	54
Total	82.5	13.1	4.3	0.0	395

Table 4. Information on log jams and beaver dams observed during LWD surveys on Gales Creek in autumn 2005. Number of pieces, width, length and size class are estimated numbers for each observation.

Reach	Description	Total pieces LWD	Width (ft)	Length (ft)	Size Class (ft dia)	Channel Location	Habitat(s)
GL05	Debris jam	5	10	60	1-2	Left Bank	Riffle/Glide
GL05	Debris jam	4	0	80	1-2	Mid Channel	Pool
GL06	Debris jam	3	64	3	1-2	Full Channel	Riffle/Pool
GL08	Debris jam	4	20	60	3-4	Full Channel	Pool
GL08	Beaver Dam	0	3	20	N/A	Full Channel	Pool/Riffle
GL08	Beaver Dam	0	4	30	N/A	Full Channel	Pool/Riffle
GL09	Debris jam	5	15	50	1-2	Left Bank	Pool