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The Demonstration of Ecosystem Management Options (DEMO) Study, a Long-Term Experiment in Variable-Retention Harvests: Rationale, Experimental and Sampling Designs, Treatment Implementation, Response Variables, and Data Accessibility

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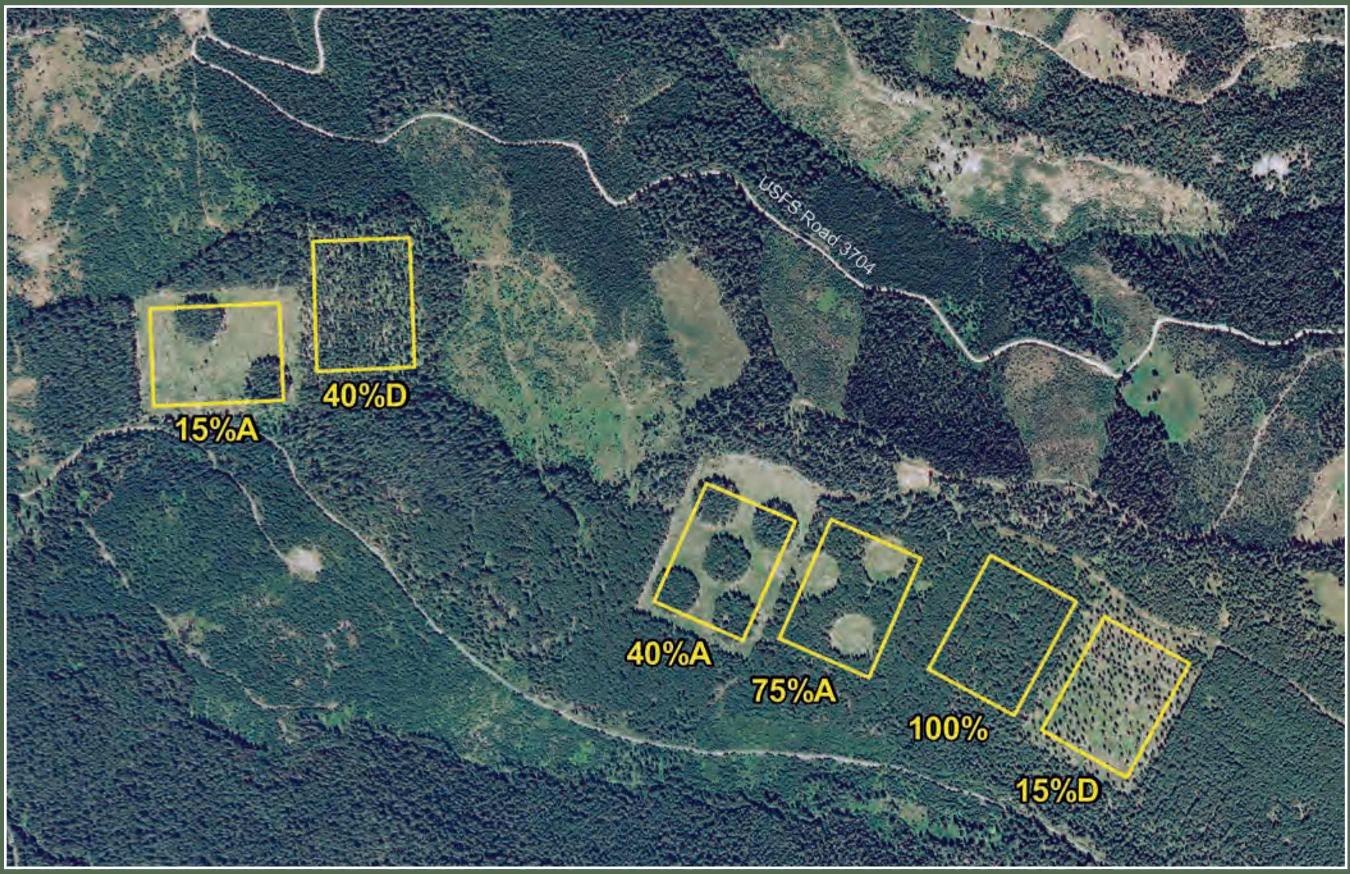

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Abstract

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The Demonstration of Ecosystem Management Options (DEMO) Study is an operational-scale experiment in variable-retention harvests with six installations in western Washington and Oregon. Initiated in 1994, the experiment was designed to test key assumptions underlying standards and guidelines in the Northwest Forest Plan for regeneration harvests on matrix lands. The orthogonal portion of the six-treatment design (15 and 40 percent retention in both aggregated and dispersed patterns) is unique among large-scale variable-retention experiments, allowing for independent tests of responses to retention level and pattern and to their interaction. The DEMO Study is a multidisciplinary experiment designed to evaluate the dynamics of a diverse array of forest organisms (understory and overstory vegetation, wildlife, arthropods, and fungi), including their short-term responses to disturbance and longer term responses to changes in forest structure. However, maintaining financial support for the study over several decades has been challenging. Consequently, most studies were limited to the short term, although assessments of overstory structure and conifer regeneration extend to 18 to 19 years after treatment. This comprehensive reference document is designed to facilitate future research on the DEMO sites by providing information needed to relocate or reestablish the sampling grids, and to access existing data for comparative analyses or syntheses. It contains details on the study design, treatment histories, experimental sites, sampling infrastructure, response variables, methods and histories of sampling, and data and metadata archives.

Keywords: DEMO Study, long-term studies, multidisciplinary studies, Pacific Northwest, structural retention, variable-retention harvests.

Preface

By the 1990s, forest managers and scientists in the Pacific Northwest recognized that the implementation of ecosystem management (i.e., managing forests to produce wood, maintain biodiversity, and provide ecosystem services) was hampered by a lack of knowledge about ecological responses to alternative silvicultural strategies. Widely acknowledged were that clearcutting as a means of regeneration harvest was detrimental to the ecological integrity of forests, and that new approaches were needed to achieve the goals of ecosystem management. Of particular interest were management strategies that involved the retention of forest structures (live trees and snags) during harvest—strategies that are now commonly known as "green-tree," "structural," or "variable-retention" harvests. In 1993, Congress allocated $1.5 million to the Pacific Northwest Research Station to establish a regionwide experiment that addressed these information needs. These funds supported the development and implementation of the Demonstration of Ecosystem Management Options (DEMO) Study, an operational-scale experiment designed to test the efficacy of different approaches to green-tree retention (varying the level or pattern of retained trees) on federal and state forest lands in Washington and Oregon. Subsequent federal funding supported a comprehensive assessment of pretreatment conditions (1994–1997), timely implementation of the harvest treatments (1997–1998), and posttreatment assessments of varying scope and duration (short term to nearly 2 decades after harvest).

The Demonstration of Ecosystem Management Options (DEMO) Study is an operational-scale experiment designed to test the efficacy of different approaches to green-tree retention on federal and state forest lands in Washington and Oregon.

Many federal and academic researchers, graduate students, and biological technicians have contributed to the long-term productivity of the DEMO Study. More than 80 research publications have been produced (including journal articles, government reports, dissertations, and theses), encompassing a diversity of disciplines (see app. 1). DEMO research is frequently cited in the retention-forestry literature, and DEMO data have been used in global-scale reviews and meta-analyses of the benefits and tradeoffs of variable-retention harvests for biodiversity.

The DEMO Study owes much of its success and long-term productivity to an active partnership between researchers and managers. During each phase of the study (including development of the general study plan), agency and academic scientists worked closely with federal and state resource managers. This partnership enabled researchers to understand and appreciate the needs of forest managers and the constraints they face. In turn, it created a collaborative research environment that enabled managers to understand the need for a rigid experimental design that provided a strong basis for statistical inference, despite the implementation of treatments or posttreatment practices that departed from traditional ones. Because the experiment involved alternative approaches to timber harvest at a time of heightened public concern over forest management practices, considerable effort was devoted to public outreach, including regular site visits. Collaboration and discussion between researchers and managers also facilitated the transfer of technical information. The DEMO Study exemplifies how a strong research-management partnership can enhance the success and productivity of large-scale, long-term experiments.

Contents

Introduction

During much of the 20th century, the perceived value of federal forests was to provide wood, water, grazing, recreation, and other commodities; little concern was expressed about the potential loss of ecological diversity from the harvest of old-growth forests (Franklin 1989). In recent decades, however, management practices on federal and state lands in western Washington and Oregon have been modified to sustain a broader array of forest values (e.g., USDA and USDI 1994, WDNR 1997). These new strategies acknowledge the need to integrate elements of natural disturbance and successional processes in forests managed for both commodity and ecological values (e.g., Brooks and Grant 1992, O'Hara 1998, Swanson and Franklin 1992). A fundamental element of these management strategies is the retention of physical structures (e.g., large live trees, snags, and down wood) during harvest that are important in the functioning of intact forest ecosystems—a practice known as structural or variable retention (Beese et al. 2003; Fedrowitz et al. 2014; Franklin et al. 1997, 2002; Gustafsson et al. 2012).

Two elements of forest structure are often manipulated to achieve the objectives of variable-retention harvests: the level of retention and the spatial pattern in which trees are retained.

Two elements of forest structure are often manipulated to achieve the silvicultural, ecological, or aesthetic objectives of variable-retention harvests: level of retention (e.g., basal area or density) and the spatial pattern in which trees are retained (dispersed vs. aggregated) (Franklin et al. 1997). For example, greater levels of retention are expected to favor survival of taxa that are sensitive to disturbance or to increases in light and temperature; lower levels of retention are expected to favor colonization and growth of early-seral or regenerating tree species (Gustaffson et al. 2012, Rosenvald and Lõhmus 2008). Similarly, dispersed retention is intended to moderate the understory microclimate (Barg and Edmonds 1999, Drever and Lertzman 2003) and to provide a spatially distributed source of live and dead wood for wildlife, epiphytes, mycorrhizal symbionts, and saproxylic species (Cline et al. 2005, Lõhmus et al. 2006, Siira-Pietikäinen et al. 2003, Sullivan and Sullivan 2001, Tittler et al. 2001). However, aggregated retention (retention of intact patches of forest) may be needed to ensure survival of species that are sensitive to disturbance or elevated levels of light or temperature (Baker et al. 2015, Franklin et al. 2018)—the "lifeboating" function of aggregates (Franklin et al. 1997). Because it leaves larger, more distinctive, and persistent openings in the forest, aggregated retention may also be more effective at maintaining ecologically complex early-seral habitat—the postdisturbance stage of natural forest development that has been reduced by intensive forest management (Kennedy and Spies 2004; Swanson et al. 2011, 2014). In their seminal paper on variable retention, Franklin et al. (1997) contrasted the broad range of hypothesized functions of dispersed and aggregated retention, including both short- and long-term objectives.

The retention of live (green) trees in harvest units is now an important component of forest management on federal lands in the Pacific Northwest, and it has become increasingly important in other temperate and boreal forest regions as well (Gustafsson et al. 2012, Lindenmayer et al. 2012a). Nevertheless, the ecological benefits or tradeoffs of varying the level or spatial pattern of retention during harvest are not fully understood. Species may differ in their responses to one or both elements of residual structure, or to their interaction. For example, trees retained in a dispersed setting may need to exceed a threshold density to effectively moderate understory microclimate. Similarly, undisturbed aggregates may need to be sufficiently large to resist wind damage or the edge effects that can compromise their lifeboating functions. Identifying these level-by-pattern interactions may be critical to balancing the multiple objectives of variable-retention harvests.

In the mid-1990s, all resource management plans and timber harvest prescriptions on U.S. Forest Service and Bureau of Land Management lands within the range of the northern spotted owl (*Strix occidentalis caurina*) were combined into a single comprehensive plan for ecosystem management—the Northwest Forest Plan (NWFP) (Tuchmann 1995, USDA and USDI 1994). Under this plan, the practice of clearcutting was eliminated; instead, on lands allocated to timber production ("matrix" lands), regeneration harvests must include partial retention of the overstory. Current retention standards and guidelines include the following: (1) retain live (green) trees in at least 15 percent of each harvest unit; (2) retain 70 percent of those trees in undisturbed aggregates of 0.2 to 1.0 ha (or larger), with the remainder dispersed or in small clumps (≤0.2 ha); (3) retain the largest and oldest decadent or leaning trees (to the extent possible); (4) retain trees indefinitely; and (5) retain or create additional down wood and snags (USDA and USDI 1994). It is widely believed that retaining large live trees, snags, and down wood during harvest will maintain or facilitate recovery of key ecological functions within managed forests (e.g., Franklin et al. 1997, Perry et al. 1989). However, the standards and guidelines for retention in the NWFP (e.g., the 15 percent minimum) are not based on experiments designed to test their validity. Rather, they reflect the collective knowledge, experience, and professional judgments of natural resource scientists and land managers who have worked in this region.

To test these assumptions, an operational-scale experiment in variable-retention harvests—the Demonstration of Ecosystem Management Options (DEMO) Study—was initiated in 1994. Franklin et al. (1999) provided a historical perspective on the motivation and evolution of the experiment. The design includes six treatments, each implemented within a 13-ha area, replicated at six locations (blocks) in mature forests dominated by Douglas-fir (*Pseudotsuga menziesii*) in western Washington and Oregon (fig. 1) (Aubry et al. 1999). Treatments represent strong contrasts in both the level of retention (15 to 100 percent of original basal area) and the spatial pattern in which trees are retained (dispersed vs. aggregated). The orthogonal portion of the experimental design (15 and 40 percent retention in both aggregated and dispersed patterns) (fig. 1) is unique among variable-retention experiments, making it possible to assess the individual and interactive effects of level and pattern of retention.

The response variables in DEMO address both ecological and silvicultural values, as well as public perceptions of the aesthetic qualities of resulting stand structures.

The response variables in DEMO address both ecological and silvicultural values, as well as public perceptions of the aesthetic qualities of resulting stand structures (Aubry et al. 1999). A diverse array of study organisms was chosen, including those critical to characterizing forest structure (live and dead trees) and those thought to be sensitive to retention level or pattern, including late-seral herbs and bryophytes, ectomycorrhizal fungi, foliage-dwelling arthropods, amphibians, forest-floor small mammals, arboreal rodents, and diurnal birds. Harvest treatments were implemented in 1997 and 1998, and initial posttreatment measurements were completed between 1998 and 2000. To capitalize on the unique opportunities afforded by this experiment, additional studies of understory microclimate and bark- and litter-dwelling arthropods were conducted in 2003 and 2004. Although the original intent was to assess the long-term responses of multiple taxa, declines in funding reduced the frequency and scope of longer term measurements to ~5-year assessments of the vegetation.

The DEMO Study has resulted in publication of more than 80 journal articles, government reports, dissertations, and theses (see app. 1 for a complete list). With the exception of the vegetation studies, however, these publications describe short-term responses to treatments. Aubry et al. (2009) provided a synthesis of these early findings. We recognize that the greater value of the DEMO experiment will emerge from an understanding of longer term responses to the treatments. This report is intended to support that goal by providing the information needed to relocate or reestablish the sampling grids and to access existing data from the study for comparative analyses or syntheses. It is a comprehensive reference document that describes the experimental sites and treatment histories, sampling methods, experimental infrastructure, and availability of existing data. It includes details on (1) study locations; (2) pretreatment forest conditions; (3) experimental design, harvest treatments, and postharvest manipulations; (4) permanent sampling grids and vegetation plots; (5) scope and history of data collection for each study discipline; and (6) data and metadata archived in the Oregon State University Forest Science Data Bank (FSDB, https://andrewsforest.oregonstate.edu/data).

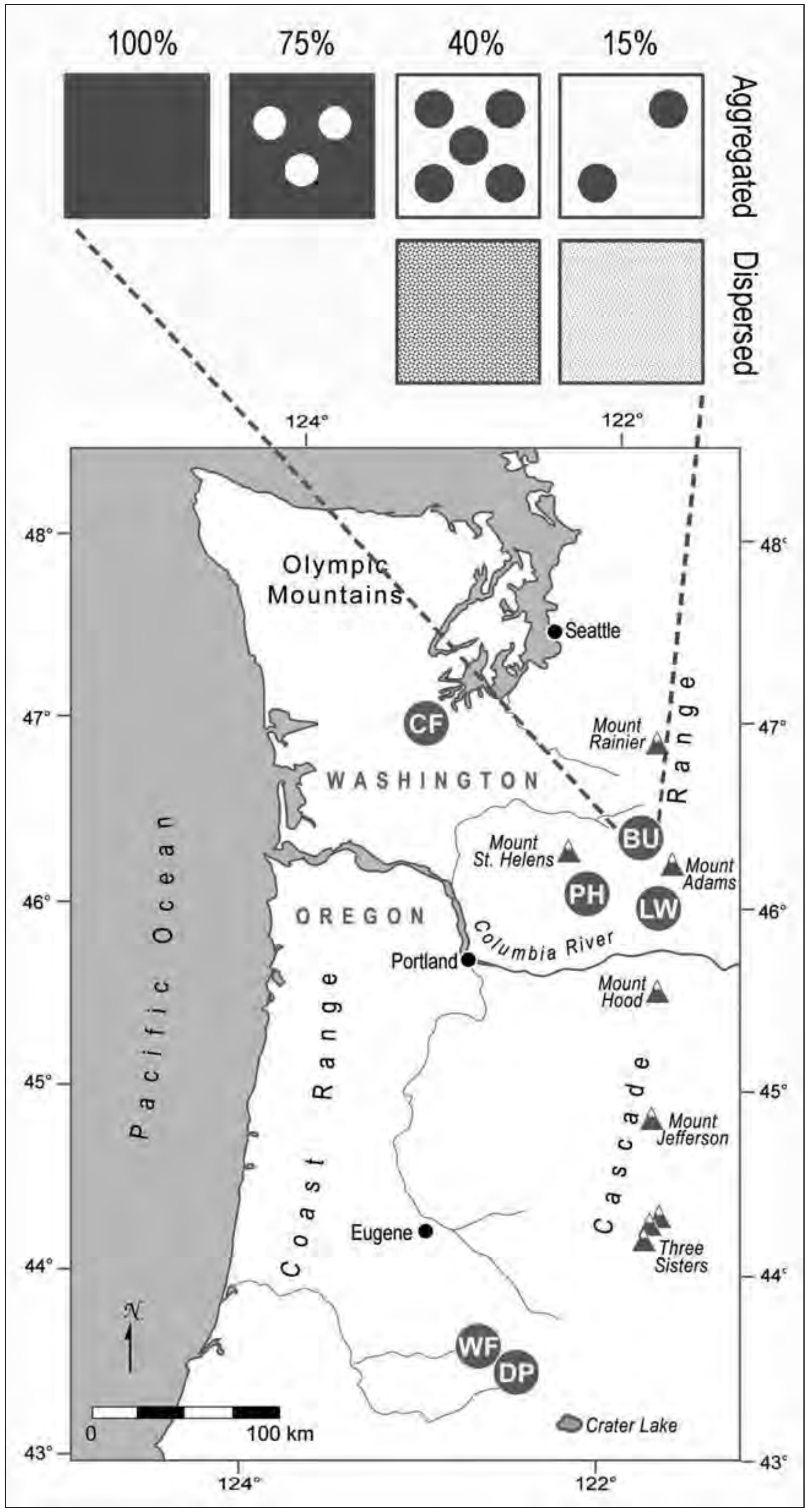

Figure 1—Geographic locations of the six experimental blocks in the DEMO Study: WF = Watson Falls, DP = Dog Prairie, BU = Butte, LW = Little White Salmon, PH = Paradise Hills, and CF = Capitol Forest.

Study Locations, Experimental Design, and Treatment Implementation

Study Locations

Six study locations (experimental blocks) were selected to represent an array of physical environments and forest types at low to moderate elevations in western Washington and Oregon (table 1). Three are in the Cascade Range (Gifford Pinchot National Forest) and one is in the Black Hills (Capitol State Forest) of southwestern Washington; two are in the Cascade Range of southwestern Oregon (Umpqua National Forest) (fig. 1). Locations were chosen subjectively, constrained by the criteria used for site selection: (1) upland areas of relatively homogeneous, mature, Douglas-fir-dominated forest; (2) sufficient area to support six square or slightly rectangular 13-ha treatment units; (3) absence of perennial streams or wetlands; and (4) minimal interaction with existing roads or harvest units. Abbott et al. (1999) described the challenges faced by forest managers in identifying potential study sites. Within each block, locations of experimental units were chosen to minimize variation in the physical environment and vegetation, given the constraints imposed by topography and past management (e.g., roads or older harvest units) (Aubry et al. 1999). Homogeneity of initial site conditions was achieved to a greater degree at the Butte, Little White Salmon, Dog Prairie, and Capitol Forest blocks than at the Paradise Hills or Watson Falls blocks, where experimental units had to be distributed over a larger area. Appendixes 2 through 7 include orthophotos of the treatment units within each block, as well as road maps, topographic maps, and detailed driving directions to each unit.

Among the six blocks, associated canopy and subcanopy tree species differ by forest zone, reflecting the geographic and elevational distributions of late-seral/climax species (table 1). Four forest zones are represented, ranging from warm/dry *Abies concolor* and *Abies grandis*, to warm/moist *Tsuga heterophylla*, to cool/moist *Abies amabilis* (Franklin and Dyrness 1988). At the time of treatment, stand ages ranged from 65 to 170 years. Past management activities differed among blocks: three had no previous activity, one was salvage-logged between 1970 and 1978, one was thinned in 1986, and one regenerated naturally after clearcut logging ~65 years earlier (table 1).

Experimental Design

The experiment is a randomized complete block design with six treatments. Treatments represent a broad range of retention levels (15, 40, 75, and 100 percent of original basal area) and, for a subset of these, two contrasting patterns (trees evenly dispersed vs. aggregated in 1-ha patches) (fig. 1). Treatments were implemented as follows: (1) **100 percent retention (100%)**: an undisturbed control for assessing responses to harvest and natural temporal variation (fig. 2). (2) **75 percent aggregated retention (75%A):** all merchantable trees (≥18 cm diameter at breast height [dbh]) were removed from three

Treatments represent a broad range of retention levels (15, 40, 75, and 100 percent of original basal area) and, for a subset of these, two contrasting patterns (trees evenly dispersed vs. aggregated in 1-ha patches).

Table 1—Environmental features and stand characteristics of the six experimental blocks in the Demonstration of Ecosystem Management Options (DEMO) Study

Experimental block	Elevation	Slope	Aspect	Stand age	Management history	Tree density[a]	Basal area	*Pseudotsuga menziesii* site index	Secondary overstory species[b]
	Meters	*Degrees*		*Years*		*Trees per hectare*	*Square meters per hectare*	*Meters at 50 years*	
Oregon—Umpqua National Forest:									
Watson Falls (WF)	945–1310	4–7	Flat	110–130	Salvage logged (1970–1978)	310–500	36–52	40–43	ABCO, TSHE, PIPO, PIMO
Dog Prairie (DP)	1460–1710	34–62	SW	165	Thinned (1986)	258–475	72–106	30	ABCO, ABMAS, CADE
Washington—Gifford Pinchot National Forest:									
Butte (BU)	975–1280	40–53	E-SE	70–80	None	759–1,781	48–65	27–32	TSHE, THPL
Little White Salmon (LW)	825–975	40–66	NW-NE	140–170	None	182–335	61–77	30	ABGR, CONU
Paradise Hills (PH)	850–1035	9–33	Varied	110–140	None	512–1,005	59–87	26–33	TSHE, THPL, ABAM
Washington—Department of Natural Resources:									
Capitol Forest (CF)[c]	210–275	28–52	Varied	65	Second growth	221–562	54–73	37–41	TSHE, THPL, ALRU

Note: Ranges are based on mean pretreatment values among the six treatment units within each experimental block.

[a] Trees ≥5.0 cm diameter at breast height.

[b] *Pseudotsuga menziesii* is the primary overstory species in each experimental block. Underscore denotes forest zone (Franklin and Dyrness 1988). Codes for secondary species: ABAM = *Abies amabilis*; ABCO = *A. concolor*; ABGR = *A. grandis*; ABMAS = *A. magnifica* var. *shastensis*; ALRU = *Alnus rubra*; CADE = *Calocedrus decurrens*; CONU = *Cornus nuttallii*; PIMO = *Pinus monticola*; PIPO = *P. ponderosa*; THPL = *Thuja plicata*; TSHE = *Tsuga heterophylla*.

[c] Experimental units and sampling grids in Capitol Forest are no longer maintained; sampling was terminated after the 2009 remeasurement.

Figure 2—Photo of the 100 percent retention (control) treatment on the Dog Prairie experimental block (2014, 16 years after harvest).

circular, 1-ha (56-m radius) "gaps" (25 percent of the treatment unit); all other trees were retained. (3) **40 percent dispersed retention (40%D):** dominant and co-dominant trees were retained in an even distribution throughout the treatment unit (fig. 3); the target basal area was that of the corresponding 40%A unit. (4) **40 percent aggregated retention (40%A):** all trees were retained within five circular, 1-ha aggregates (40 percent of the treatment unit); all merchantable trees in the surrounding matrix ("cleared areas") were harvested (fig. 4) except those retained for conversion to snags (see details on snag creation below). (5) **15 percent dispersed retention (15%D):** dominant and co-dominant trees were retained in an even distribution throughout the treatment unit (fig. 5); the target basal area was that of the corresponding 15%A unit. (6) **15 percent aggregated retention (15%A):** all trees were retained within two circular, 1-ha aggregates (15 percent of the treatment unit) (fig. 6); all merchantable trees in the surrounding matrix were harvested except those retained for conversion to snags.

Three aspects of the study design warrant additional discussion. First, the latter two treatments test the minimum retention standard (15 percent) in the Northwest Forest Plan (USDA and USDI 1994); the others provide for strong contrasts with these. Second, treatment combinations were not chosen as operational alternatives, but rather to allow for clear separation of the effects of retention level and pattern, or to test their interaction. Finally, because treatments were defined by proportional reductions in basal area rather than absolute basal-area targets, variation in initial structure among and within blocks resulted in significant postharvest variation among treatment replicates (table 2). Maguire et al. (2007) discussed this variation and the extent to which basal area targets were achieved among treatment units within each block.

Figure 3—The 40 percent dispersed-retention treatment on the Dog Prairie experimental block (2014, 16 years after harvest).

Figure 4—The harvested area next to one of the five aggregates in the 40 percent aggregated-retention treatment on the Dog Prairie experimental block (2014, 16 years after harvest). A second aggregate is seen in the distance, as are several artificially created snags in the harvested area.

Figure 5—The 15 percent dispersed-retention treatment on the Dog Prairie experimental block (2014, 16 years after harvest).

Figure 6—Inside one of the two aggregates in the 15 percent aggregated-retention treatment on the Dog Prairie experimental block (2014, 16 years after harvest).

Table 2—Density and basal area of trees (≥5 cm diameter at breast height) before and after harvest

		Before harvest		After harvest	
Block	**Treatment**	**Density**	**Basal area**	**Density**	**Basal area**
		Trees per hectare	*Square meters per hectare*	*Trees per hectare*	*Square meters per hectare*
Watson Falls	100%	310	43.7	388	44.4
	75%A	501	36.1	544	34.3
	40%D	389	47.7	154	27.1
	40%A	357	60.3	161	24.6
	15%D	382	51.6	88	8.6
	15%A	445	45.4	158	8.4
Dog Prairie	100%	295	89.6	320	99.4
	75%A	300	94.1	296	90.1
	40%D	372	72.4	149	38.0
	40%A	257	92.8	115	37.9
	15%D	385	79.7	88	21.0
	15%A	460	105.6	84	20.9
Butte	100%	1,119	58.2	1,080	58.2
	75%A	1,781	51.4	1,559	41.2
	40%D	1,019	48.7	524	28.5
	40%A	1,281	57.1	690	24.5
	15%D	757	55.7	178	12.1
	15%A	928	64.8	201	10.8
Little White Salmon	100%	182	72.1	213	69.9
	75%A	336	60.7	294	43.9
	40%D	211	77.0	112	37.1
	40%A	193	73.3	99	26.7
	15%D	272	77.4	49	8.8
	15%A	230	63.5	86	11.8
Paradise Hills	100%	1,005	70.9	1,035	74.7
	75%A	512	76.1	396	54.2
	40%D	877	67.3	139	23.7
	40%A	642	58.7	284	24.2
	15%D	684	86.7	53	10.8
	15%A	732	79.1	123	10.8
Capitol Forest	100%	327	64.7	324	62.9
	75%A	372	63.7	263	45.4
	40%D	334	57.5	93	26.0
	40%A	355	71.5	119	24.8
	15%D	221	53.7	35	11.3
	15%A	563	73.3	85	10.3

Treatment Implementation: Yarding, Snag Creation, Slash Reduction, and Planting of Tree Seedlings

To minimize extraneous variation, methods of yarding and all postharvest activities were applied consistently within each block (table 3). Local forest managers selected the most appropriate yarding method: on sloping terrain, helicopters or suspension cables were used; on more gentle terrain, ground-based systems (shovel loaders and rubber-tired skidders) were used (see Halpern and McKenzie [2001] for details). Within each block, felling and yarding were completed within a period of 3 to 7 months (1997 or 1998).

To provide replacement snags for the future and to address snag-retention guidelines in the Northwest Forest Plan, 6.5 trees per hectare were retained in the harvested portions of each unit and subsequently topped or girdled.

Because they posed a safety hazard, most snags were felled in the harvested portions of the treatment units. To provide replacement snags for the future and to address snag-retention guidelines in the Northwest Forest Plan (USDA and USDI 1994), 6.5 trees per hectare (typically those with decay or broken tops) were retained in the harvested portions of each unit and subsequently topped or girdled (table 4). Treatment of nonmerchantable trees (<18 cm dbh) in harvested areas also differed among blocks: at two blocks they were either felled, or felled if damaged; elsewhere, they were left standing (table 3). During harvest, preexisting down wood was retained, but there were no prescriptions to add material. At most blocks, tree canopies were left attached to the uppermost log to reduce slash accumulation. Following harvest, slash loadings were evaluated with respect to potential fire hazard and ease of planting. At one block (Watson Falls), slash loadings were deemed to be excessive and were partially reduced by machine piling and burning on temporary skid roads (table 3) (see Halpern and McKenzie [2001] for details).

To ensure that federal and state stocking levels were met, conifer seedlings (typically a mix of species) were planted in spring 1998 or 1999 in the harvested portions of all experimental units. Planting densities varied among blocks (table 5) but were considerably lower than those of operational units to limit interactions with natural regeneration. At Dog Prairie, substantial loss of seedlings to herbivory by western pocket gophers (*Thomomys mazama*) required replanting of all units in 2001 (table 5). Other seedling-related treatments included netting (for protection) and some branch pruning in the Oregon blocks (table 5). See Urgenson et al. (2013a) for details on the survival and growth of planted seedlings. To date, no precommercial thinning has occurred on these experimental sites.

Table 3—Methods and dates of harvest and postharvest management activities

Block/ treatment	Yarding method[a]	Timber felled	Timber yarded	Noncommercial stems felled[b]	Slash piles created	Slash piles burned	Temporary roads rehabilitated
Watson Falls:							
75%A	Tracked shovel loaders	4 Jun–25 Jul 1998	10 Jun–25 Jul 1998	14 Sep–1 Oct 1998	7–27 Oct 1998	6 and 21 Nov 1998	13 Aug 1998
40%D		8 Sep–3 Oct 1998	8 Sep–13 Oct 1998	12–20 Oct 1998	5–10 Nov 1998	23 Nov 1999	26 Oct 1998
40%A		22 Jun–22 Jul 1998	24 Jul–11 Aug 1998	1–6 Oct 1998	28 Oct–4 Nov 1998	22–23 Nov 1999	12 Aug 1998
15%D		4 Jun–25 Jul 1998	10 Jun–25 Jul 1998	14 Sep–1 Oct 1998	7–27 Oct 1998	6, 18–20 Nov 1998	13 Aug 1998
15%A		4 Jun–25 Jul 1998	10 Jun–25 Jul 1998	14 Sep–1 Oct 1998	7–27 Oct 1998	6 Nov 1998	13 Aug 1998
Dog Prairie:							
75%A	Helicopters	20 Jul–2 Sep 1998	3 Aug–4 Sep 1998				
40%D		20 Jul–2 Sep 1998	3 Aug–4 Sep 1998				
40%A		20 Jul–2 Sep 1998	3 Aug–4 Sep 1998				
15%D		20 Jul–2 Sep 1998	3 Aug–4 Sep 1998				
15%A		20 Jul–2 Sep 1998	3 Aug–4 Sep 1998				
Butte:							
75%A	Helicopters	12–27 May 1997	28 May–7 Jun 1997				
40%D		6–19 Jun 1997	20 Jun–14 Jul 1997				
40%A		12–15 May 1997	16 May–14 Jul 1997				
15%D		15–27 May 1997	28 May–14 Jun 1997				
15%A		4–9 Aug 1997	10 Aug–25 Sep 1997				
Little White Salmon:							
75%A	Helicopters	28 Aug–28 Sep 1998	1–27 Oct 1998				
40%D		28 Jun–28 Jul 1998	20 Jul–20 Oct 1998				
40%A		28 Aug–28 Sep 1998	1–27 Oct 1998				
15%D		2 Apr–4 Jun 1998	2 Jul–20 Oct 1998				
15%A		30 Mar–30 May 1998	25 Jul–17 Oct 1998				

Table 3—Methods and dates of harvest and postharvest management activities (continued)

Block/ treatment	Yarding method[a]	Timber felled	Timber yarded	Noncommercial stems felled[b]	Slash piles created	Slash piles burned	Temporary roads rehabilitated
Paradise Hills:							
75%A	Tracked shovel loaders and rubber-tired skidders	7–28 Aug 1997	2–5 Sep 1997	7–28 Aug 1997			
40%D		1–30 Sep 1997	29 Sep–17 Oct 1997	1–30 Sep 1997			1 Sep 1998
40%A		14–29 Aug 1997	8–24 Sep 1997	14–29 Aug 1997			2 Sep 1998
15%D		16 Jun–22 Jul 1997	23 Jun–1 Aug 1997	16 Jun–22 Jul 1997			3 Sep 1998
15%A		21 Jul–6 Aug 1997	3–29 Aug 1997	21 Jul–6 Aug 1997			3–4 Sep 1998
Capitol Forest:							
75%A	Suspension cables	4 Dec 1997–6 Jan 1998	17 Dec 1997–16 Jan 1998				
40%D	Suspension cables (shovel loader, 1.2 ha)	4 Dec 1997–6 Feb 1998	12 Dec 1997–17 Feb 1998				
40%A	Suspension cables (shovel loader, 0.8 ha of southern edge)	17 Mar–7 Apr 1998	11 Mar–6 May 1998				
15%D	Suspension cables (shovel loaders, 2.4 ha of northern and southern edges)	17 Dec 1997–17 Feb 1998	9 Feb–11 Mar 1998				
15%A	Suspension cables	4 Dec 1997–25 Feb 1998	16 Jan–2 Apr 1998				

Note: See table 4 for details on snag creation.
[a] Yarding method applies to all units within each experimental block except where noted.
[b] Dates of felling of all noncommercial stems in harvested areas (Paradise Hills), or damaged stems only (Watson Falls).

Table 4—Methods and dates of snag creation

Block/treatment	Method[a]	Dates	Other notes[b]
Watson Falls:			
75%A	Girdled	2–11 Jun 1999	
40%D	Girdled	27–28 Jun 1999	2 regirdled (Aug 2004)
40%A	Girdled	23–24 Jun 1999	
15%D	Girdled	2–11 Jun 1999	
15%A	Girdled	2–11 Jun 1999	
Dog Prairie:			
75%A	Girdled	5 Jul–1 Aug 1999	
40%D	Girdled	5 Jul–1 Aug 1999	7 regirdled (Aug 2004)
40%A	Girdled	5 Jul–1 Aug 1999	
15%D	Girdled	5 Jul–1 Aug 1999	3 regirdled (Aug 2004)
15%A	Girdled	5 Jul–1 Aug 1999	7 regirdled (Aug 2004)
Butte:			
75%A	Topped at ~12 m	4 Jul–6 Aug 1998	
40%D	Topped at ~12 m	4 Jul–6 Aug 1998	
40%A	Topped at ~12 m	4 Jul–6 Aug 1998	3 girdled
15%D	Topped at ~12 m	4 Jul–6 Aug 1998	
15%A	Topped at ~12 m	4 Jul–6 Aug 1998	5 topped, 1 regirdled (26 Sep 2003)
Little White Salmon:			
75%A	Girdled at 1 m	1–20 Nov 1998	
40%D	Girdled at 1 m	1–30 Apr 1999	1 regirdled (19 May 2004)
40%A	Girdled at 1 m	1–30 Apr 1999	
15%D	Girdled at 1 m	1–30 Apr 1999	
15%A	Girdled at 1 m	1–30 Apr 1999	
Paradise Hills:			
75%A	Topped at ~12 m	28 Aug–12 Oct 1998	
40%D	Topped at ~12 m	28 Aug–12 Oct 1998	1 girdled
40%A	Topped at ~12 m	28 Aug–12 Oct 1998	
15%D	Topped at ~12 m	28 Aug–12 Oct 1998	
15%A	Topped at ~12 m	28 Aug–12 Oct 1998	11 girdled
Capitol Forest:			
75%A	Girdled at 1.4 m	8–19 Apr 1999	
40%D	Girdled at 1.4 m	8–19 Apr 1999	
40%A	Girdled at 1.4 m	8–19 Apr 1999	1 regirdled (16 Aug 2004)
15%D	Girdled at 1.4 m	8–19 Apr 1999	
15%A	Girdled at 1.4 m	8–19 Apr 1999	

[a] A total of 6.5 snags/ha were created in the harvested portions of each treatment unit.
[b] Several trees that did not die from initial girdling required regirdling or subsequent topping.

Table 5—Planting of seedlings: species, stock type, density, planting dates, and other activities

Block/ treatment	Species[a]	Stock type	Density	Planting (or replanting) dates	Replanting density	Other activities
			Number per hectare		*Number per hectare*	
Watson Falls:						
75%A	PSME	BR 2-0	149.3	17 Apr 1999		Netting (23 Apr 2001)
	PIPO	BR 1-0	176.7			
	PIMO	BR 2-0	83.3			Pruning (29 Jul–1 Aug 2002)
40%D	PSME	BR 2-0	201.9	15 Jun 1999		Netting (23 Apr 2001)
	PIPO	BR 1-0	165.1			
	PIMO	BR 2-0	135.9			Pruning (28 Aug–19 Sep 2002)
40%A	PSME	BR 2-0	228.5	2 Jun 1999		Netting (23 Apr 2001)
	PIPO	BR 1-0	197.6			
	PIMO	BR 2-0	98.8			Pruning (10 Oct 2002)
15%D	PSME	BR 2-0	207.6	14–15 Apr 1999		Netting (23 Apr 2001)
	PIPO	BR 1-0	195.8			
	PIMO	BR 2-0	71.6			Pruning (17 Oct 2002)
15%A	PSME	BR 2-0	220.0	15–17 Apr 1999		Netting (23 Apr 2001)
	PIPO	BR 1-0	187.4			
	PIMO	BR 2-0	58.6			Pruning (1–28 Aug 2002)
Dog Prairie:						
75%A	PSME	BR 2-0	163.0	24 May–5 Jun 1999	212.0	Netting (6 Jun 2001)
	PIMO	BR 2-0	54.0	(8 May 2001)	37.2	
	ABMAS	BR 2-0	60.7		37.2	
40%D	PSME	BR 2-0	120.4	24 May–5 Jun 1999	47.5	Netting (31 May 2001)
	PIMO	BR 2-0	22.2	(9 May 2001)	9.0	
	ABMAS	BR 2-0	47.5		7.7	
40%A	PSME	BR 2-0	171.1	24 May–5 Jun 1999	176.4	Netting (6 Jun 2001)
	PIMO	BR 2-0	21.9	(8 May 2001)	16.8	
	ABMAS	BR 2-0	52.6		16.8	
15%D	PSME	BR 2-0	161.1	24 May–5 Jun 1999	177.2	Netting (6 Jun 2001)
	PIMO	BR 2-0	31.3	(8–9 May 2001)	22.7	
	ABMAS	BR 2-0	47.0		27.3	
15%A	PSME	BR 2-0	146.1	24 May–5 Jun 1999	324.1	Netting (31 May 2001)
	PIMO	BR 2-0	37.5	(26 Apr 2001)	28.4	
	ABMAS	BR 2-0	99.3		52.7	

Table 5—Planting of seedlings: species, stock type, density, planting dates, and other activities (continued)

Block/ treatment	Species[a]	Stock type	Density	Planting (or replanting) dates	Replanting density	Other activities
			Number per hectare		*Number per hectare*	
Butte:						
75%A	PSME	BR 2-0	684.3	Apr 1998		
	PIMO	BR 2-0	66.8			
40%D	PSME	BR 2-0	238.4	26 May 1998		
	PIMO	BR 2-0	60.6			
40%A	PSME	BR 2-0	377.5	30 Apr 1998		
	PIMO	BR 2-0	57.6			
15%D	PSME	BR 2-0	414.3	1 May 1998		
	PIMO	BR 2-0	28.5			
15%A	PSME	BR 2-0	735.4	28 Apr 1998		
	PIMO	BR 2-0	90.2			
Little White Salmon:						
75%A	PSME	BR 2-0	303.7	16 Jun 1999		
	PIPO	BR 1-1	50.1			
	ABPR	BR 2-0	48.4			
	PIMO	BR P-1	100.1			
40%D	PSME	BR 2-0	316.5	1 Jun 1999		
	PIPO	BR 1-1	54.0			
	ABPR	BR 2-0	46.3			
	PIMO	BR P-1	84.9			
40%A	PSME	BR 2-0	256.0	24 Jun 1999		
	PIPO	BR 1-1	41.6			
	ABPR	BR 2-0	41.6			
	PIMO	BR P-1	102.4			
15%D	PSME	BR 2-0	312.7	16 Jun 1999		
	PIPO	BR 1-1	39.1			
	ABPR	BR 2-0	31.3			
	PIMO	BR P-1	93.8			
15%A	PSME	BR 2-0	299.7	17 Jun 1999		
	PIPO	BR 1-1	50.0			
	ABPR	BR 2-0	50.0			
	PIMO	BR P-1	99.9			

Table 5—Planting of seedlings: species, stock type, density, planting dates, and other activities (continued)

Block/ treatment	Species[a]	Stock type	Density	Planting (or replanting) dates	Replanting density	Other activities
			Number per hectare		*Number per hectare*	
Paradise Hills:						
75%A	PSME	BR 2-0	200.3	16 Jun 1999		
	ABPR	BR 2-0	133.5			
	PIMO	BR 2-0	100.1			
	THPL	BR P-1	50.1			
	TSHE	BR P-1	50.1			
40%D	PSME	BR 2-0	219.6	1–25 Jun 1999		
	ABPR	BR 2-0	164.1			
	PIMO	BR 2-0	89.9			
	THPL	BR P-1	38.3			
	TSHE	BR P-1	50.0			
40%A	PSME	BR 2-0	200.6	24 Jun 1999		
	ABPR	BR 2-0	100.3			
	PIMO	BR 2-0	100.3			
	THPL	BR P-1	37.6			
	TSHE	BR P-1	0.0			
15%D	PSME	BR 2-0	195.4	16 Jun 1999		
	ABPR	BR 2-0	101.6			
	PIMO	BR 2-0	93.8			
	THPL	BR P-1	46.9			
	TSHE	BR P-1	46.9			
15%A	PSME	BR 2-0	194.3	17 Jun 1999		
	ABPR	BR 2-0	92.5			
	PIMO	BR 2-0	92.5			
	THPL	BR P-1	62.0			
	TSHE	BR P-1	27.8			
Capitol Forest:						
75%A	PSME	BR 1-1	741.0	25 Jan 1999		
40%D	PSME	BR 1-1	741.0	15 Mar 2000		
40%A	PSME	BR 1-1	741.0	27 Jan 1999		
15%D	PSME	BR 1-1	741.0	29 Jan 1999		
15%A	PSME	BR 1-1	741.0	3 Feb 1999		

[a] Species codes: ABMAS = *Abies magnifica* var. *shastensis*; ABPR = *A. procera*; PIMO = *Pinus monticola*; PIPO = *P. ponderosa*; PSME = *Pseudotsuga menziesii*; THPL = *Thuja plicata*; TSHE = *Tsuga heterophylla*.

Sampling of Major Response Variables

Systematic Sampling Grids

A permanent grid was established in each 13 hectare experimental unit to support systematic sampling of most biological responses (vegetation, amphibians, small mammals, birds, and arthropods).

A permanent grid was established in each 13-ha experimental unit to support systematic sampling of most biological responses (overstory and understory vegetation, amphibians, forest-floor small mammals, arboreal rodents, diurnal forest birds, and bark- and litter-dwelling arthropods) (Aubry et al. 1999). To provide flexibility in unit placement on the landscape, grids vary in shape (8 × 8 or 7 × 9 points). However, it was not possible to fully control for landscape context; consequently, areas surrounding the grids in each block may differ in topographic and ecological characteristics. Grid points are spaced 40 m apart (slope-corrected distances); those on the perimeter are located at least 40 m from the harvest unit boundary. All grid points are marked with steel reinforcing bars (~50 cm long) covered by PVC posts (~1.5 m tall). Each post has an aluminum tag stamped with a unique treatment, row, and column identifier (e.g., 1A1; see apps. 2 through 7 for labelled diagrams of the sampling grids in each block). The four corner points of each grid are georeferenced at submeter accuracy (Albers coordinates are provided in app. 8). Systematic assessments of grid system integrity were last completed in 2015–2016 in all experimental units except 75%A (last visited in 1998–1999) or at Capitol Forest (last sampled in 2009). To assist with navigation in the field, bearings for the rows and columns of each grid are provided in appendix 9. A complete set of interpolated grid-point locations is available under the TP108 study code in the Oregon State University (OSU) Forest Science Data Bank (FSDB) (http://andlter.forestry.oregonstate.edu/data/abstract.aspx?dbcode=TP108; see the "Download Study Location Information" link).

Overstory and Understory Vegetation

Overstory and understory vegetation were sampled in all experimental blocks prior to and at various intervals after treatment. Points on the systematic sampling grid serve as the centers of permanent vegetation plots (fig. 7). A nested design is used to sample snags (0.08-ha circular plot); overstory trees and planted seedlings (0.04-ha circular plot); understory trees, shrubs, and coarse woody debris (four 1 × 6 m belt or 6-m line transects); and tree seedlings, herbs, bryophytes, and ground conditions (six 20 × 50 cm quadrats per transect). Within each plot, all overstory trees and snags are identified by uniquely numbered aluminum tags. In all or a subset of tree plots per treatment, understory transects are arranged perpendicularly (offset 45 degrees from the grid system) (see app. 10 for transect bearings). Transects are marked by polyvinyl chloride (PVC) posts at their end points (4 and

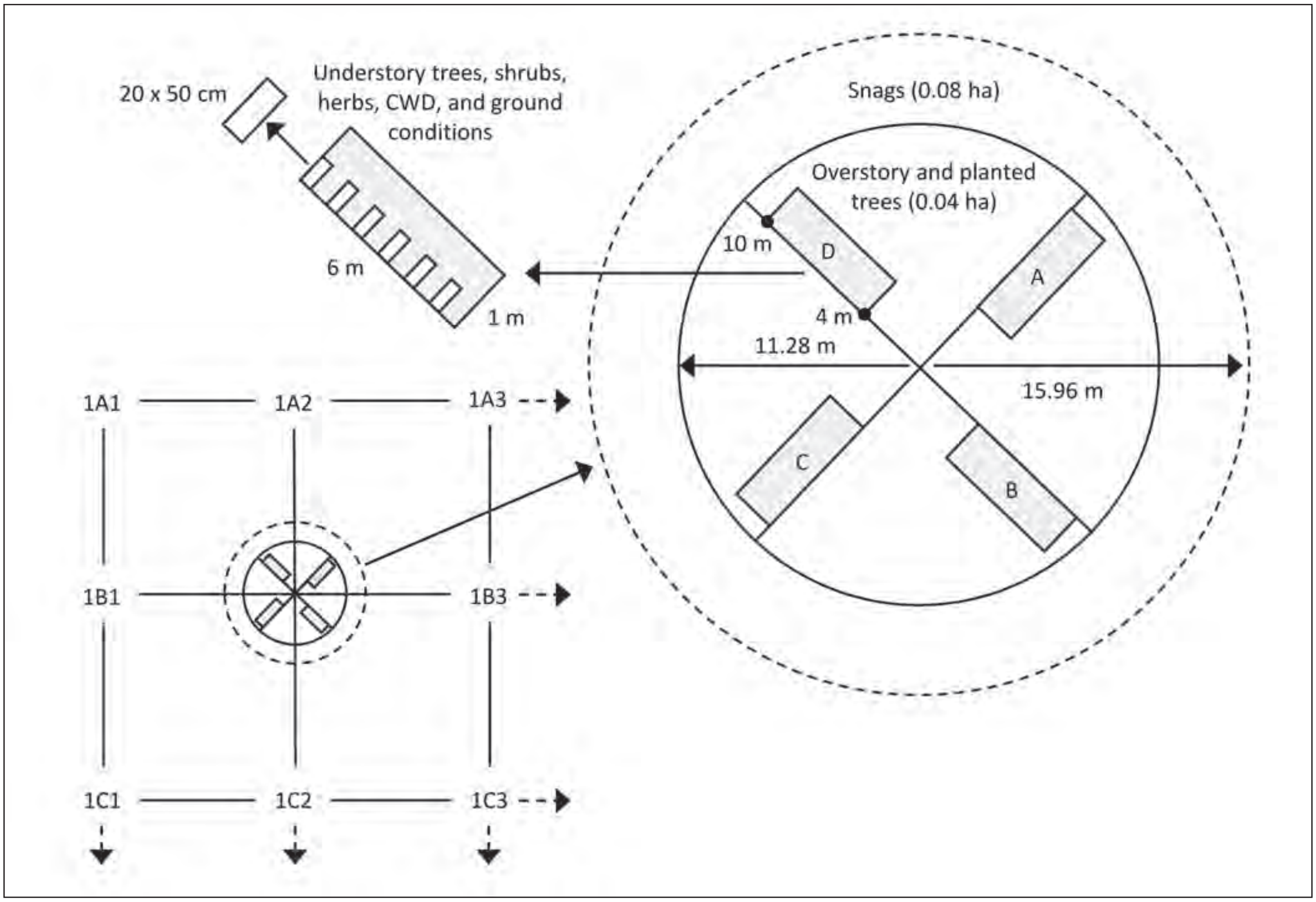

Figure 7—Permanent nested-plot design for sampling vegetation along the systematic grid in each treatment unit. Plots are identified by three-character codes representing the treatment number (1 to 6), grid row (letter), and grid column (number). Snags (>25 cm diameter at breast height [dbh], >0.5 m tall) are measured in 0.08-ha plots; overstory trees (≥5 cm dbh) and planted seedlings are measured in 0.04-ha plots. Understory trees (<5 cm dbh) are sampled in four 1 × 6 m belt transects; shrubs and coarse woody debris (CWD) are sampled along four 6-m line transects. Herbs, bryophytes, tree seedlings, and ground conditions are sampled in six 20 × 50 cm quadrats per transect.

10 m from plot center) (fig. 7). Where trees or logs prevented placement of end posts at these locations, posts were offset. Similarly, where trees or logs made it difficult to connect end points with a meter tape, one or more intermediate posts were established. A complete listing of these offset and intermediate posts is available under the TP108 study code in the OSU Forest Science Data Bank (http://andlter.forestry.oregonstate.edu/data/abstract.aspx?dbcode=TP108; see "Entity title 2").

Systematic assessments of the integrity of vegetation transects were last completed in 2015–2016, except for the 75%A treatments in all blocks and all treatments at Capitol Forest, which were last assessed in 1998. Sampling intensity for vegetation varies by treatment. In the unharvested control (100%), alternate grid points are sampled for overstory and understory variables (n = 32 points per treatment). In the dispersed-retention treatments (40%D, 15%D), all points (*n* = 63 or 64) are sampled for overstory and alternate points are sampled for understory. In the aggregated-retention treatments (40%A, 15%A), all points are sampled for overstory and understory in the aggregates (*n* = 24–25 in 40%A, *n* = 10 in 15%A), and a subset of points is sampled in the harvested area (*n* = 12 in 40%A, *n* = 22 in 15%A).

Vegetation was sampled prior to harvest, shortly after harvest, and at ~5-year intervals thereafter.

Vegetation was sampled prior to harvest (1994–1996), shortly after harvest (1998–2000), and at ~5-year intervals thereafter (2003/2004, 2008/2009, and 2016) (table 6). Response variables include an array of structural, compositional, and functional-group metrics. Sampling was terminated in the 75%A treatment at all sites after the first postharvest measurements. At Capitol Forest (CF), understory sampling was terminated after the first postharvest measurement, and overstory sampling was terminated after the 2009 measurement (table 6). Additional details on sampling and analyses of overstory and understory vegetation are available in previous publications (Dovčiak et al. 2006; Halpern et al. 1999, 2005, 2012; Maguire et al. 2006, 2007; Urgenson et al. 2013a, 2013b). All data are archived in FSDB; database contents are described in appendix 11.

Additional short-term studies explored edge-related gradients in understory vegetation (Nelson and Halpern 2005a, 2005b) and conifer regeneration (Whyte 2018, Whyte and Halpern 2019) in or adjacent to forest aggregates, and substrate-specific responses of bryophytes to varying levels of dispersed retention (Halpern et al. 2014). Data from these studies are not archived in FSDB but are available upon request from the authors.

Amphibians and Forest-Floor Small Mammals

Amphibians and forest-floor small mammals were sampled in each treatment unit in all experimental blocks for 2 consecutive years, both before and after treatment (table 7). At each point on the systematic grid, a single pitfall trap was installed near logs or other structures, if possible. Traps consisted of two No. 10 cans taped together to form a cylinder closed at the bottom with a diameter of about 16 cm and a depth of about 35 cm (Corn and Bury 1990). Treatment units within each block were trapped nearly synchronously. Trapping was initiated within a 5-day period after the onset of fall rains (late September to early November), and traps remained open for about 28 days.

Pitfalls were operated as kill traps (although some amphibians were found alive) by filling them partially with water that remained near freezing temperatures during autumn sampling; traps were checked weekly. Data collected for all captures included species, weight (±0.5 g), total length (±1 mm, salamanders

Table 6—Dates of pre- and posttreatment sampling of vegetation

Response variable	Pre- or post-treatment	Watson Falls	Dog Prairie	Butte	Little White Salmon	Paradise Hills	Capitol Forest
Plot physical/site characteristics	Pre	1994–1995	1996	1994–1995	1995	1995	1995
Overstory canopy cover:							
“Moosehorn” densiometer	Pre	1994–1995	1996	1994–1995	1995	1995	1995
“Truck-mirror” densiometer	Pre				1997–1998	1997	1997
	Post	1999	1999	1998	1999	1998	1998
Overstory trees: harvest damage	Post	1999	1999	1998	1999	1998	1998
Overstory trees: diameter	Pre	1994–1995	1996	1994–1995	1995	1995	1995
	Post[a]	1999	1999	1998	1999	1998	1998
		2003	2003	2003	2003	2003	2003
		2009	2009	2009	2009	2009	2009
		2016	2016	2016	2016	2016	
Overstory trees: height	Pre	1995	1997	1995	1996	1996	1996
	Post[b]	2000	2000	1999	2000	1999	1999
		2003	2003	2003	2003	2003	2003
		2009	2009	2009	2009	2009	2009
		2016	2016	2016	2016	2016	
Overstory trees: mortality	Post[c]	2000	2000	1999	2000	1999	1999
		2001	2001	2000	2001	2000	2000
		2003	2003	2001	2003	2001	2001
		2009	2009	2003	2009	2003	2003
		2016	2016	2009	2016	2009	2009
				2016		2016	
Snags: diameter, height, and decay class	Pre	1994–1995	1996	1994–1995	1995	1995	1995
	Post[d]	1999	1999	1998	1999	1998	1998
		2000	2000	1999	2000	1999	1999
		2001	2001	2000	2001	2000	2000
		2003	2003	2001	2003	2001	2001
		2009	2009	2003	2009	2003	2003
		2016	2016	2009	2016	2009	2009
				2016		2016	

Table 6—Dates of pre- and posttreatment sampling of vegetation (continued)

Response variable	Pre- or post-treatment	Watson Falls	Dog Prairie	Butte	Little White Salmon	Paradise Hills	Capitol Forest
Logging disturbance: soil disturbance, slash cover/depth	Post	1999	1999	1998	1999	1998	1998
Ground-surface conditions: cover of substrates	Pre	1994–1995	1996	1994–1995	1995	1995	1995
	Post[a]	1999	2000	1998	1999	1998	1998
		2004	2004	2004	2004	2004	
		2008	2008	2009	2008	2008	
Coarse woody debris: volume by species and decay class	Pre	1994–1995	1996	1994–1995	1995	1995	1995
	Post[a]	1999	1999	1998	1999	1998	1998
		2004	2004	2004	2004	2004	
		2008	2008	2009	2008	2008	
Bryophytes: total cover	Pre	1994–1995	1996	1994–1995	1995	1995	1995
	Post[a]			1998	1999	1998	1998
				2004	2004	2004	
				2009	2008	2008	
Bryophytes: species presence	Pre	1994–1995	1996	1994–1995	1995	1995	1995
	Post[a]			1998	1999	1998	1998
Bryophytes: cover and diversity by substrate (100%, 40%D, and 15%D only)	Post			2005	2005	2005	
Herbs: species cover	Pre	1994–1995	1996	1994-1995	1995	1995	1995
	Post[a]	1999	2000	1998	1999	1998	1998
		2004	2004	2004	2004	2004	
		2008	2008	2008	2008	2008	
Shrubs/understory trees: species cover, height	Pre	1994–1995	1996	1994–1995	1995	1995	1995
	Post[a]	1999	2000	1998	1999	1998	1998
		2004	2004	2004	2004	2004	
		2008	2008	2009	2008	2008	

Table 6—Dates of pre- and posttreatment sampling of vegetation (continued)

Response variable	Pre- or post-treatment	Watson Falls	Dog Prairie	Butte	Little White Salmon	Paradise Hills	Capitol Forest
Seedling density (<10 cm tall)	Pre	1994–1995	1996	1994–1995	1995	1995	1995
	Post[a]	1999	2000	1998	1999	1998	1998
		2004	2004	2004	2004	2004	
		2008	2008	2009	2008	2008	
Natural regeneration density (≥10 cm tall, <5 cm dbh)	Pre	1994–1995	1996	1994–1995	1995	1995	1995
	Post[a]	1999	2000	1998	1999	1998	1998
		2003	2009	2009	2009	2003	
		2009	2016	2016	2016	2009	
		2016				2016	
Natural regeneration leader growth	Post	2003				2003	
Planted seedlings: survival and height	Post[a]	1999	1999	1998	1999	1999	1999
		2000	2000	1999	2000	2000	2000
		2003	2001	2000	2003	2003	2001[e]
		2009	2003	2003	2009	2009	2003
			2009	2009			2009
Repeat photography (permanent photo points)[f]	Pre	1996–1998	1998		1996–1998	1996–1997	1996–1997
	Post	2000	2000	2000	2000	2000	2000
		2006	2006	2006	2006	2006	2006

[a] 75%A last sampled in 1998–1999.
[b] 75%A last sampled in 2003.
[c] 75%A last sampled in 2001.
[d] 75%A last sampled in 2000.
[e] 40%D only, planted 1 year later than the other treatments.
[f] Image files are available on request from the Oregon State University Forest Science Data Bank (see entity 20 under study code TP108; http://andlter.forestry.oregonstate.edu/data/abstract.aspx?dbcode=TP108).

Table 7—Dates of pre- and posttreatment sampling of wildlife

Response variable (sampling method)	Pre- or post-treatment	Watson Falls	Dog Prairie	Butte	Little White Salmon	Paradise Hills	Capitol Forest
Amphibians and forest-floor small mammals (pitfall trapping)	Pre	1995–1996	1995–1996	1995–1996	1995–1996	1995–1996	1995–1996
	Post	1999–2000	1999–2000	1998–1999	1999–2000	1998–1999	1998–1999
Arboreal rodents (live trapping)	Pre[a]	1995–1996[b]	1995[c]	1995–1996	1994–1995[c]	1994–1995[c]	1995–1996
	Post	1999–2000		1998–1999			1998–1999
Bats (ultrasonic detectors)	Pre	1994–1995	1995–1996	1994–1995	1994–1995	1994–1995	1995–1996
	Post	1999–2000	1999–2000	1998–1999	1999–2000	1998–1999	1998–1999
Diurnal forest birds (point counts)[d]	Pre	1994–1995	1996–1997	1995–1996	1995–1996	1995–1996	1995–1996
	Post	2000–2001	2000–2001	1998–1999	1999–2000	1998–1999	1999–2000
Diurnal forest birds (spot mapping)	Pre	1994	1997	1996	1996	1996	1996
	Post	2000–2001	2000–2001	1998–1999	1999–2000	1998–1999	1999–2000

[a] During pretreatment trapping, 75%A was not sampled because of logistical constraints.
[b] Live trapping of arboreal rodents also occurred during pilot studies in 1993 and 1994.
[c] Pretreatment data indicated that flying squirrel abundances were too low to justify posttreatment sampling.
[d] Data on Douglas' squirrels (*Tamiasciurus douglasii*) and Townsend's chipmunks (*Tamias townsendii*) were also obtained during point counts of diurnal birds.

only), snout-vent length (±1 mm, salamanders and frogs), and condition (alive, dead, decaying). Sex was usually reported for dead animals (~70 percent of captures) and, if possible, for live animals. Data collected for a subset of dead female amphibians included presence of eggs in the body cavity, number of yolked eggs, typical diameter of yolked eggs (±0.5 mm), and number of egg generations present. Other notes included loss or condition of the tail. Live animals were marked by toe clipping and released.

Small mammals were dissected in the lab. Data collected included species, sex, body size (total and tail length, weight), and reproductive data. Dental or skull characters were used to identify shrews and voles; a tail-length threshold of 96 mm was used to separate adult *Peromyscus keeni* from *P. maniculatus* (Allard et al. 1987). In addition, juveniles (<16 g) with undamaged tails <85 mm in length were identified as *P. maniculatus*. Additional details on sampling and data analyses for amphibians and small mammals are available in previous publications (Gitzen 2006, Gitzen and West 2002, Gitzen et al. 2007, Maguire et al. 2005). Data are archived in FSDB; database contents are described in appendix 12.

Arboreal Rodents

Arboreal rodents were sampled for 2 consecutive years both before and after treatment in only three of the experimental blocks (table 7) because pretreatment sampling in the remaining blocks indicated that flying squirrel abundances were too low to detect treatment effects (Lehmkuhl et al. 1999). Live-trap and mark-recapture techniques were employed. One Tomahawk 201 trap was set at each grid point from mid-September to early November. Before treatment, trap placement alternated between the ground and a height of 1.5 m on the bole of an adjacent tree; after treatment, all traps were placed on the ground. During each year, traps were opened for 4 consecutive nights in each of 2 consecutive weeks, closed for 2 weeks, then opened again for a second 2-week period. Thus, each trapping session encompassed 6 weeks per year (16 trap-nights per trap per year).

Each trap was covered with a waxed milk carton and had an insulated nest box attached to it. Traps were baited with a mixture of peanut butter, rolled oats, and molasses, and checked daily. Captured animals were individually marked with a numbered metal tag in each ear, identified to species, sexed, aged, weighed, and released. During the first pretreatment year (1995), logistical constraints prevented sampling of the 75%A treatments. Additional details on sampling and analyses of arboreal rodents are available in previous publications (Holloway et al. 2012, Wilk et al. 2015). Data are archived in FSDB; database contents are described in appendix 12.

Bats

Bat activity was sampled in all experimental blocks for 2 consecutive years both before and after treatment (table 7). Ultrasonic detectors were used to survey for 2 consecutive nights on at least three occasions per field season (late June through early September). Before treatment, one monitoring station was placed in each experimental unit. After treatment, one station was placed in the control (100%) and two in both dispersed-retention (40%D, 15%D) and aggregated-retention (40%A, 15%A) treatments. In the latter, one detector was placed in an aggregate and one in the harvested area. Detectors were placed 1 m from the ground surface, oriented 30 degrees from horizontal, and set to record for 8 to 9 hours, beginning at dusk. For data analyses, bat species were grouped based on echolocation call characteristics as either small-bodied *Myotis* or larger bodied non-*Myotis*. Additional details on sampling and analyses of bat activity are available in previous publications (Erickson 1998, Erickson and Adams 2003, Erickson and West 2003). Data are archived in FSDB; database contents are described in appendix 12.

Diurnal Forest Birds

Diurnal forest birds were sampled in all experimental blocks. Sampling included both point counts (2 consecutive years both before and after treatment) and territory (spot) mapping (1 year before treatment and 2 consecutive years after treatment) (table 7). For point counts, four stations were established in each treatment unit >160 m apart and >80 m from the treatment boundaries. Each unit was surveyed six times during the breeding season (May to mid July). All birds within 50 m were tallied by species for 8 minutes at each station, and each survey was completed within 3 hours of dawn. Spot mapping was conducted as observers walked between point-count stations and after point counts were completed. Indices of relative abundance were computed as the mean number of detections per species, visit, and treatment unit. Pairing success (defined as the number of territories in each treatment unit in which males successfully paired) was assessed by observing (1) females in territories, (2) pairing and nesting behavior, and (3) changes in male song type. Additional details on sampling and analyses of diurnal forest birds are available in previous publications (Leu 2000, Wilk 2019). Data are archived in FSDB; database contents are described in appendix 12.

Foliage-, Bark-, and Litter-Dwelling Arthropods

Foliage-dwelling arthropods were sampled in all blocks before treatment (1996) and for 2 consecutive years after treatment (1999, 2000) (table 8). In each treatment unit, one dominant Douglas-fir was rigged for canopy access. In 40%A and 15%A treatments, the tree selected was near the center of a planned aggregate; after treatment a second tree was added near the edge of the aggregate to assess edge effects. Each tree was sampled in June and August of each year at three canopy positions: within 5 m of the top, mid-canopy, and within 5 m of the lowest foliated branch. At each position, a plastic bag was placed over a branch for a distance of 0.5 m, the branch was clipped, and the bag was sealed. In addition to sampling overstory Douglas-fir, three understory vine maples (*Acer circinatum*) were sampled in each treatment unit in the three Washington blocks in which vine maple was common. Locations within each unit were chosen in a manner similar to that of Douglas-fir, but only a single branch was sampled per individual.

Arthropods collected from each sample were sorted and identified in the laboratory. Foliage and branch material were dried at 50 °C to a constant weight. Arthropod abundance was standardized as the number of individuals per kilogram of plant sample. Taxa were analyzed by functional group (folivores, sap-suckers, gall-formers, predators, and detritivores), although the abundance patterns of common species were also examined. Additional details on sampling and analyses of foliage-dwelling arthropods are available in previous publications (Progar and

Table 8—Dates of pre- and posttreatment sampling of foliage-, bark-, and litter-dwelling arthropods

Response variable (sampling method)	Pre- or posttreatment	Watson Falls	Dog Prairie	Butte	Little White Salmon	Paradise Hills	Capitol Forest
Foliage-dwelling arthropods (branch sampling)	Pre	1996	1996	1996	1996	1996	1996
	Post	1999–2000	1999–2000	1999–2000	1999–2000	1999–2000	1999–2000
Bark-dwelling arthropods (crawl trapping)	Post[a]	2003–2004		2003–2004	2003–2004		
Litter-dwelling arthropods (pitfall trapping)	Post[a]	2003–2004		2003–2004	2003–2004	2003–2004	

[a] 75%A was not sampled because of logistical constraints.

Schowalter 2002, Progar et al. 1999, Schowalter et al. 2005). Only pretreatment data are archived in FSDB; database contents are described in appendix 13.

Bark- and litter-dwelling arthropods (the latter limited to spiders and carabid beetles) were sampled 5 to 7 years after treatment in a subset of the experimental blocks and treatments (table 8). Sample locations coincided with permanent vegetation plots to assess the importance of local habitat structure. Bark-dwelling arthropods were sampled using "crawl" traps placed 1.5 to 2 m from the ground surface on live and dead trees. Drift fences guided crawling arthropods upward into a collecting cup containing a preservative. Traps were installed on 20 live and 20 dead trees (all Douglas-firs ≥50 cm dbh) in each of four treatments (100%, 40%D, 40%A, and 15%D) and on half as many live and dead trees in 15%A. Because many snags were felled during harvest, a significant proportion (35 to 80 percent) of snags in the dispersed-retention treatments were those created artificially by girdling or topping (see "Treatment Implementation: Yarding, Snag Creation, Slash Reduction, and Planting of Tree Seedlings"). Traps were installed in April–May 2003 and remained open for 2 to 4 weeks during each of four to six sampling periods from May through August. Specimens were identified in the laboratory: spiders to the lowest taxon possible and non-arachnids to order. Abundance was expressed as an activity-density index (number of individuals collected/trap/day). Additional details on sampling and analyses of bark-dwelling arthropods are provided in Halaj et al. (2009). Data are archived in FSDB; database contents are described in appendix 13.

Litter-dwelling arthropods were sampled 5 to 7 years after treatment in a subset of the experimental blocks and treatments (table 8) using pitfall traps. Each trap consisted of two plastic cups (12.5 cm in diameter). A larger, 8-cm-deep "sleeve" cup buried flush with the soil surface formed a receptacle for a smaller "collecting" cup containing preservative. Each trap was covered by a metal "roof" (13 ×

13 cm) set 3 to 5 cm above the soil surface. In the unharvested control (100%) and dispersed-retention treatments (40%D, 15%D), traps were placed in 15 randomly selected vegetation plots. In the aggregated-retention treatments (40%A, 15%A), traps were installed in plots at varying distances from aggregate edges, both inside and outside of the aggregates: (1) the centers of aggregates (n = 2 to 5 per treatment unit); (2) intermediate positions within aggregates (~15 m from the edge, n = 3 to 4 per unit); (3) aggregate edges (n = 6 to 8 per unit); and (4) harvested areas (~20 to 100 m from the edge, n = 8 per treatment). Traps were installed in June 2003 and sampled for 2 weeks in each of June, July, and August in 2003 and 2004. Collected arthropods were preserved in ethanol and identified to the lowest taxon possible. Analyses focused on the major predaceous groups: Araneae (spiders), Opiliones (harvestmen), and Carabidae (ground beetles). Additional details on sampling and analyses of litter-dwelling arthropods are provided in Halaj et al. (2008). Data are archived in FSDB; database contents are described in appendix 13.

Ectomycorrhizal Fungi

Ectomycorrhizal sporocarps (mushrooms and truffles) were sampled in all treatments in three of the experimental blocks (table 9). Sampling was timed to peak fruiting in spring and fall in 2 to 3 consecutive years both before and after harvest. Mushrooms (epigeous sporocarps) were collected from six strip plots (2 × 50 m) per treatment unit. Three were permanent plots (one each at upper-, mid-, and lower-slope positions); three were nonpermanent plots (repositioned at each sampling date). In the aggregated-retention treatments (75%A, 40%A, and 15%A), postharvest samples were distributed in proportion to the area comprising aggregates and clearings.

Truffles (hypogeous sporocarps) were sampled in 25 4-m^2 plots per treatment unit, arrayed along transects nested within the nonpermanent plots. However, for one pre- and posttreatment sample in both spring and fall, truffle plots were systematically dispersed across each grid. As with mushroom plots, in the aggregated-retention treatments, postharvest samples were distributed in proportion to the area comprising aggregates and clearings. In each truffle plot, the forest floor was raked to a depth of 5 to 10 cm to expose sporocarps in the upper soil layers. Sporocarps were identified to the lowest taxonomic level possible, dried for 8 to 18 hours at 63 °C, and

Table 9—Dates of pre- and posttreatment sampling of ectomycorrhizal fungi

Response variable	Pre- or posttreatment	Watson Falls	Dog Prairie	Butte	Little White Salmon	Paradise Hills	Capitol Forest
Mushroom and truffle sporocarps	Pre	1993–1996	1995–1997	1994–1996			
	Post	1999–2001	1999–2001	1998–2000			

weighed to the nearest 0.01 g. Analyses focused on seasonal differences in sporocarp production (biomass) among treatments. Additional details on sampling and analyses of ectomycorrhizal fungi are available in Luoma et al. (2004). Data are archived in FSDB; database contents are described in appendix 14.

Microclimate

Microclimatic conditions were assessed in a subset of the experimental blocks and treatments 6 to 7 years after harvest (2004) (table 10). The primary response variables included light availability, air and soil temperature (daily mean and maximum), and soil moisture. Two sampling designs were used. The first design sampled variation across the gradient of dispersed retention (0, 15, 40, and 100 percent) with the harvested (cleared) portions of 15%A used to represent 0 percent retention. Measurements were made at 20 of the 22 to 32 permanent vegetation plots within each unit. The second design sampled variation across the edges of aggregates (15%A only). Four transects (two per aggregate) were established in each unit along the lines of the systematic grid; at each aggregate, transects were oriented perpendicular to each other to sample different exposures. Each transect began at the aggregate center and extended into the harvested area to a distance of 63 m from the aggregate edge. Measurements were made at 15 points along the transect: eight inside the aggregate (0, 5, 10, 15, 20, 30, 40 and 56.4 m from the edge) and seven in the harvested area (5, 10, 15, 20, 30, 40, and 63 m from the edge).

Estimates of light availability were obtained from hemispherical photographs of the forest canopy taken 2 m above the ground surface. Images were analyzed with the software Gap Light Analyzer 2.0 (GLA) (Frazer et al. 1999), employing the standard overcast sky model (UOC). Total transmitted light, or photosynthetic photon flux density (PPFD), was calculated for the growing season (June through September). Air and soil temperature were measured using temperature

Table 10—Dates of posttreatment sampling of microclimate

Study	Pre- or posttreatment	Watson Falls	Dog Prairie	Butte	Little White Salmon	Paradise Hills	Capitol Forest
Variation with level of retention[a]	Post			2004	2004	2004	
Gradients in and adjacent to forest aggregates[b]	Post			2004	2004	2004	

[a] Four environments were sampled representing a gradient of dispersed retention in each block: the harvested portion of 15%A (0 percent retention), 15%D, 40%D, and 100% (control).
[b] Transects were used to sample gradients in microclimate across the edges of aggregates in 15%A. Data were compared to two types of controls: 0 percent retention (harvested portions of 15%A) and 100%.

data loggers (Model DS1921G, iButton Thermochron).[1] Two loggers were used at each sample point: the first on a wooden stake 1 m above the ground surface (air), the second 15 cm beneath the ground surface (soil). Loggers for air temperature were placed on the inside of one-half of a small (10 cm deep) plastic cup covered with aluminum foil to prevent direct radiation and perforated to allow airflow. Cups were attached to a wooden post extending perpendicular from the top of each stake. Air and soil temperatures were recorded hourly during a 2- to 3-week period between mid July and late September. Measurements were synchronous within blocks but staggered among blocks. From these continuous measurements, 5 days were selected for analysis to represent the most stressful summer conditions (i.e., hot sunny days).

Volumetric soil moisture was measured using time domain reflectometry (TDR). Stainless steel probes, 30 cm long, were inserted at a 30° angle to the soil surface to sample the upper 15 cm of mineral soil. Probes remained in place for the entire sampling period. At the time of measurement, probes were attached to a TDR monitor with alligator clips soldered to coaxial wire and data were recorded on a palmtop computer. Multiple measurements were made over the growing season to track the seasonal decline in available moisture. At each measurement, all points within a block were sampled in a 1- to 2-day period of dry weather (no precipitation during the previous 48 hours). All blocks were visited in the same week. Additional details on sampling and analyses of microclimatic conditions are available in previous publications (Heithecker 2005; Heithecker and Halpern 2006, 2007). Data are archived in FSDB; database contents are described in appendix 15.

Public Perceptions (Aesthetics)

Several survey-based studies were conducted to evaluate public perceptions of the visual qualities of variable-retention harvests, although they did not use the DEMO treatments directly (Ribe 2005a, 2005b; 2006; 2009; Ribe et al. 2013). Opinion surveys were based on photographs (some simulated) representing a broad array of retained forest structures, accompanied by narratives describing the ecological and resource values portrayed by these images. The data generated by these studies are not archived in FSDB, but the publications resulting from this work are listed in appendix 1.

[1] The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

The DEMO Study: Unique Opportunities for Research on Variable-Retention Harvests

Long-term ecological studies are recognized as critical tools for documenting and addressing environmental challenges in a world increasingly dominated by human influences (Hobbie et al. 2003, Lindenmayer et al. 2012b, Strayer et al. 1986), and provide unique insights into ecological processes that are highly dynamic or time dependent (e.g., reflecting the life spans, growth rates, or dispersal abilities of organisms). Long-term experiments also serve broader purposes in science and resource management: they provide data that can be used to develop, test, or parameterize theoretical or simulation models; they serve as infrastructures and catalysts for multi- or interdisciplinary endeavors; and they address questions and uncertainties that help to shape natural resource management and policy (Lindenmayer et al. 2012b, Poage and Anderson 2007).

Globally, retention forestry is emerging as an important tool for providing wood while maintaining biodiversity (Gustaffson et al. 2012, Lindenmayer et al. 2012a). In various parts of the world, operational-scale experiments in variable retention have been initiated to address the information needs of forest managers (see review in Gustaffson et al. 2012). These studies generally support the hypothesis that partial retention of the overstory benefits biodiversity, at least in the short term (Fedrowitz et al. 2014, Gustaffson et al. 2012, Mori and Kitigawa 2014, Rosenvald and Lõhmus 2008). However, there is a critical need for longer term studies, given the life spans of many forest organisms and the long time periods during which forests regenerate and mature. The DEMO Study is unique among operational-scale, variable-retention experiments in its longevity and design, investments in infrastructure and data quality, and ease of accessing existing data and metadata archives. This report provides critical documentation of these investments to facilitate future studies, analyses, and syntheses.

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List of Tree Species Identified in This Report

Common name	Scientific name
Douglas-fir	*Pseudotsuga menziesii* (Mirb.)
Grand fir	*Abies grandis* (Douglas ex D. Don) Lindl.
Incense cedar	*Calocedrus decurrens* (Torr.) Florin
Pacific dogwood	*Cornus nuttallii* Audubon ex Torr. & A. Gray
Pacific silver fir	*Abies amabilis* (Douglas ex Loudon) Douglas ex Forbes
Ponderosa pine	*Pinus ponderosa* Lawson & C. Lawson
Red alder	*Alnus rubra* Bong.
Shasta red fir	*Abies magnifica* A. Murray bis var. *shastensis* Lemmon
Vine maple	*Acer circinatum* Pursh
Western hemlock	*Tsuga heterophylla* (Raf.) Sarg.
Western redcedar	*Thuja plicata* Donn ex D. Don
Western white pine	*Pinus monticola* Douglas ex. D. Don
White fir	*Abies concolor* (Gord & Glend.) Lindl. Ex Hildebr.

U.S. Equivalents

When you have:	Multiply by:	To get:
Millimeters (mm)	0.0394	Inches
Centimeters (cm)	0.394	Inches
Meters (m)	3.28	Feet
Square meters (m^2)	10.76	Square feet
Hectares (ha)	2.47	Acres
Grams (g)	0.0352	Ounces
Degrees Celsius (°C)	1.8 °C + 32	Degrees Fahrenheit

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Swanson, M.E.; Studevant, N.M.; Campbell, J.L.; Donato, D.C. 2014. Biological associates of early-seral pre-forest in the Pacific Northwest. Forest Ecology and Management. 324: 160–171.

Tittler, R.; Hannon, S.J.; Norton, M.R. 2001. Residual tree retention ameliorates short-term effects of clear-cutting on some boreal songbirds. Ecological Applications. 11(6): 1656–1666.

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Urgenson, L.S.; Halpern, C.B.; Anderson, P.D. 2013a. Twelve-year responses of planted and naturally regenerating conifers to variable-retention harvest in the Pacific Northwest, USA. Canadian Journal of Forest Research. 43(1): 46–55.

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Appendix 1: Publications, Dissertations, and Theses From the DEMO Study, 1996–2018

Citations are arranged chronologically within each category.

History, Overview, and Synthesis

Abbott, R.S.; White, J.D.; Woodard, B.L. 1999. The benefits and challenges of large-scale silvicultural experiments: perspectives from forest managers on the Demonstration of Ecosystem Management Options (DEMO) study. Northwest Science. 73(Special Issue): 118–125.

Aubry, K.B.; Amaranthus, M.P.; Halpern, C.B.; White, J.D.; Woodard, B.L.; Peterson, C.E.; Lagoudakis, C.A.; Horton, A.J. 1999. Evaluating the effects of varying levels and patterns of green-tree retention: experimental design of the DEMO study. Northwest Science. 73(Special Issue): 12–26.

Franklin, J.F.; Norris, L.A.; Berg, D.R.; Smith, G.R. 1999. The history of DEMO: an experiment in regeneration harvest of northwestern forest ecosystems. Northwest Science. 73(Special Issue): 3–11.

Aubry, K.B.; Halpern, C.B.; Maguire, D.A. 2004. Ecological effects of variable-retention harvests in the northwestern United States: the DEMO study. Forest Snow and Landscape Research. 78(1): 119–134.

Maguire, D.A.; Canavan, S.; Halpern, C.B.; Aubry, K.B. 2005. Fate of taxa after variable-retention harvesting in Douglas-fir forests of the northwestern United States. In: Peterson, C.E.; Maguire, D.A., eds. Balancing ecosystem values: innovative experiments for sustainable forestry. Gen. Tech. Rep. PNW-GTR-635. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 271–279.

Thompson, J. 2007. Green-tree retention in harvest units: boon or bust for biodiversity? Science Findings 96. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 6 p. http://www.fs.fed.us/pnw/sciencef/scifi96.pdf.

Aubry, K.B.; Halpern, C.B.; Peterson, C.E. 2009. Variable-retention harvests in the Pacific Northwest: a review of short-term findings from the DEMO study. Forest Ecology and Management. 258(4): 398–408.

Peterson, C.E.; Anderson, P.D. 2009. Large-scale interdisciplinary experiments inform current and future forestry management options in the U.S. Pacific Northwest. Forest Ecology and Management. 258(4): 409–414.

Disturbance and Microclimate

Halpern, C.B.; McKenzie, D. 2001. Disturbance and post-harvest ground conditions in a structural retention experiment. Forest Ecology and Management. 154(1–2): 215–225.

Heithecker, T.D. 2005. Variation in microclimate associated with dispersed-retention harvests in coniferous forests of the Pacific Northwest. Seattle, WA: University of Washington. 44 p. M.S. thesis.

Heithecker, T.D.; Halpern, C.B. 2006. Variation in microclimate associated with dispersed-retention harvests in coniferous forests of western Washington. Forest Ecology and Management. 226(1): 60–71.

Heithecker, T.D.; Halpern, C.B. 2007. Edge-related gradients in microclimate in forest aggregates following structural retention harvests in western Washington. Forest Ecology and Management. 248(3): 163–173.

Overstory and Understory Vegetation

Pipp, A.K. 1998. Effects of forest age versus forest structure on epiphytic lichen biomass and diversity. Missoula, MT: University of Montana. 84 p. M.S. thesis.

Zenner, E.K. **1998**. A new index for describing the structural complexity of forests. Corvallis, OR: Oregon State University. 177 p. Ph.D. dissertation.

Halpern, C.B.; Evans, S.A.; Nelson, C.R.; McKenzie, D.; Liguori, D.A.; Hibbs, D.E.; Halaj, M.G. 1999. Response of forest vegetation to varying levels and patterns of green-tree retention: an overview of a long-term experiment. Northwest Science. 73(Special Issue): 27–44.

McKenzie, D.; Halpern, C.B.; Nelson, C.R. 2000. Overstory influences on herb and shrub communities in mature forests of western Washington, USA. Canadian Journal of Forest Research. 30(10): 1655–1666.

Winter, L.E. 2000. Five centuries of structural development in an old-growth Douglas-fir stand in the Pacific Northwest: a reconstruction from tree-ring records. Seattle, WA: University of Washington. 134 p. Ph.D. dissertation.

Zenner, E.K.; Hibbs, D.E. 2000. A new method for modeling the heterogeneity of forest structure. Forest Ecology and Management. 129(1–3): 75–87.

Pipp, A.K.; Henderson, C.; Callaway, R.M. 2001. Effects of forest age and forest structure on epiphytic lichen biomass and diversity in a Douglas-fir forest. Northwest Science. 75(1): 12–24.

Keyes, C.R. 2002. Recruitment of ponderosa pine seedlings beneath partial overstories. Corvallis, OR: Oregon State University. 193 p. Ph.D. dissertation.

Moore, J.R.; Maguire, D.A.; Phillips, D.L.; Halpern, C.B. 2002. Effects of varying levels and patterns of green-tree retention on amount of harvesting damage. Western Journal of Applied Forestry. 17(4): 202–206.

Winter, L.E.; Brubaker, L.B.; DeWitt, D.Q.; Franklin, J.F.; Miller, E.A. 2002. Initiation of an old-growth Douglas-fir stand in the Pacific Northwest: a reconstruction from tree-ring records. Canadian Journal of Forest Research. 32(6): 1039–1056.

Moore, J.R.; Mitchell, S.J.; Maguire, D.A.; Quine, C.P. 2003. Wind damage in alternative silvicultural systems: review and synthesis of previous studies. In: Ruck, B.; Kottmeier, C.; Mattheck, C.; Quine, C.; Willhelm, G., eds. Proceedings of the international conference: wind effects on trees. Karlsruhe, Germany: University of Karlsruhe: 191–198.

Nelson, C.R. 2004. Effects of timber harvest and forest edges on abundance, viability, and physiology of understory plants in *Pseudotsuga* forests of western Washington. Seattle, WA: University of Washington. 97 p. Ph.D. dissertation.

Halpern, C.B.; McKenzie, D.; Evans, S.A.; Maguire, D.A. 2005. Initial responses of forest understories to varying levels and patterns of green-tree retention. Ecological Applications. 15(1): 175–195.

Nelson, C.R.; Halpern, C.B. 2005a. Edge-related responses of understory plants to aggregated retention harvest in the Pacific Northwest. Ecological Applications. 15(1): 196–209.

Nelson, C.R.; Halpern, C.B. 2005b. Short-term effects of timber harvest and forest edges on ground-layer mosses and liverworts. Canadian Journal of Botany. 83(6): 610–620.

Dovčiak, M.; Halpern, C.B.; Saracco, J.F.; Evans, S.A.; Liguori, D.A. 2006. Persistence of ground-layer bryophytes in a structural retention experiment: initial effects of level and pattern of overstory retention. Canadian Journal of Forest Research. 36(11): 3039–3052.

Maguire, D.A.; Mainwaring, D.B.; Halpern, C.B. 2006. Stand dynamics after variable-retention harvesting in mature Douglas-fir forests of western North America. Allgemeine Forst Und Jagdzeitung. 177: 120–131.

Maguire, D.A.; Halpern, C.B.; Phillips, D.L. 2007. Changes in forest structure following variable-retention harvests in Douglas-fir dominated forests. Forest Ecology and Management. 242: 708–726.

Nelson, C.R.; Halpern, C.B.; Antos J.A. 2007. Variation in responses of late-seral herbs to disturbance and environmental stress. Ecology. 88(11): 2880–2890.

Michel, A.K.; Winter, S. 2009. Tree microhabitat structures as indicators of biodiversity in Douglas-fir forests of different stand ages and management histories in the Pacific Northwest, U.S.A. Forest Ecology and Management. 257(6): 1453–1464.

Lam, T.Y. 2010. Exploration of statistical methods for synthesizing the effects of variable-retention harvesting on multiple taxa. Corvallis, OR: Oregon State University. 262 p. Ph.D. dissertation.

Evans, S.A.; Halpern, C.B.; McKenzie, D. 2012. The contributions of forest structure and substrate to bryophyte diversity and abundance in mature coniferous forests of the Pacific Northwest. The Bryologist. 115(2): 278–294.

Halpern, C.B.; Halaj, J.; Evans, S.A.; Dovčiak, M. 2012. Level and pattern of overstory retention interact to shape long-term responses of understories to timber harvest. Ecological Applications. 22(8): 2049–2064.

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Halpern, C.B.; Dovčiak, M.; Urgenson, L.S.; Evans, S.A. 2014. Substrates mediate responses of forest bryophytes to a gradient in overstory retention. Canadian Journal of Forest Research. 44(8): 855–866.

Whyte, B.J. 2018. Long-term influence of retained forest aggregates on conifer regeneration in harvest units of the Pacific Northwest. Seattle, WA: University of Washington. 44 p. M.S. thesis.

Whyte, B.J.; Halpern, C.B. 2019. Forest aggregates influence conifer recruitment and height growth in a long-term variable-retention experiment. Forest Ecology and Management. 441: 42–56.

Amphibians, Forest-Floor Small Mammals, Arboreal Rodents, Bats, and Diurnal Forest Birds

Thompson, R.L. 1996. Home range and habitat use of western red-backed voles in mature coniferous forests in the Oregon Cascades. Corvallis, OR: Oregon State University. 88 p. M.S. thesis.

Brett, T.A. 1997. Habitat associations of woodpeckers at multiple scales in managed forests of the southern Oregon Cascades. Corvallis, OR: Oregon State University. 95 p. M.S. thesis.

Feen, J.S. 1997. Winter den sites of northern flying squirrels in Douglas-fir forests of the south-central Oregon Cascades. Corvallis, OR: Oregon State University. 45 p. M.S. thesis.

Erickson, J.L. 1998. The influence of regional, landscape, and local habitat conditions on bat activity in forests of the Pacific Northwest. Seattle, WA: University of Washington. 152 p. Ph.D. dissertation.

Gitzen, R.A. 1999. Small mammal responses to experimental forest gaps in the southern Washington Cascades. Seattle, WA: University of Washington. 125 p. M.S. thesis.

Lehmkuhl, J.F.; West, S.D.; Chambers, C.L.; McComb, W.C.; Manuwal, D.A.; Aubry, K.B.; Erickson, J.L.; Gitzen, R.A.; Leu, M. 1999. Assessing wildlife response to varying levels and patterns of green-tree retention in western Oregon and Washington. Northwest Science. 73(Special Issue): 45–63.

Manning, T.; Maguire, C.C. 1999. A new elevation record for the red tree vole in Oregon: implications for national forest management. American Midland Naturalist. 142(2): 421–423.

Gitzen, R.A.; West, S.D. 2000. Occurrences of the coast mole (*Scapanus orarius orarius*) in the southern Washington Cascades. Northwestern Naturalist. 81(2): 65–66.

Leu, M. 2000. Breeding territory settlement patterns and mate choice in a monochromatic tyrannid flycatcher. Seattle, WA: University of Washington. 119 p. Ph.D. dissertation.

Erickson, J.L.; West, S.D. 2002. The influence of regional climate and nightly weather conditions on activity patterns of insectivorous bats. Acta Chiropterologica. 4(1): 17–24.

Gitzen, R.A.; West, S.D. 2002. Small mammal response to experimental canopy gaps in the southern Washington Cascades. Forest Ecology and Management. 168(1–3): 189–201.

Jacobs, K.M. 2002. Response of small mammal mycophagy to varying levels and patterns of green-tree retention in mature forests of western Oregon and Washington. Corvallis, OR: Oregon State University. 97 p. M.S. thesis.

Maguire, C.C. 2002. Dead wood and the richness of small terrestrial vertebrates in southwestern Oregon. In: Shea, P.; Laudenslayer, W.; Weatherspoon, P.; Valentine, B., eds. Symposium on the ecology and management of dead wood in western forests. Gen. Tech. Rep. PNW-GTR-181. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 331–334.

McDade, K.A. 2002. Habitat relationships of small terrestrial vertebrates and invertebrates in managed forests in the southern Oregon Cascades. Corvallis, OR: Oregon State University. 212 p. M.S. thesis.

Erickson, J.L.; Adams, M.J. 2003. A comparison of bat activity at low and high elevations in the Black Hills of western Washington. Northwest Science. 77(2): 126–130.

Erickson, J.L.; West, S.D. 2003. Associations of bats with local structure and landscape features of forested stands in western Oregon and Washington. Biological Conservation. 109(1): 95–102.

Manning, T.; Maguire, C.C.; Jacobs, K.M.; Luoma, D.L. 2003. Additional habitat, diet and range information for the white-footed vole (*Arborimus albipes*). American Midland Naturalist. 150(1): 116–123.

Waldien, D.L.; Cooley, M.M.; Weikel, J.; Hayes, J.P.; Maguire, C.C.; Manning, T.; Maier, T.; Maier, T.J. 2004. Incidental captures of birds in small mammal traps: a cautionary note for interdisciplinary studies. Wildlife Society Bulletin. 32(4): 1260–1268.

Maguire, C.C.; Manning, T.; West, S.D.; Gitzen, R.A. 2005. Green-tree retention in managed forests: post-harvest responses of salamanders. In: Peterson, C.E.; Maguire, D.A., eds. Balancing ecosystem values: innovative experiments for sustainable forestry. Gen. Tech. Rep. PNW-GTR-635. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 265–270.

McDade, K.A.; Maguire, C.C. 2005. Comparative effectiveness of three techniques for salamander and gastropod land surveys. American Midland Naturalist. 153(2): 309–320.

Gitzen, R.A. 2006. Responses of small mammals to green-tree retention harvests in forests of western Oregon and Washington. Seattle, WA: University of Washington. 128 p. Ph.D. dissertation.

Mayrhofer, M. 2006. Spatial point processes and brown creepers (*Certhia americana*): estimating habitat use of a silvicultural experiment. Seattle, WA: University of Washington. 59 p. M.S. thesis.

Gitzen, R.A.; West, S.D.; Maguire, C.C.; Manning, T.; Halpern, C.B. 2007. Response of terrestrial small mammals to varying amounts and patterns of green-tree retention in Pacific Northwest forests. Forest Ecology and Management. 251(3): 142–155.

Jacobs, K.M.; Luoma, D.L. 2008. Small mammal mycophagy response to variations in green-tree retention. Journal of Wildlife Management. 72(8): 1747–1755.

Thompson, R.L.; Chambers, C.L.; McComb, B.C. 2009. Home range and habitat of western red-backed voles in the Oregon Cascades. Northwest Science. 83(1): 46–56.

Holloway, G.L.; Smith, W.P.; Halpern, C.B.; Gitzen, R.A.; Maguire, C.C.; West, S.D. 2012. Influence of forest structure and experimental green-tree retention on northern flying squirrel (*Glaucomys sabrinus*) abundance. Forest Ecology and Management. 285: 187–194.

Wilk, R.J.; Harrington, T.B.; Gitzen, R.A.; Maguire, C.C. 2015. Forest-floor disturbance reduces chipmunk (*Tamias* spp.) abundance two years after variable-retention harvest of Pacific Northwestern Forests. Northwest Science. 89(1): 75–92.

Wilk, R.J. 2019. Effects of variable-retention treatments on numbers of singing small passerine birds in Pacific Northwest forests. Northwestern Naturalist. 100(1): 60–70.

Ectomycorrhizal Fungi

Cazares, E.; Luoma, D.L.; Amaranthus, M.P.; Chambers, C.L.; Lehmkuhl, J.F. 1999. Interaction of fungal sporocarp production with small mammal abundance and diet in Douglas-fir stands of the southern Cascade Range. Northwest Science. 73(Special Issue): 64–76.

Stockdale, C.A. 2001. Green-tree retention and ectomycorrhiza legacies: the spatial influences of retention trees on mycorrhiza community structure and diversity. Corvallis, OR: Oregon State University. 78 p. M.S. thesis.

Jacobs, K.M. 2002. Response of small mammal mycophagy to varying levels and patterns of green-tree retention in mature forests of western Oregon and Washington. Corvallis, OR: Oregon State University. 97 p. M.S. thesis.

Luoma, D.L.; Eberhart, J.L.; Molina, R.; Amaranthus, M.P. 2004. Response of ectomycorrhizal fungus sporocarp production to varying levels and patterns of green-tree retention. Forest Ecology and Management. 202(1–3): 337–354.

Kolaczkowksi, O. 2005. Effects of spatially dispersed green-tree retention on ectomycorrhiza diversity. Corvallis, OR: Oregon State University. 60 p. M.S. thesis.

Luoma, D.L.; Eberhart, J. 2005. Results from green-tree retention experiments: ectomycorrhizal fungi. In: Peterson, C.E.; Maguire, D.A., eds. Balancing ecosystem values: innovative experiments for sustainable forestry. Gen. Tech. Rep. PNW-GTR-635. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 257–264.

Luoma, D.L.; Stockdale, C.A.; Molina, R.; Eberhart, J.L. 2006. The spatial influence of *Pseudotsuga menziesii* retention trees on ectomycorrhiza diversity. Canadian Journal of Forest Research. 36(10): 2561–2573.

Foliage-, Bark-, and Litter-Dwelling Arthropods

Progar, R.A.; Schowalter, T.D.; Work, T. 1999. Arboreal invertebrate responses to varying levels and patterns of green-tree retention in Northwestern forests. Northwest Science. 73(Special Issue): 77–86.

Work, T. 2000. Edge effects of clearcut harvesting on ground arthropod species composition and predator community structure in old-growth Douglas-fir forests. Corvallis, OR: Oregon State University. 98 p. Ph.D. dissertation.

Progar, R.A.; Schowalter, T.D. 2002. Canopy arthropod assemblages along a precipitation and latitudinal gradient among Douglas-fir *Pseudotsuga menziesii* forests in the Pacific Northwest of the United States. Ecography. 25(2): 129–138.

Schowalter, T.D.; Zhang, Y.L.; Progar, R.A. 2005. Canopy arthropod response to density and distribution of green trees retained after partial harvest. Ecological Applications. 15(5): 1594–1603.

Halaj, J.; Halpern, C.B.; Yi, H. 2008. Responses of litter-dwelling spiders and carabid beetles to varying levels and patterns of green-tree retention. Forest Ecology and Management. 255(3–4): 887–900.

Halaj, J.; Halpern, C.B.; Yi, H. 2009. Effects of green-tree retention on abundance and guild composition of corticolous arthropods. Forest Ecology and Management. 258(5): 850–859.

Public Perceptions (Aesthetics)

McDade, K. 1999. The new Northwest? Regional perspectives of national forest management by recreation type, place of residence, and time spent in the Pacific Northwest. Eugene, OR: University of Oregon. 97 p. M.S. thesis.

Ribe, R.G. 1999. Regeneration harvests versus clearcuts: public views of the acceptability and aesthetics of Northwest Forest Plan harvests. Northwest Science. 73(Special Issue): 102–117.

Ribe, R.G. 2002. Is scenic beauty a proxy for acceptable management? The influence of environmental attitudes on perceptions of forest scenes. Environment and Behavior. 34: 757–780.

Ribe, R.G.; Armstrong, E.T.; Gobster, P.H. 2002. Scenic vistas and the changing policy landscape: visualizing and testing the role of visual resources in ecosystem management. Landscape Journal. 21(1): 42–66.

Ribe, R.G.; Matteson, M.Y. 2002. Views of old forestry and new among reference groups in the Pacific Northwest. Western Journal of Applied Forestry. 17(4): 173–182.

Ribe, R.G. 2005a. Comparing changes in scenic beauty produced by green-tree retention harvests, thinnings and clearcuts: evidence from three Pacific Northwest experiments. In: Peterson, C.E.; Maguire, D.A., eds. Balancing ecosystem values: innovative experiments for sustainable forestry. Gen. Tech. Rep. PNW-GTR-635. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 137–145.

Ribe, R.G. 2005b. Aesthetic perceptions of green-tree retention harvests in vista views: the interaction of cut level, retention pattern and harvest shape. Landscape and Urban Planning. 73(4): 277–293.

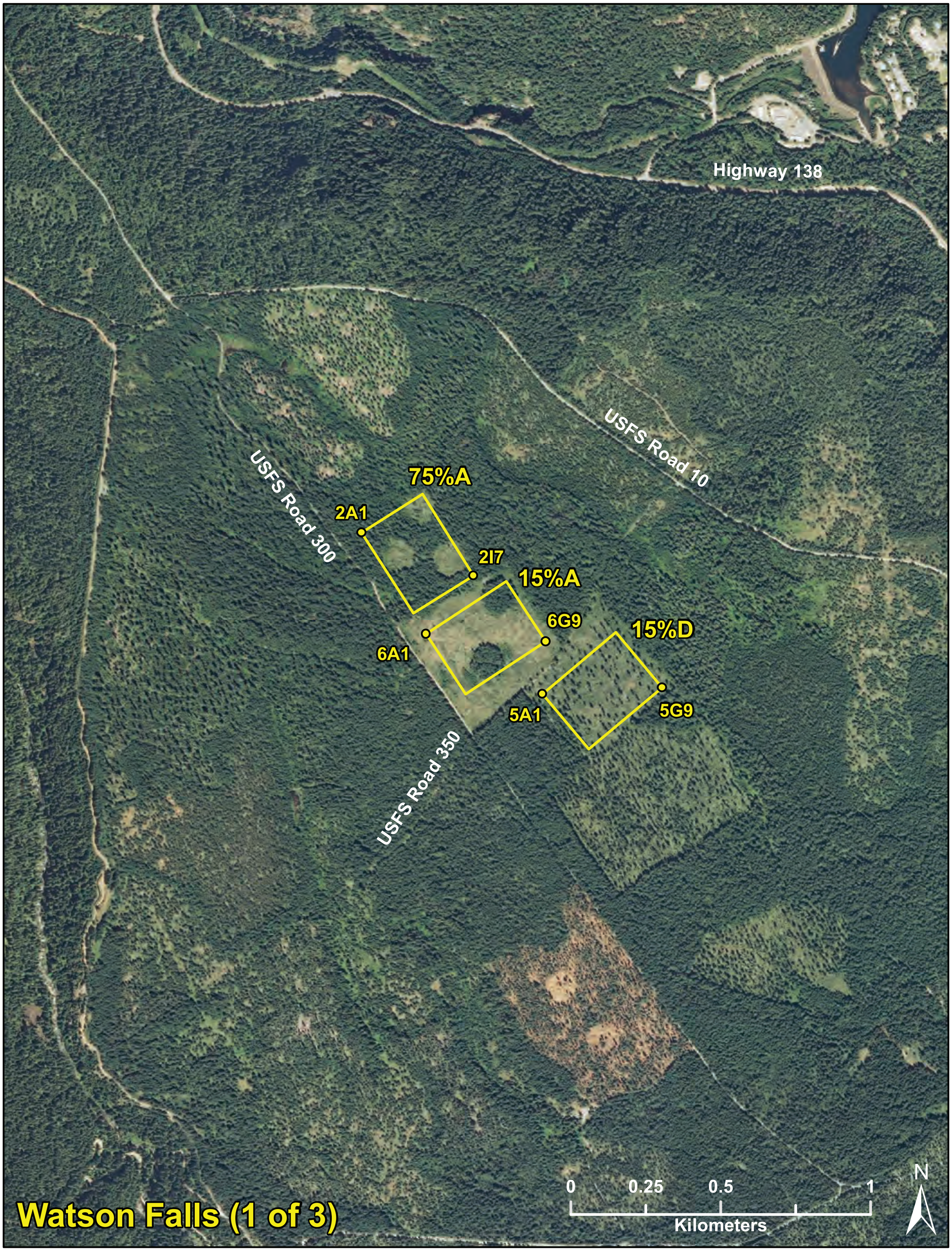
Ribe, R.G. 2006. Perceptions of forestry alternatives in the US Pacific Northwest: information effects and acceptability distribution analysis. Journal of Environmental Psychology. 26(2): 100–115.

Ribe, R.G. 2009. In-stand scenic beauty of variable retention harvests and mature forests in the U.S. Pacific Northwest: the effects of basal area, density, retention pattern and down wood. Journal of Environmental Management. 91(1): 245–260.

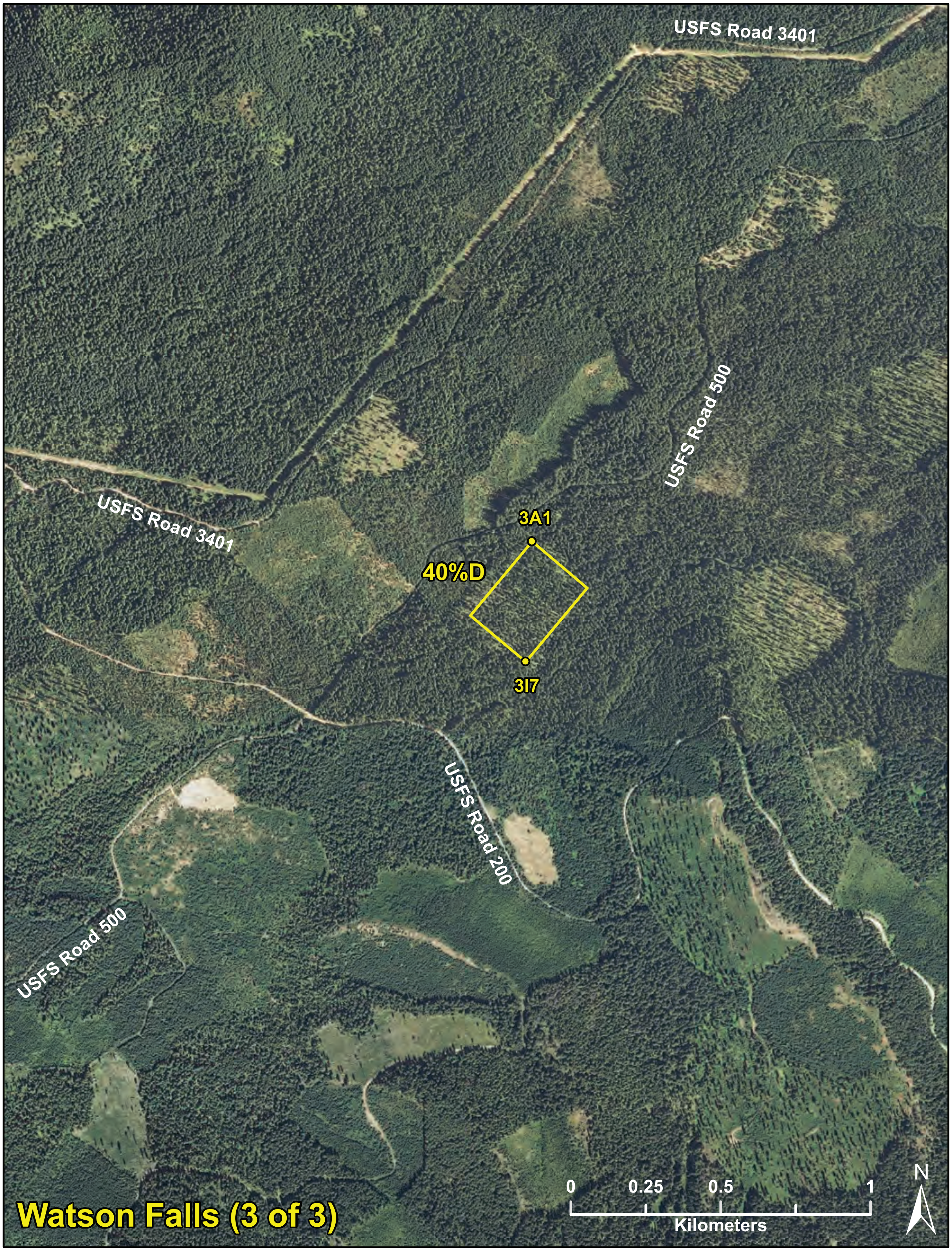
Ribe, R.G.; Ford, R.M.; Williams, K.J.H. 2013. Clearfell controversies and alternative timber harvest designs: how acceptability perceptions vary between Tasmania and the U.S. Pacific Northwest. Journal of Environmental Management. 114: 46–62.

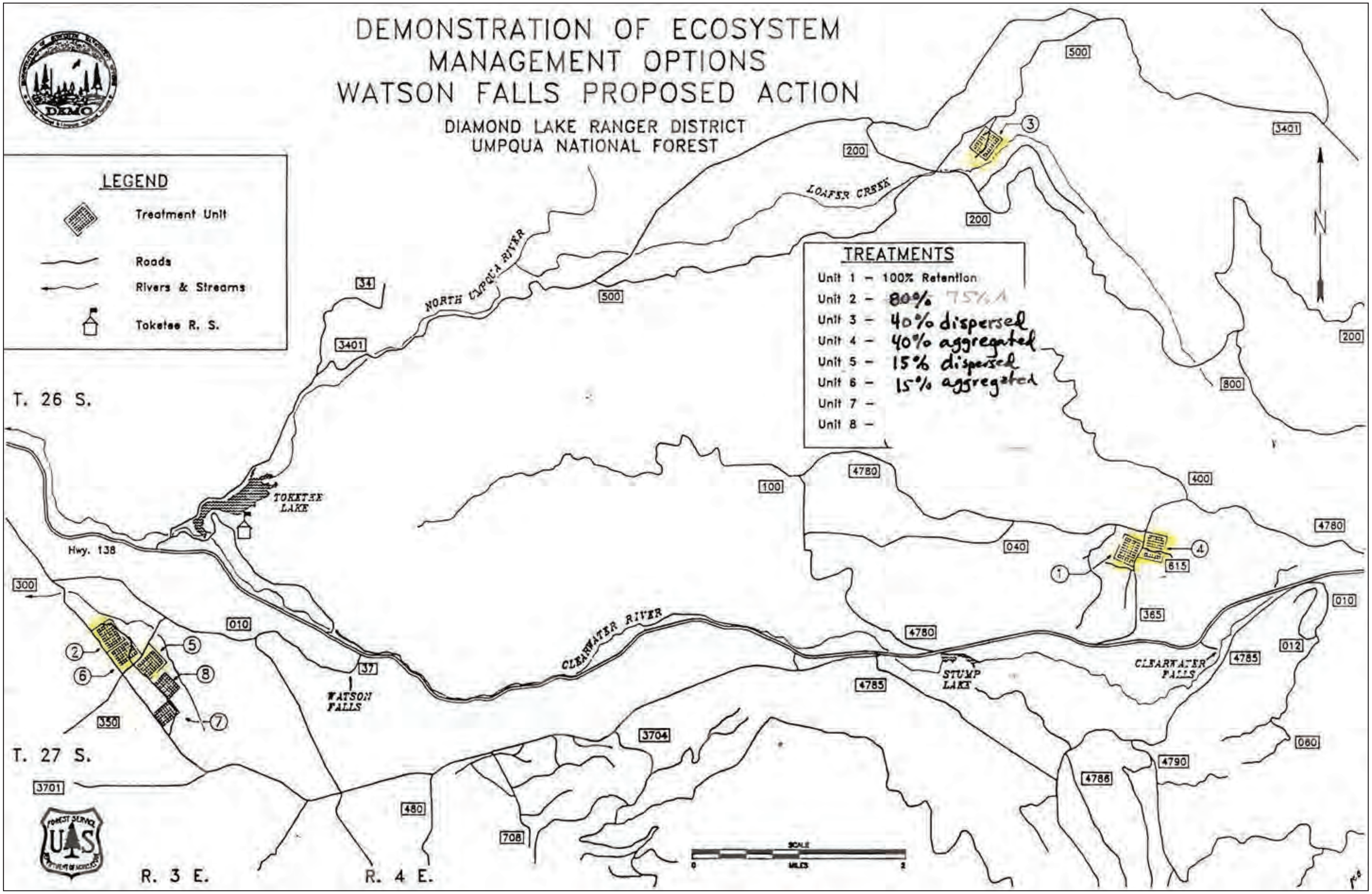
Appendix 2: Locations and Navigational Aids to and Within Treatment Units at the Watson Falls Experimental Block in Oregon

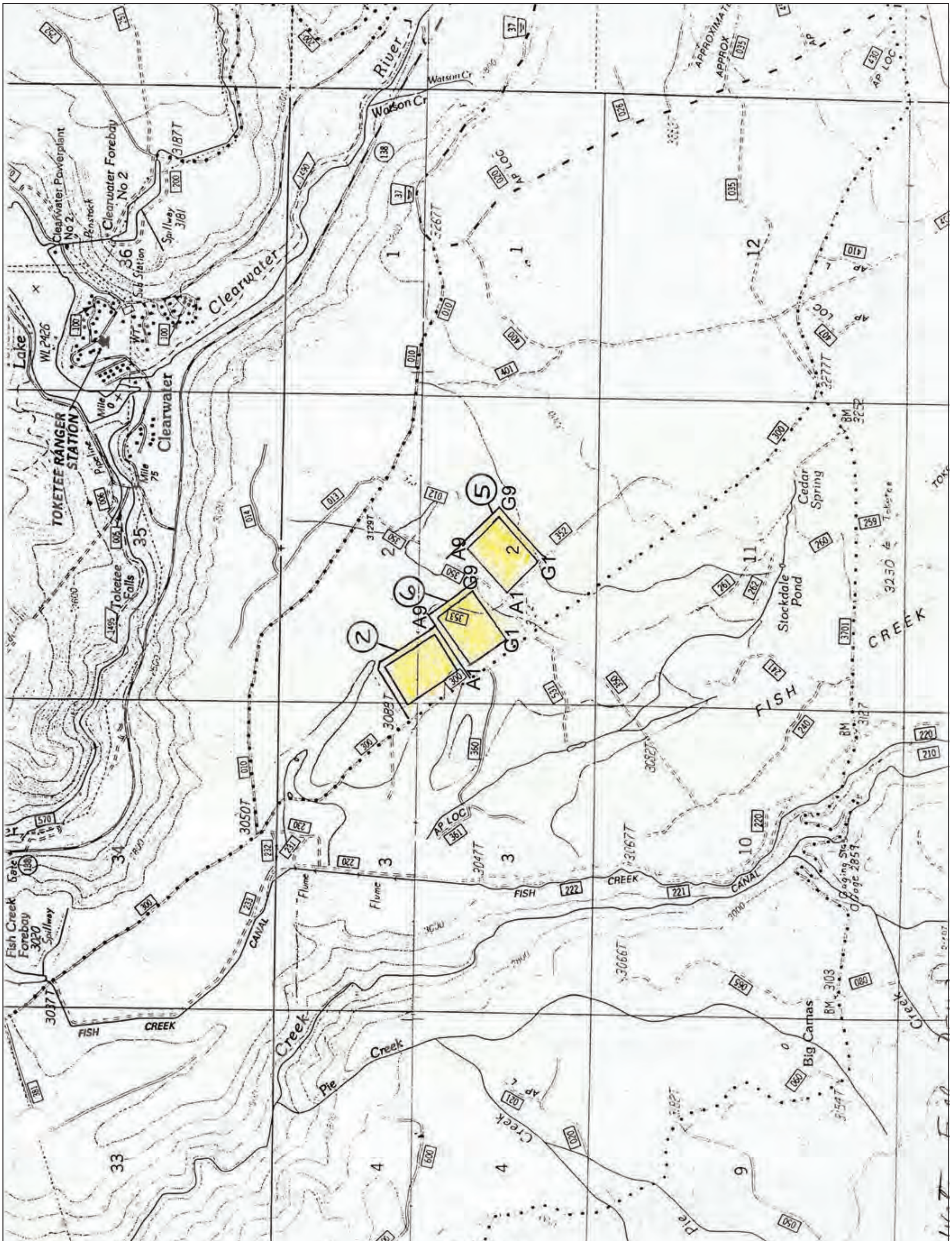
Orthophotos are from 2011. Unit labels are (1) 100% = unharvested control, (2) 75%A = 75 percent aggregated retention, (3) 40%D = 40 percent dispersed retention, (4) 40%A = 40 percent aggregated retention, (5) 15%D = 15 percent dispersed retention, and (6) 15%A = 15 percent aggregated retention. Grid points in each treatment unit are identified by 3-character codes indicating treatment number (1 through 6, as listed above), row (letter), and column (number); two corner grid points are labelled here. Orthophotos are followed by road and topographic maps, detailed driving directions to the treatment units, and diagrams of the sampling grids, which include grid-point identifiers and the locations of aggregates (40%A, 15%A) or gaps (75%A).

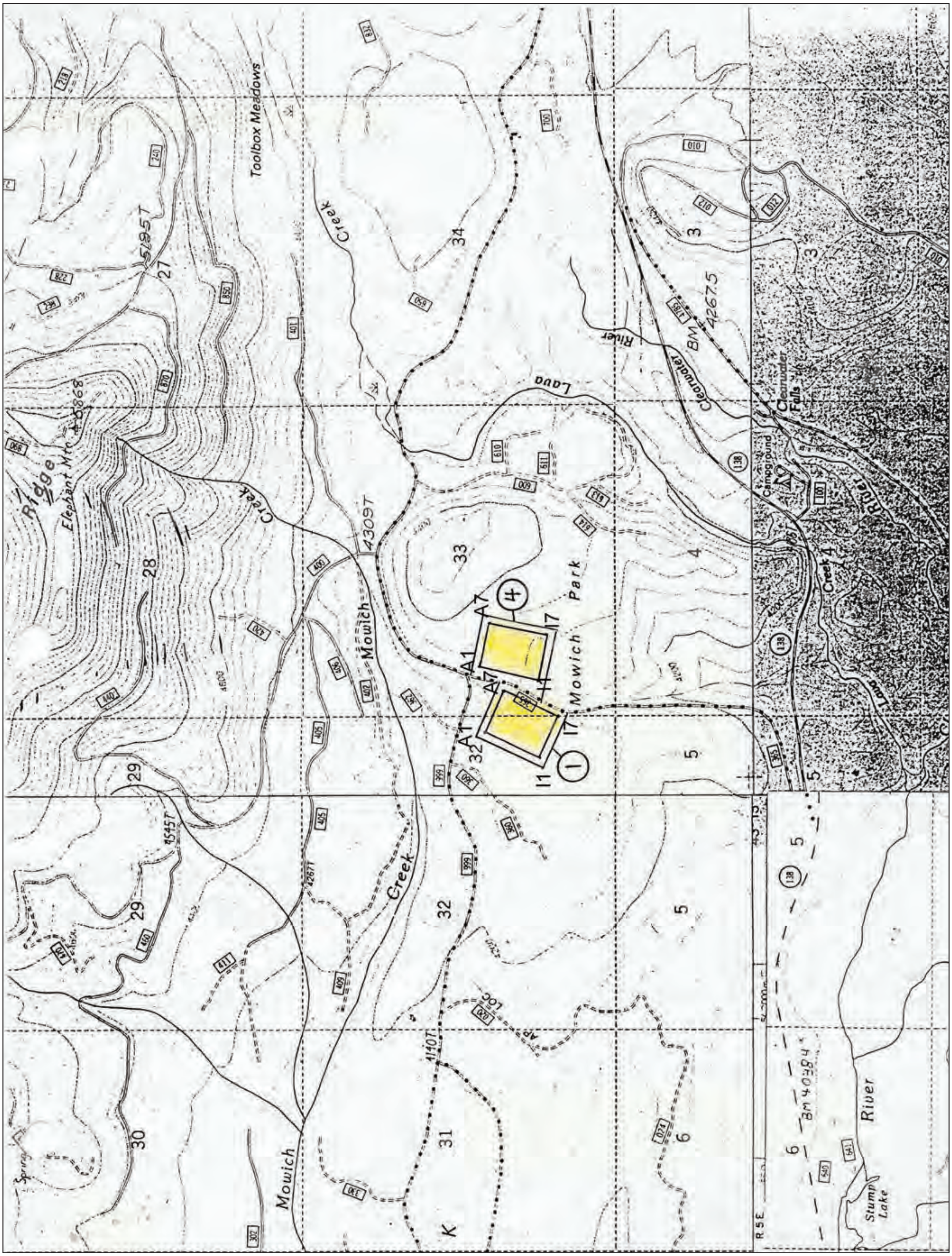

Highway 138
USFS Road 10
USFS Road 300
USFS Road 350
75%A
2A1
2I7
15%A
6G9
6A1
15%D
5A1
5G9
0
0.25
0.5
1
Kilometers
N
Watson Falls (1 of 3)

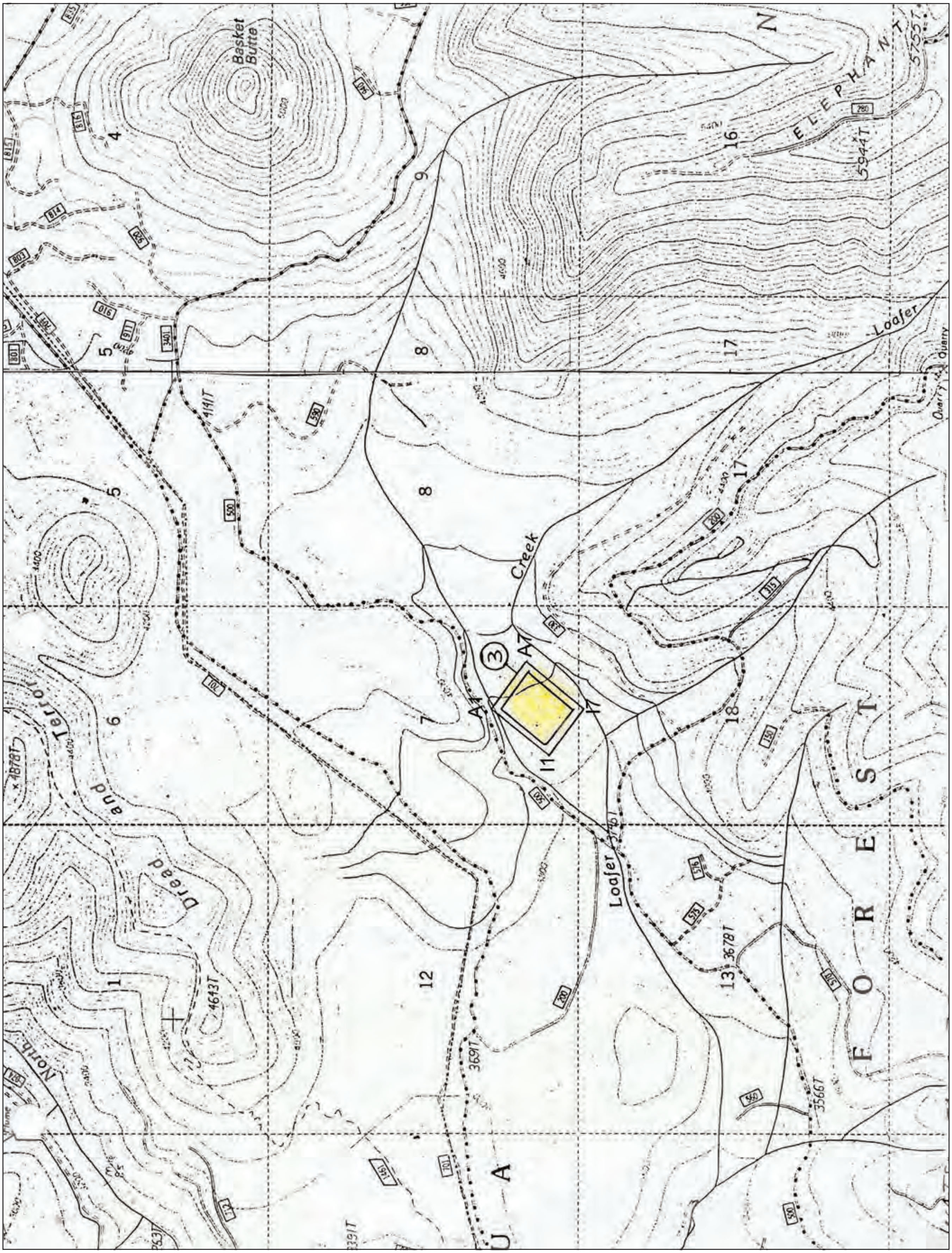
USFS Road 999
1A1
4A1
100%
40%A
1I7
4I7
USFS Road 365
Highway 138
0
0.25
0.5
1
Kilometers
N
Watson Falls (2 of 3)


USFS Road 3401
USFS Road 500
USFS Road 3401
3A1
40%D
3I7
USFS Road 200
USFS Road 500
Watson Falls (3 of 3)
0
0.25
0.5
1
Kilometers
N


DEMONSTRATION OF ECOSYSTEM
MANAGEMENT OPTIONS
WATSON FALLS PROPOSED ACTION
DIAMOND LAKE RANGER DISTRICT
UMPQUA NATIONAL FOREST
LEGEND
Treatment Unit
Roads
Rivers & Streams
Toketee R. S.
TREATMENTS
Unit 1 – 100% Retention
Unit 2 – ~~80%~~ 75%A
Unit 3 – 40% dispersed
Unit 4 – 40% aggregated
Unit 5 – 15% dispersed
Unit 6 – 15% aggregated
Unit 7 –
Unit 8 –
NORTH UMPQUA RIVER
LOAFER CREEK
CLEARWATER RIVER
TOKETEE LAKE
WATSON FALLS
STUMP LAKE
CLEARWATER FALLS
Hwy. 138
T. 26 S.
T. 27 S.
R. 3 E.
R. 4 E.
N
SCALE
MILES
0
2
500
3401
200
34
800
400
4780
100
040
615
365
010
012
4785
060
4790
4786
3704
708
480
37
300
350
3701


TOKETEE RANGER STATION
Clearwater Powerplant
Clearwater Forebay No 2
Clearwater
River
Watson Cr
Lake
Toketee Falls
Fish Creek Forebay 3020
Spillway
FISH CREEK
CANAL
Flume
Pie Creek
Stockdale Pond
Cedar Spring
Big Camas
FISH CREEK
A1
A9
G1
G9
AP LOC
APPROX


Toolbox Meadows
Elephant Mtn
Ridge
Mowich Creek
Mowich Park
Clearwater River
Clearwater Falls
Campground
Stump Lake
River
R 5 E


Basket Butte
ELEPHANT
Loafer
Creek
Loafer
Dread
and
Terror
F O R E S T
Quarry

Driving Directions to the Demonstration of Ecosystem Management Options (DEMO) Study Treatment Units in the Watson Falls Experimental Block.

Directions are not provided for 75%A because it was not sampled after the initial posttreatment measurements were made; its location is depicted in the orthophotos and topographic maps.

100% (WF1) and 40%A (WF4). Units are adjacent on opposite sides of Road 365.

100% (WF1)

Mileage	Location
0	Exit northeast from Highway 138 onto Road 365 (Mowich Connect Road).
1.2	Stop at intersection of Roads 365 and 999; WF1 is on the west side of Road 365.

Additional notes: Enter unit from the east (Road 365) to reach the “7” grid line; it is much closer from the road than is the “A” grid from Road 999. Enter at the first DEMO sign along the road on the east side of WF1; it lies east of plot 1I7. There are no DEMO signs on the north side of unit along Road 999.

40%A (WF4)

Mileage	Location
0	Exit northeast from Highway 138 onto Road 365 (Mowich Connect Road).
1.2	Stop at intersection of Roads 365 and 999; WF4 is on the east side of Road 365.

40%D (WF3)—two routes

Route 1. From the east (Diamond Lake)

Mileage	Location
—	Exit to the north from Highway 138 onto Road 2610 to Lemolo Lake (paved).
0	Pass turnoff to Poole Creek Campground; at Y-intersection with Road 3401 (at Lemolo Resort Area) bear to the left onto Road 3401 (set mileage to 0 here).
3.1	Bear left at the Y-intersection with Road 500 (not signed); take Road 500.
3.2	Pass Road 590 on the left (barricaded, with sign).
4.6	Turn left onto Road 581 (with sign) which continues into unit; it is possible to drive over the steep dip in the road but not necessary, given its proximity to plots.

40%D (WF3)—two routes (continued)

Route 2. From the west (Toketee Ranger Station)

Mileage	Location
—	From Toketee Ranger Station, return to Highway 138; turn right onto Road 34 (Toketee-Rigdon Road)
0	Road 34; travel northeast along the west side of Toketee Lake.
1.3	Pass turnoff to Toketee Campground.
2.3	Turn right onto Road 3401.
3.0	Pass over Umpqua River bridge.
8.6	Turn right onto Road 200.
9.5	Turn left onto Road 500 (note many DEMO signs on right; southwest side of unit).
10.3	Turn right onto Road 581 (with sign) which continues into unit; it is possible to drive over the steep dip in the road but not necessary, given its proximity to plots.

Additional note: DEMO signs along 500 Road (southwest side of unit).

15%D (WF5)

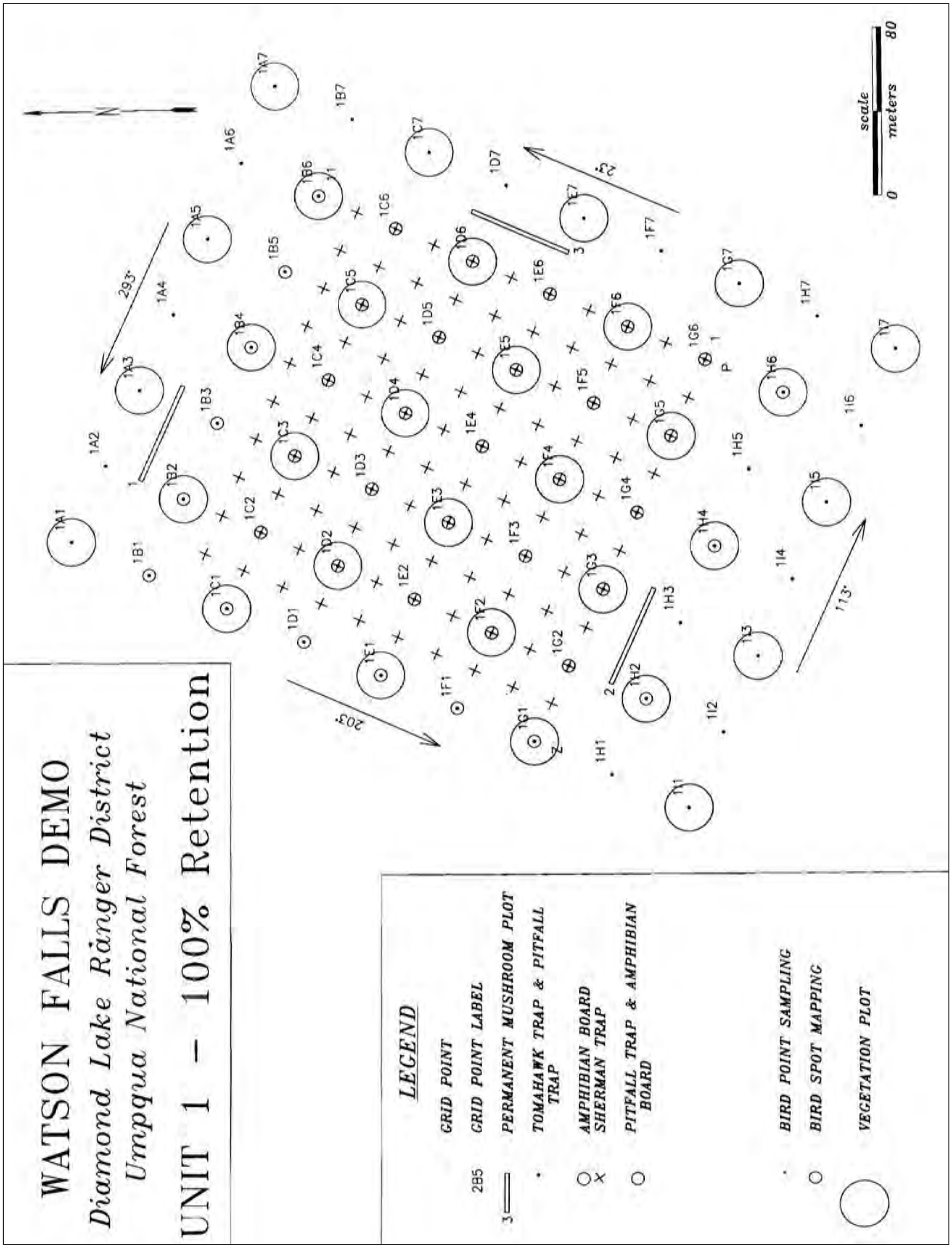
Mileage	Location
0	Exit south from Highway 138 onto Road 37 (signs for Watson Falls picnic ground).
1.2	Right on Road 010 (Fish Creek Forebay Road).
2.0	Pass intersection with Road 350 on the left (350 is blocked by a barrier).
3.1	Left onto Road 300 (Brink Road).
3.8, 3.9	Pass first and second DEMO signs along southwest edge of WF2.
4.0	Pass northwest edge of WF6 cleared area.
4.3	Left onto Road 350, Brink Connect Road (signed); stop at barrier.
4.4	Walk up Road 350 to barrier; Road 352, to the right, lies along southwest edge of WF5; Road 353, to the left, goes into WF6.

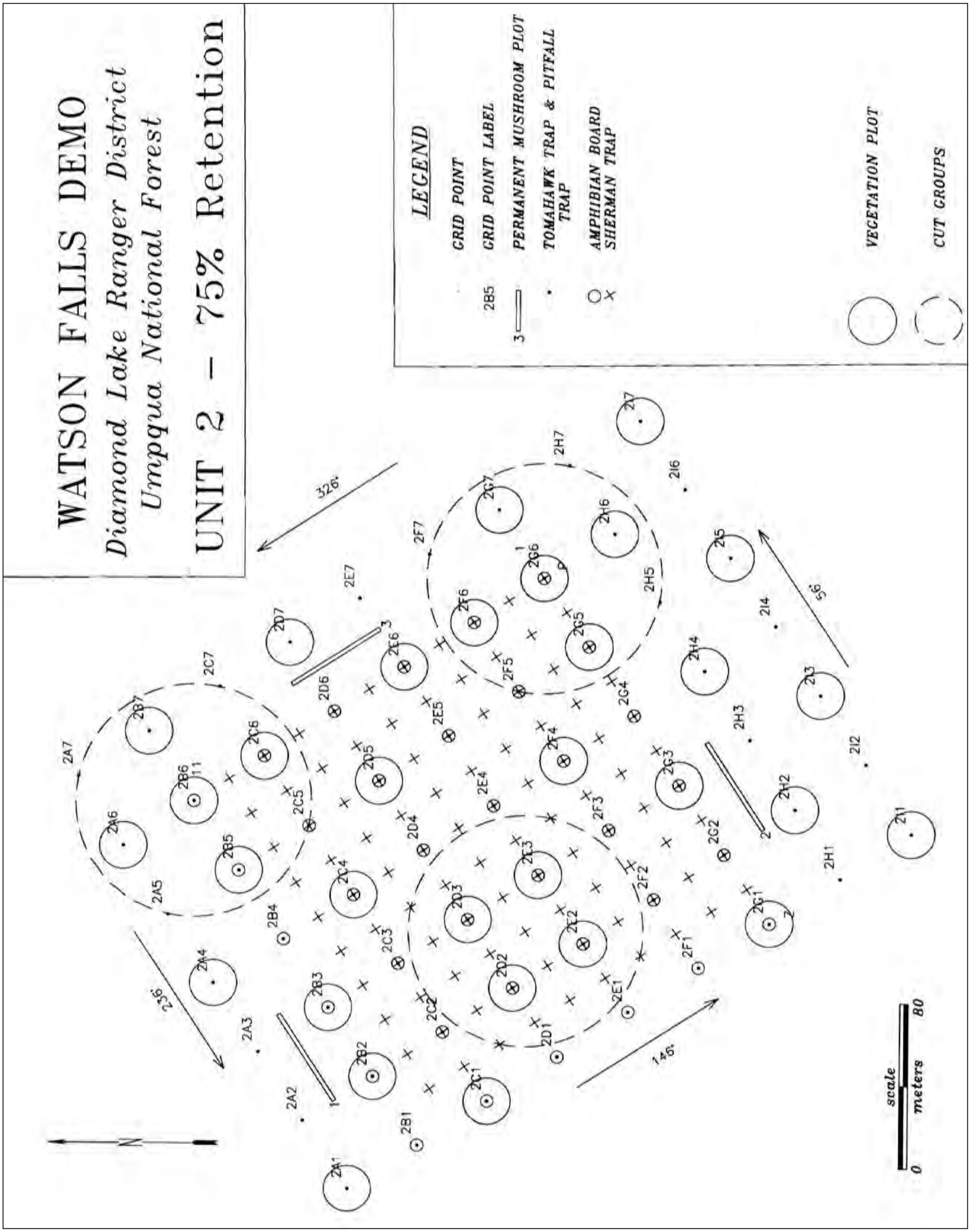
Additional notes: Good access along southwest edge of unit (along Road 352). Along roadside, orange flagging leads to plot 5E1. Dense, tall, spiny *Ceanothus* is present: advise long sleeves and leather gloves. Transect posts were established at all grid points (i.e., in all tree plots) prior to harvest, but the posts are no longer maintained in these “alternate” plots.

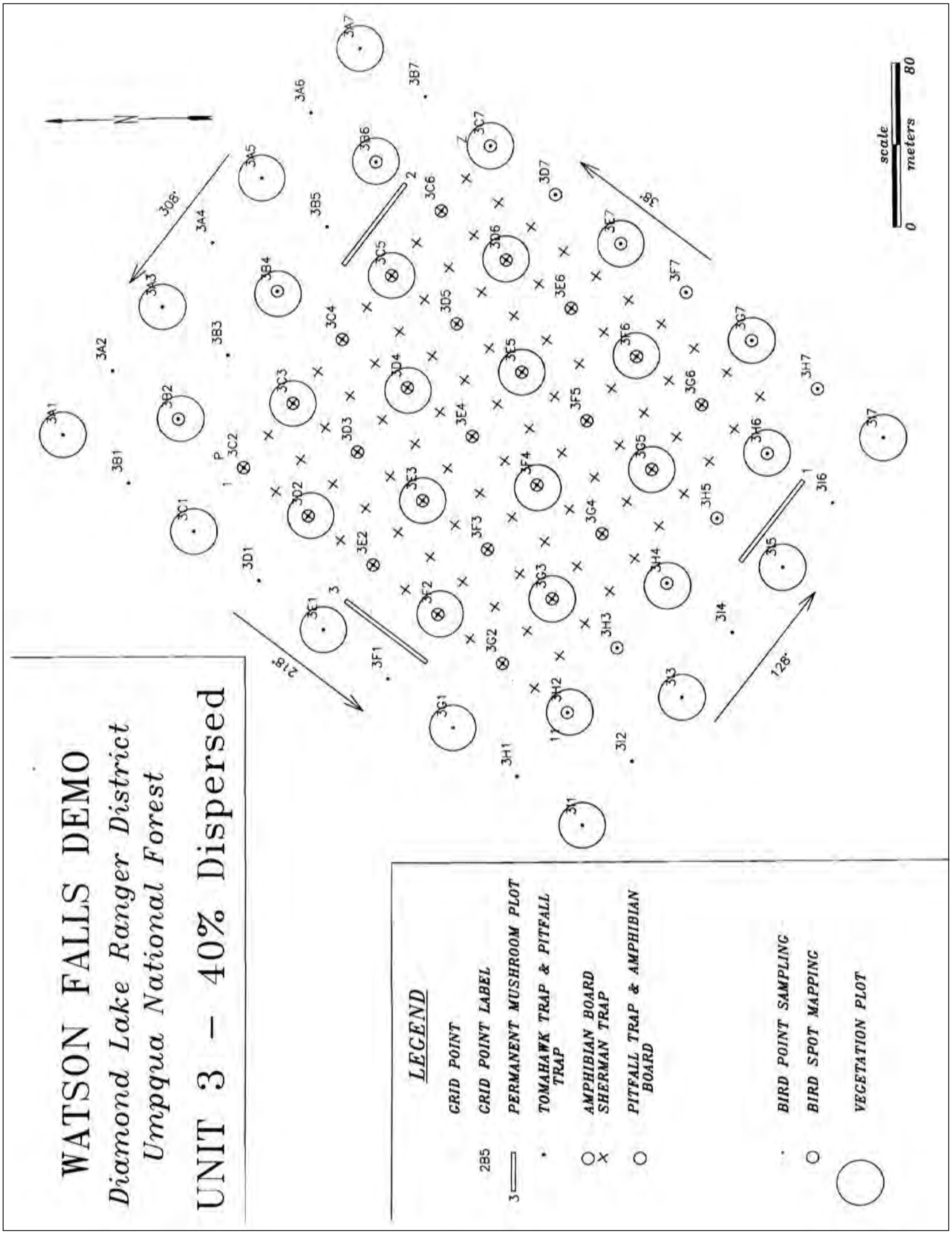
15%A (WF6)

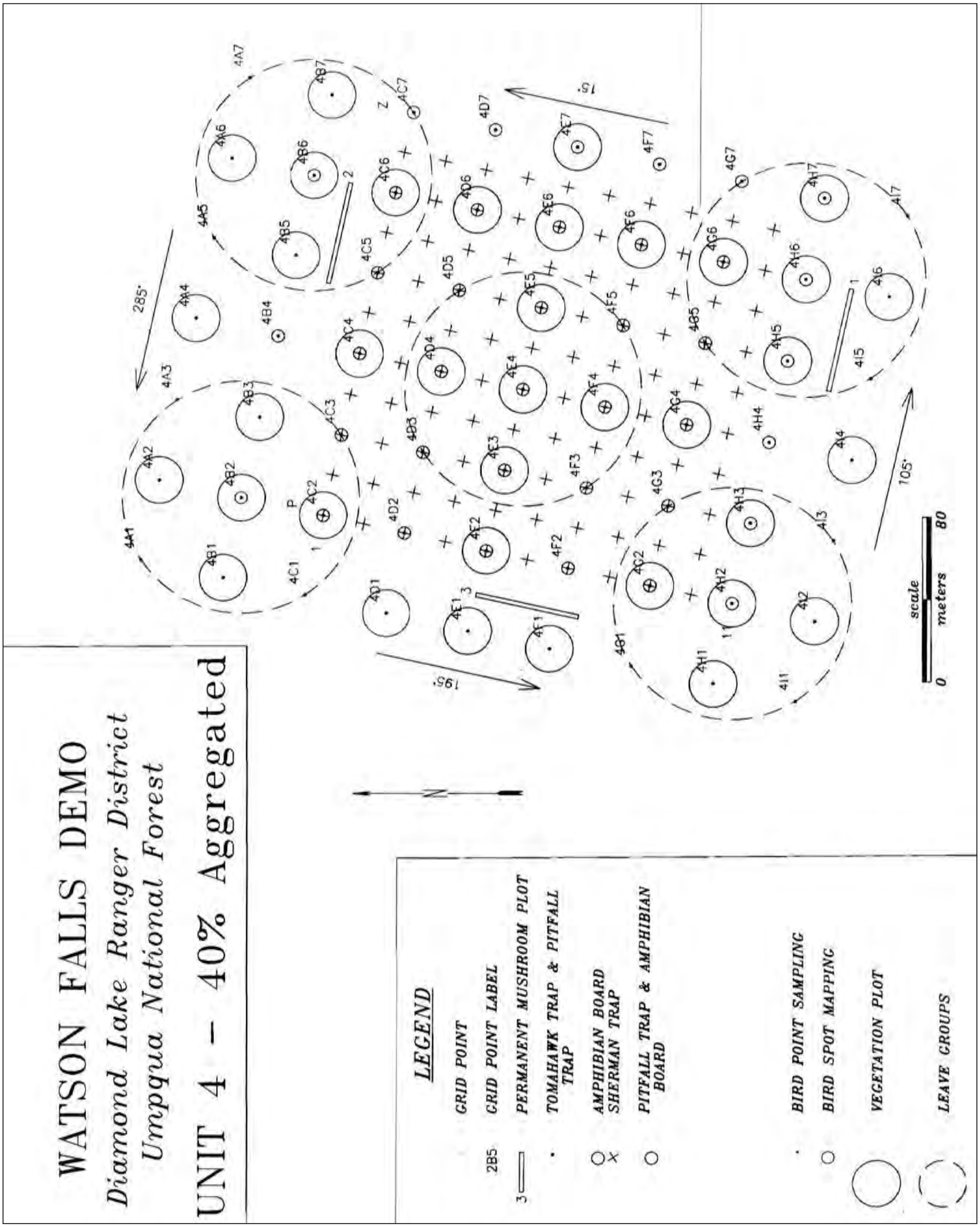
Mileage	Location
0	Exit south from Highway 138 onto Road 37 (signs for Watson Falls picnic ground).
1.2	Right on Road 010 (Fish Creek Forebay Road).
2.0	Pass intersection with Road 350 on the left (350 is blocked by a barrier).
3.1	Left onto Road 300 (Brink Road).
3.8, 3.9	Pass first and second DEMO signs along southwest edge of WF2.
4.0	Pass northwest edge of WF6 cleared area.
4.3	Left onto Road 350, Brink Connect Road (signed); stop at barrier.
4.4	Walk up Road 350 to barrier; Road 352, to the right, lies along southwest edge of WF5; Road 353, to the left, goes into WF6.

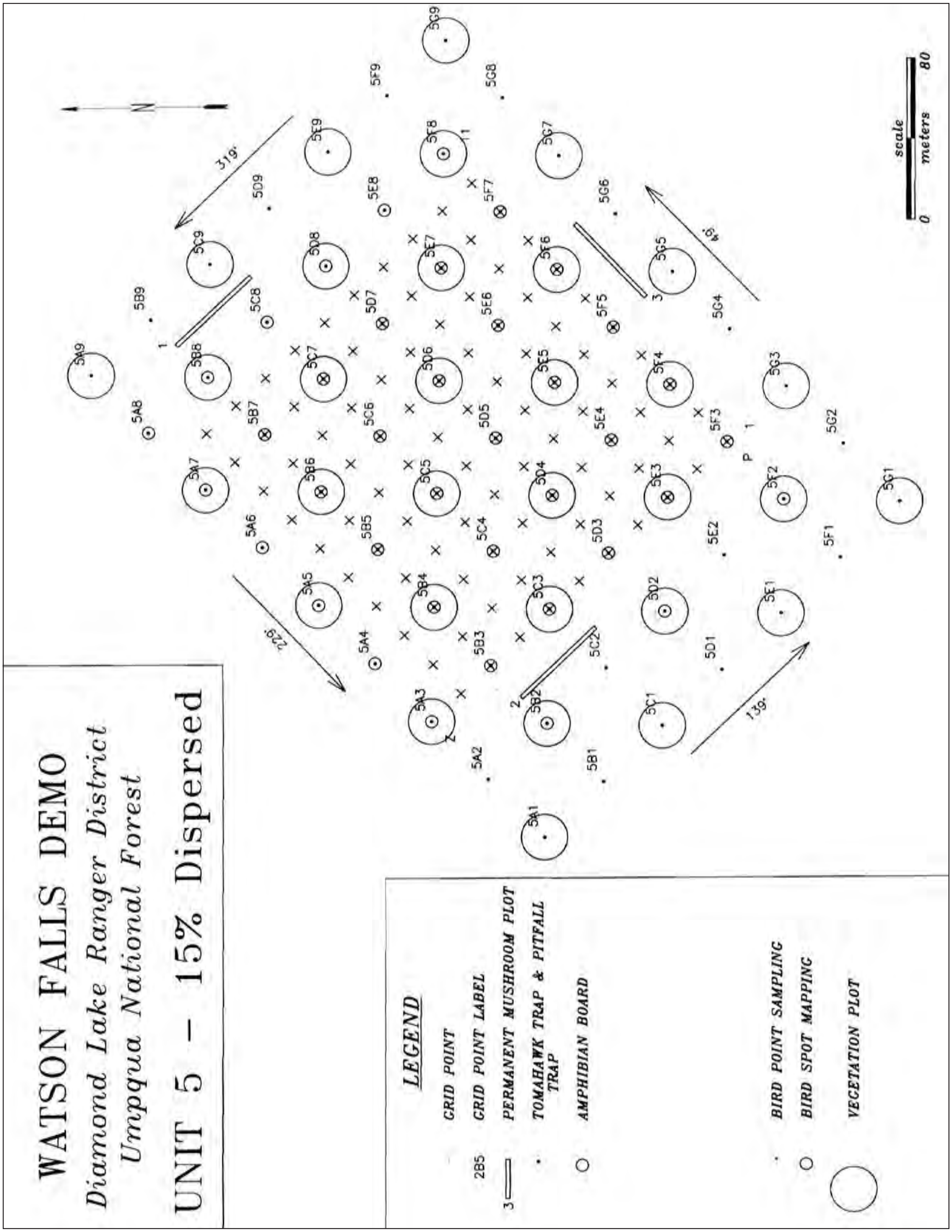
Additional notes: Good access along gravel Road 353, which takes off to the northwest from the intersection of Roads 350 and 352 (essentially the northwest corner of WF5). Dense, tall, spiny *Ceanothus* is present: advise long sleeves and leather gloves. Extremely dense white fir advanced regeneration in/adjacent to the two aggregates.

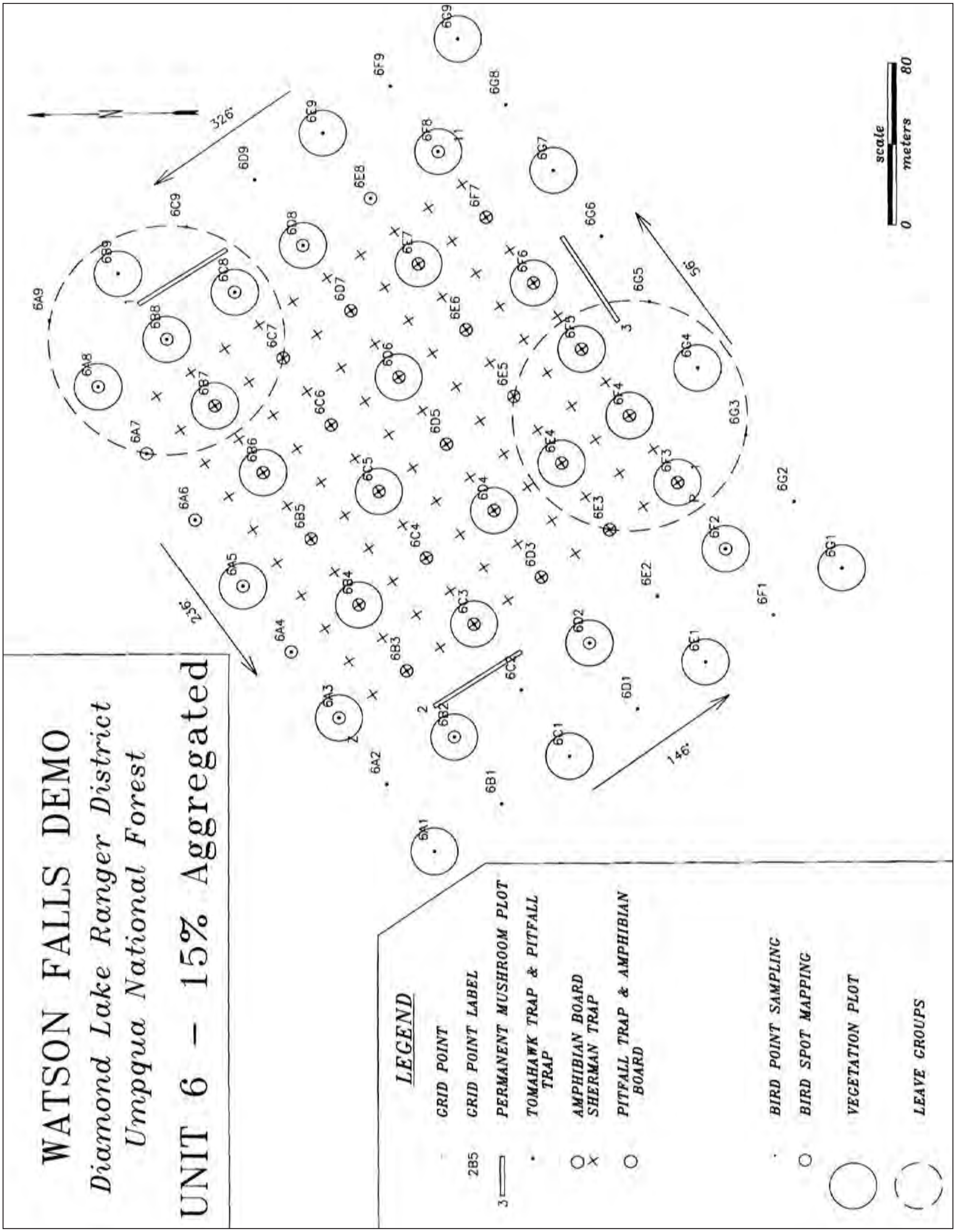

WATSON FALLS DEMO
Diamond Lake Ranger District
Umpqua National Forest
UNIT 1 – 100% Retention
N
293°
203°
113°
23°
scale
0
80
meters
LEGEND
2B5 GRID POINT
GRID POINT LABEL
3 PERMANENT MUSHROOM PLOT
TOMAHAWK TRAP & PITFALL TRAP
AMPHIBIAN BOARD SHERMAN TRAP
PITFALL TRAP & AMPHIBIAN BOARD
BIRD POINT SAMPLING
BIRD SPOT MAPPING
VEGETATION PLOT


WATSON FALLS DEMO
Diamond Lake Ranger District
Umpqua National Forest
UNIT 2 – 75% Retention
LEGEND
GRID POINT
2B5 GRID POINT LABEL
3 PERMANENT MUSHROOM PLOT
TOMAHAWK TRAP & PITFALL TRAP
AMPHIBIAN BOARD
SHERMAN TRAP
VEGETATION PLOT
CUT GROUPS
N
scale
meters
0
80
326'
236'
146'
56'


WATSON FALLS DEMO
Diamond Lake Ranger District
Umpqua National Forest
UNIT 3 – 40% Dispersed
LEGEND
GRID POINT
2B5 GRID POINT LABEL
3 PERMANENT MUSHROOM PLOT
TOMAHAWK TRAP & PITFALL TRAP
AMPHIBIAN BOARD
SHERMAN TRAP
PITFALL TRAP & AMPHIBIAN BOARD
BIRD POINT SAMPLING
BIRD SPOT MAPPING
VEGETATION PLOT
N
scale
0 80
meters
308°
218°
128°
38°

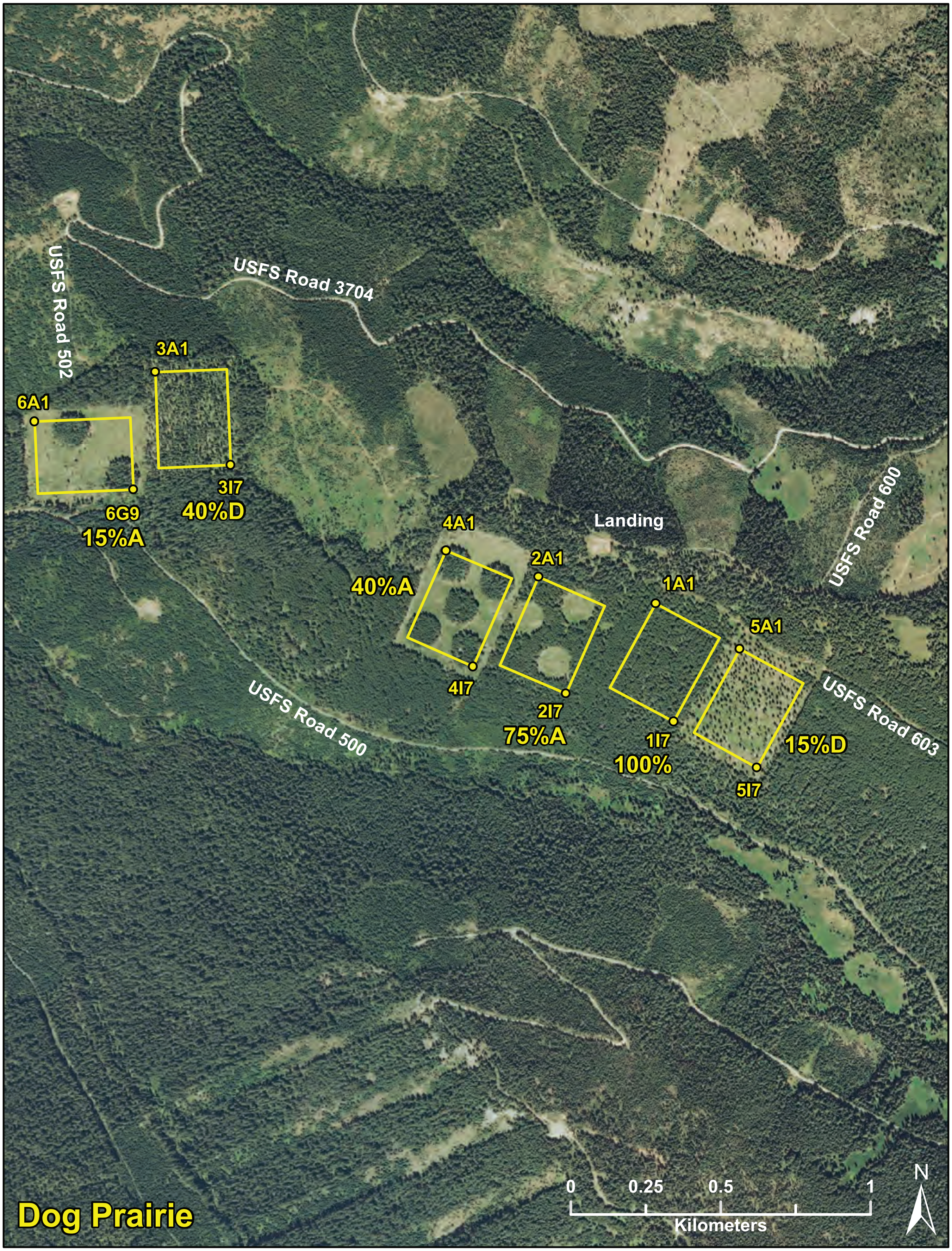

WATSON FALLS DEMO
Diamond Lake Ranger District
Umpqua National Forest
UNIT 4 – 40% Aggregated
LEGEND
GRID POINT
2B5 GRID POINT LABEL
PERMANENT MUSHROOM PLOT
TOMAHAWK TRAP & PITFALL TRAP
AMPHIBIAN BOARD SHERMAN TRAP
PITFALL TRAP & AMPHIBIAN BOARD
BIRD POINT SAMPLING
BIRD SPOT MAPPING
VEGETATION PLOT
LEAVE GROUPS
scale
meters
0
80
285°
195°
105°
15°

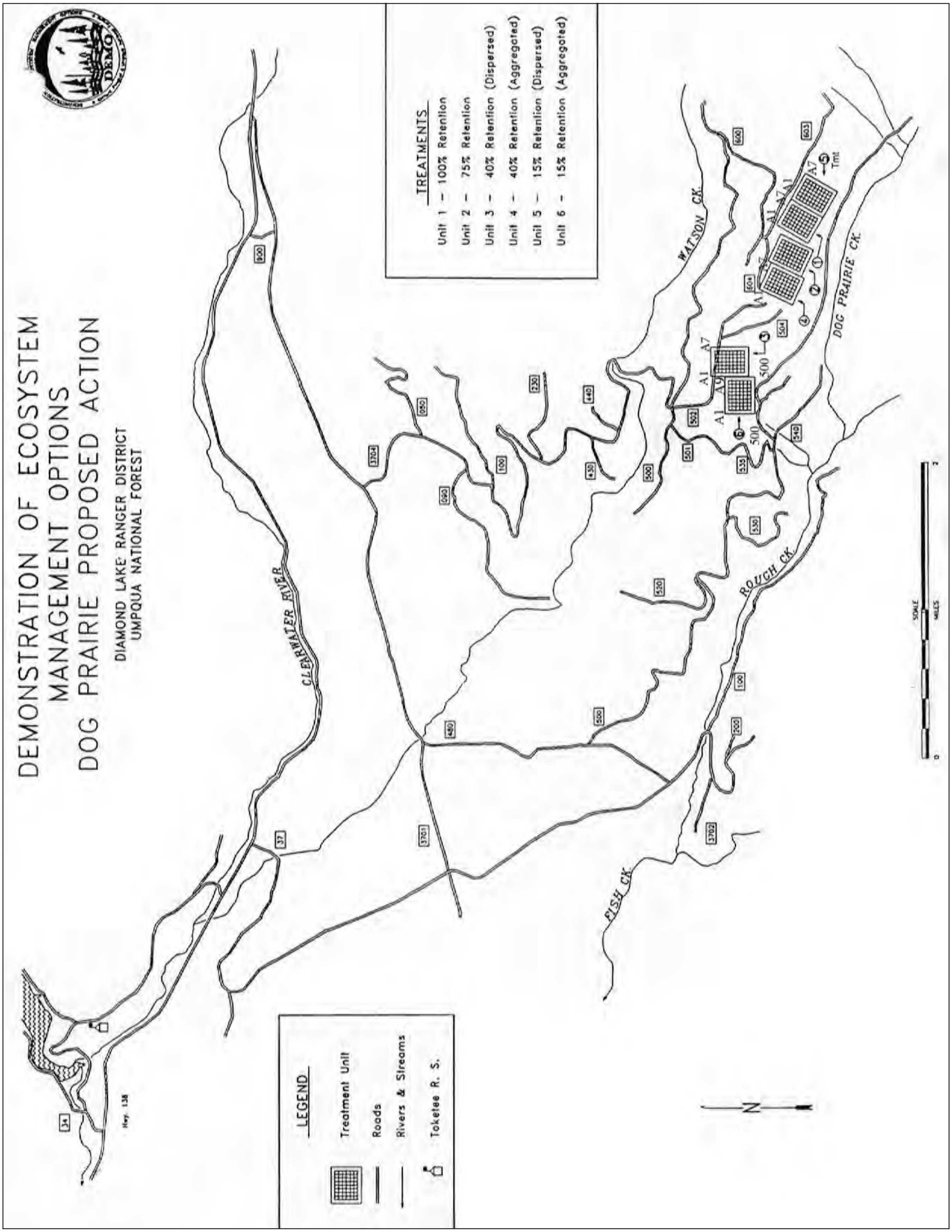

WATSON FALLS DEMO
Diamond Lake Ranger District
Umpqua National Forest
UNIT 5 – 15% Dispersed
LEGEND
GRID POINT
GRID POINT LABEL
PERMANENT MUSHROOM PLOT
TOMAHAWK TRAP & PITFALL TRAP
AMPHIBIAN BOARD
BIRD POINT SAMPLING
BIRD SPOT MAPPING
VEGETATION PLOT
scale
meters
0
80
N


WATSON FALLS DEMO
Diamond Lake Ranger District
Umpqua National Forest
UNIT 6 – 15% Aggregated
LEGEND
GRID POINT
2B5 GRID POINT LABEL
PERMANENT MUSHROOM PLOT
TOMAHAWK TRAP & PITFALL TRAP
AMPHIBIAN BOARD
SHERMAN TRAP
PITFALL TRAP & AMPHIBIAN BOARD
BIRD POINT SAMPLING
BIRD SPOT MAPPING
VEGETATION PLOT
LEAVE GROUPS
scale
0 80
meters
N

Appendix 3: Locations and Navigational Aids to and Within Treatment Units at the Dog Prairie Experimental Block in Oregon

Orthophoto is from 2011. Unit labels are (1) 100% = unharvested control, (2) 75%A = 75 percent aggregated retention, (3) 40%D = 40 percent dispersed retention, (4) 40%A = 40 percent aggregated retention, (5) 15%D = 15 percent dispersed retention, and (6) 15%A = 15 percent aggregated retention. Grid points in each treatment unit are identified by 3-character codes indicating treatment number (1 through 6, as listed above), row (letter), and column (number); two corner grid points are labelled here. Orthophotos are followed by a road map, detailed driving directions to the treatment units, and diagrams of the sampling grids, which include grid-point identifiers and the locations of aggregates (40%A, 15%A) or gaps (75%A).


USFS Road 502
USFS Road 3704
3A1
6A1
3I7
6G9
40%D
15%A
4A1
Landing
2A1
USFS Road 600
40%A
1A1
5A1
4I7
2I7
USFS Road 500
75%A
1I7
100%
15%D
5I7
USFS Road 603
0
0.25
0.5
1
Kilometers
N
Dog Prairie


DEMONSTRATION OF ECOSYSTEM
MANAGEMENT OPTIONS
DOG PRAIRIE PROPOSED ACTION
DIAMOND LAKE RANGER DISTRICT
UMPQUA NATIONAL FOREST
TREATMENTS
Unit 1 – 100% Retention
Unit 2 – 75% Retention
Unit 3 – 40% Retention (Dispersed)
Unit 4 – 40% Retention (Aggregated)
Unit 5 – 15% Retention (Dispersed)
Unit 6 – 15% Retention (Aggregated)
LEGEND
Treatment Unit
Roads
Rivers & Streams
Toketee R. S.
CLEARWATER RIVER
WATSON CK.
DOG PRAIRIE CK.
ROUGH CK.
FISH CK.
Hwy. 138
DEMO
SCALE
MILES

Driving Directions to the Demonstration of Ecosystem Management Options (DEMO) Study Treatment Units in the Dog Prairie Experimental Block

Directions are not provided for 75%A because it was not sampled after the initial posttreatment measurements were made; its location is depicted in the orthophoto and road map.

100% (DP1), 15%D (DP5), and 40%A (DP4).

Units all accessible from the same point.

Mileage	Location
0	Exit south from Highway 138 onto Road 37 (signs for Watson Falls picnic ground).
1.2	Pass Road 010 on the right.
2.8	Turn left (east) onto Road 3701 (Big Camas Road).
5.4	Turn right (south) onto Road 3704.
6.7, 8.3, 9.6	Pass Road 100 on left (6.7 miles), pass Road 230 on left (8.3 miles), cross Watson Creek (signed; 9.6 miles).
10.7	Sharp curve through complex intersection with Road 500 and Road 502 (502 goes to the top of DP3).
12.9	Turn sharply to the right onto Road 600 (no sign but two metal gate posts; road susceptible to washout).
13.8	Arrive at open landing at the ridge top.

Additional notes: To access **DP1** and **DP5**, walk along Road 603 to the east. **DP1** has as two DEMO signs along road; **DP5** has one DEMO sign along the road. **DP1** has pink flagging from road to plots 1A2 and 1B2. Walk further to access **DP5**. At the far end of **DP5**, there is a sturdy survey pin at the road edge (south side) "200 deg, 233 ft to plot 5A7." Plot 5A7 is not sampled (lies in a small forested [non-thinned] patch retained because of the presence of a rare fungus). To access **DP4**, walk west along Road 604 (no DEMO signs); easy access and visible from the road.

40%D (DP3)

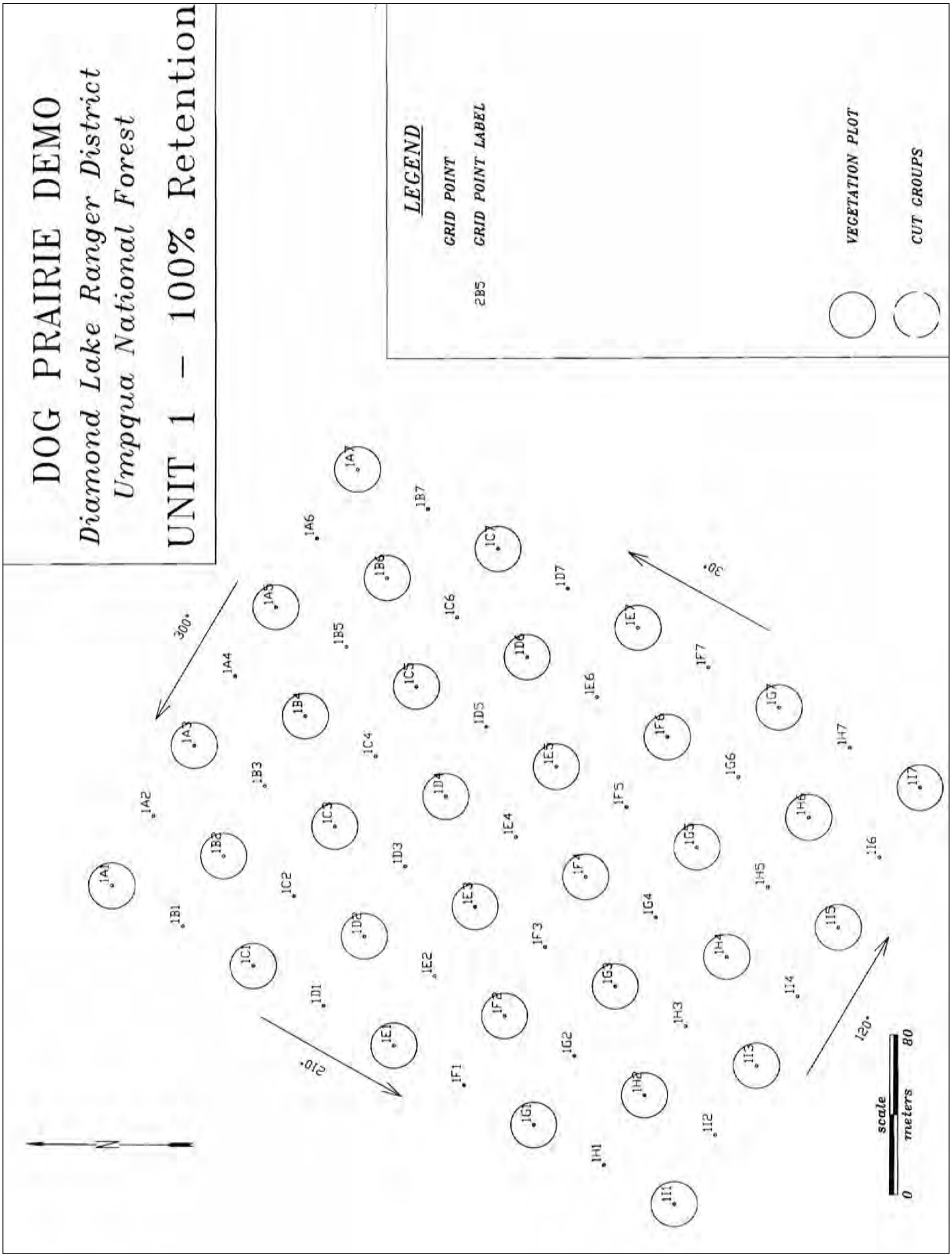
Mileage	Location
0	Exit south from Highway 138 onto Road 37 (signs for Watson Falls picnic ground).
1.2	Pass Road 010 on the right (road to WF2, WF4, and WF6).
2.8	Turn left (east) onto Road 3701 (Big Camas Road).
5.4	Turn right (south) onto Road 3704.
6.7, 8.3, 9.6	Pass Road 100 on the left (6.7 miles), pass Road 230 on the left (8.3 miles), cross over Watson Creek (signed (9.6 miles).
10.7	Turn sharply to the left onto Road 502 at complex intersection of Roads 3704, 500, and 502 (just beyond sharp curve in Road 3704). Do not take what appears to be the main graveled road (Road 500). Road 502 is 90 degrees to the left of Road 500 and is poorly signed; pink flagging hung on trees into Road 502.
10.9	Park at landing on ridgetop; walk ridge line through top of unit (five DEMO signs).

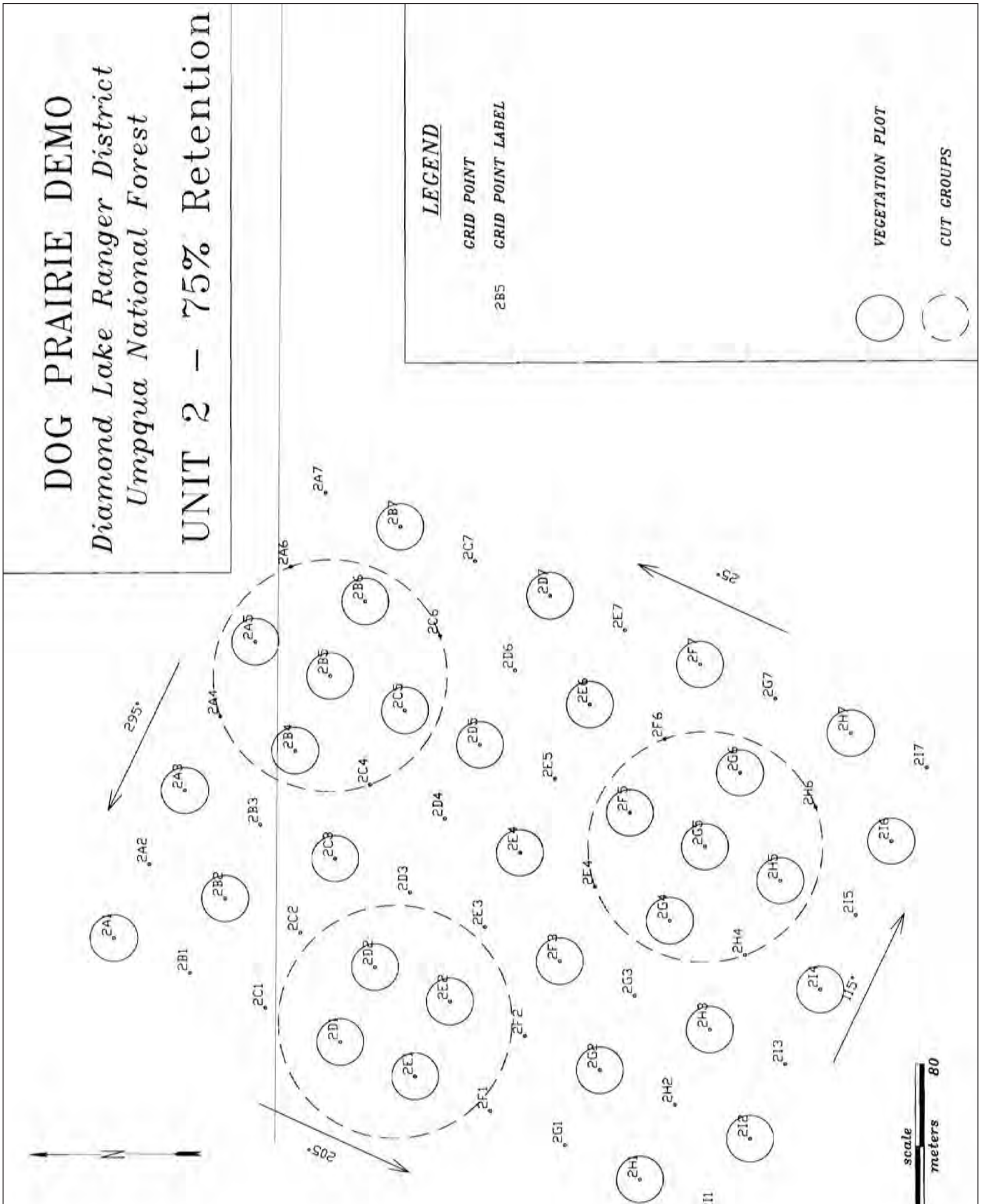
Additional note: Road runs through upper row of unit for most of the distance.

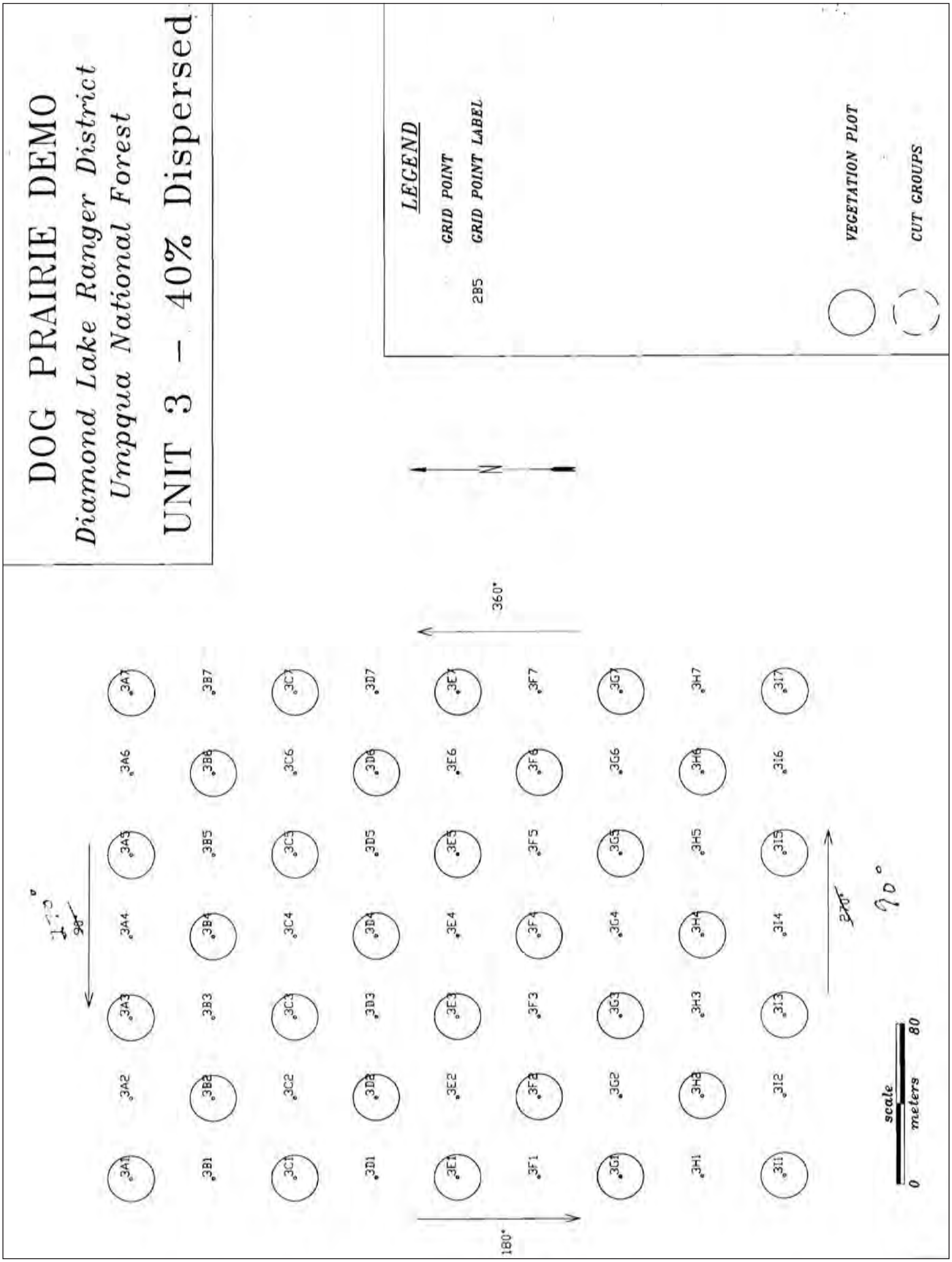
15%A (DP6)

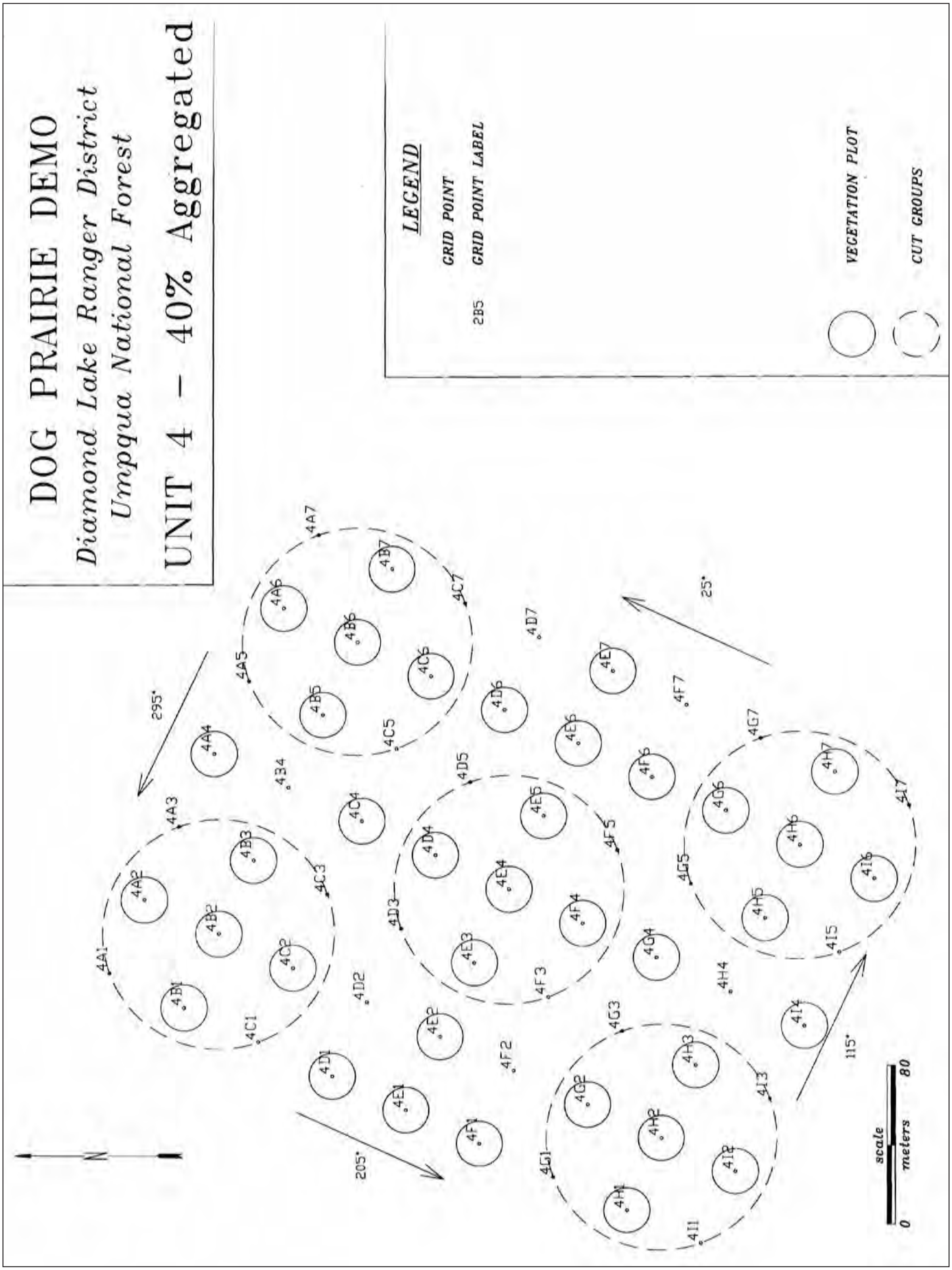
Mileage	Location
0	Exit south from Highway 138 onto Road 37 (signs for Watson Falls picnic ground).
1.2	Pass Road 010 on the right.
2.8	Turn left (east) onto Road 3701 (Big Camas Road).
3.7	Turn right (south) onto Road 480 (Fish Cutoff Road). Note: large campsite on east side of road ~0.7 miles south of intersection with Road 3701.
4.9	Turn left onto Road 500 (left fork of Y).
7.2	Pass Road 530 on the right (some side roads are not signed).
8.4	Unit is above the road on the left; no DEMO signs.

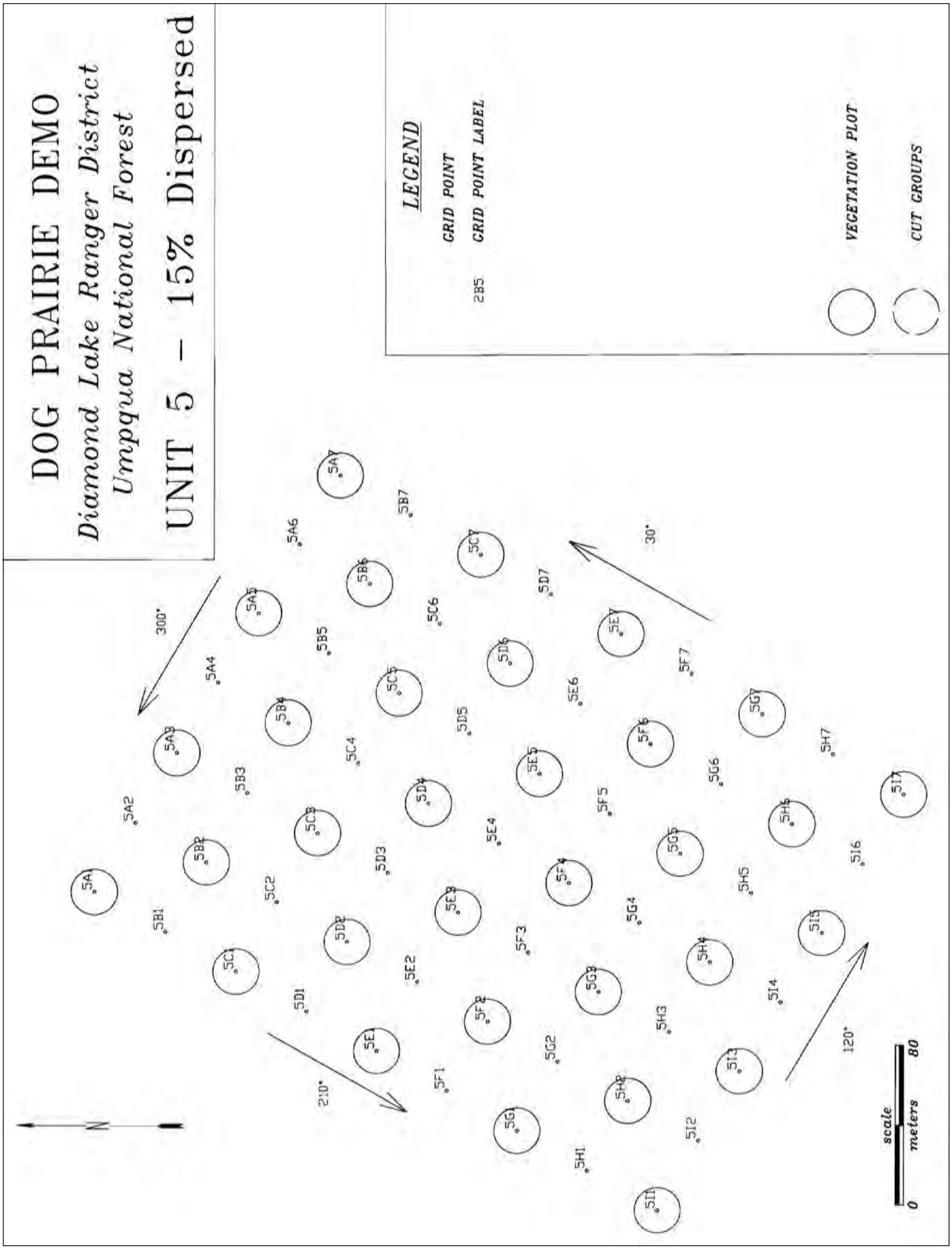
Additional notes: Flagged pink from road to plot 6G3; good access to lower aggregate (plot 6G9) from far end of road.

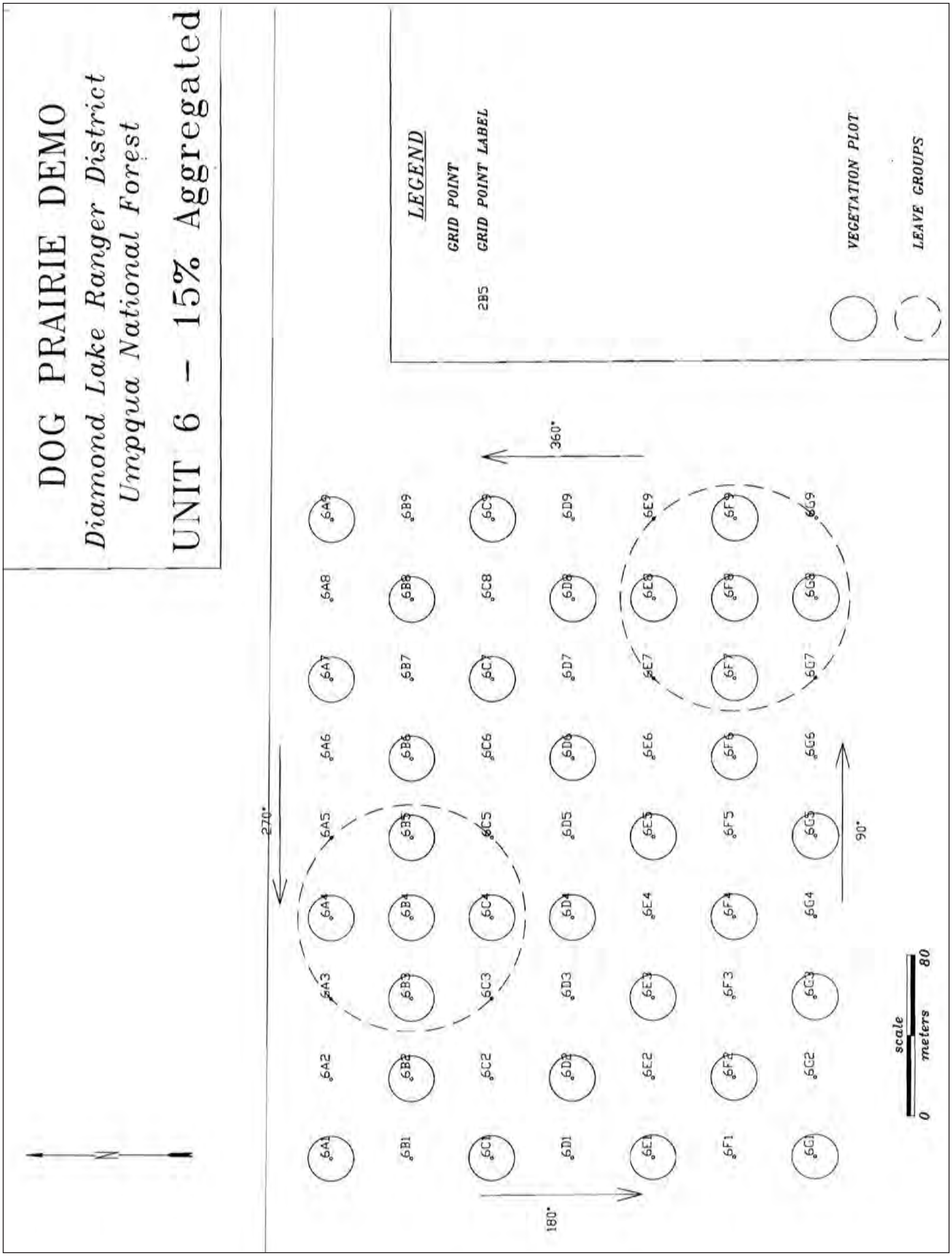

DOG PRAIRIE DEMO
Diamond Lake Ranger District
Umpqua National Forest
UNIT 1 – 100% Retention
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
CUT GROUPS
scale
0
80
meters
N
300°
30°
210°
120°


DOG PRAIRIE DEMO
Diamond Lake Ranger District
Umpqua National Forest
UNIT 2 – 75% Retention
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
CUT GROUPS
295°
25°
205°
115°
scale
0 80
meters


DOG PRAIRIE DEMO
Diamond Lake Ranger District
Umpqua National Forest
UNIT 3 – 40% Dispersed
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
CUT GROUPS
N
360°
180°
scale
meters
0
80

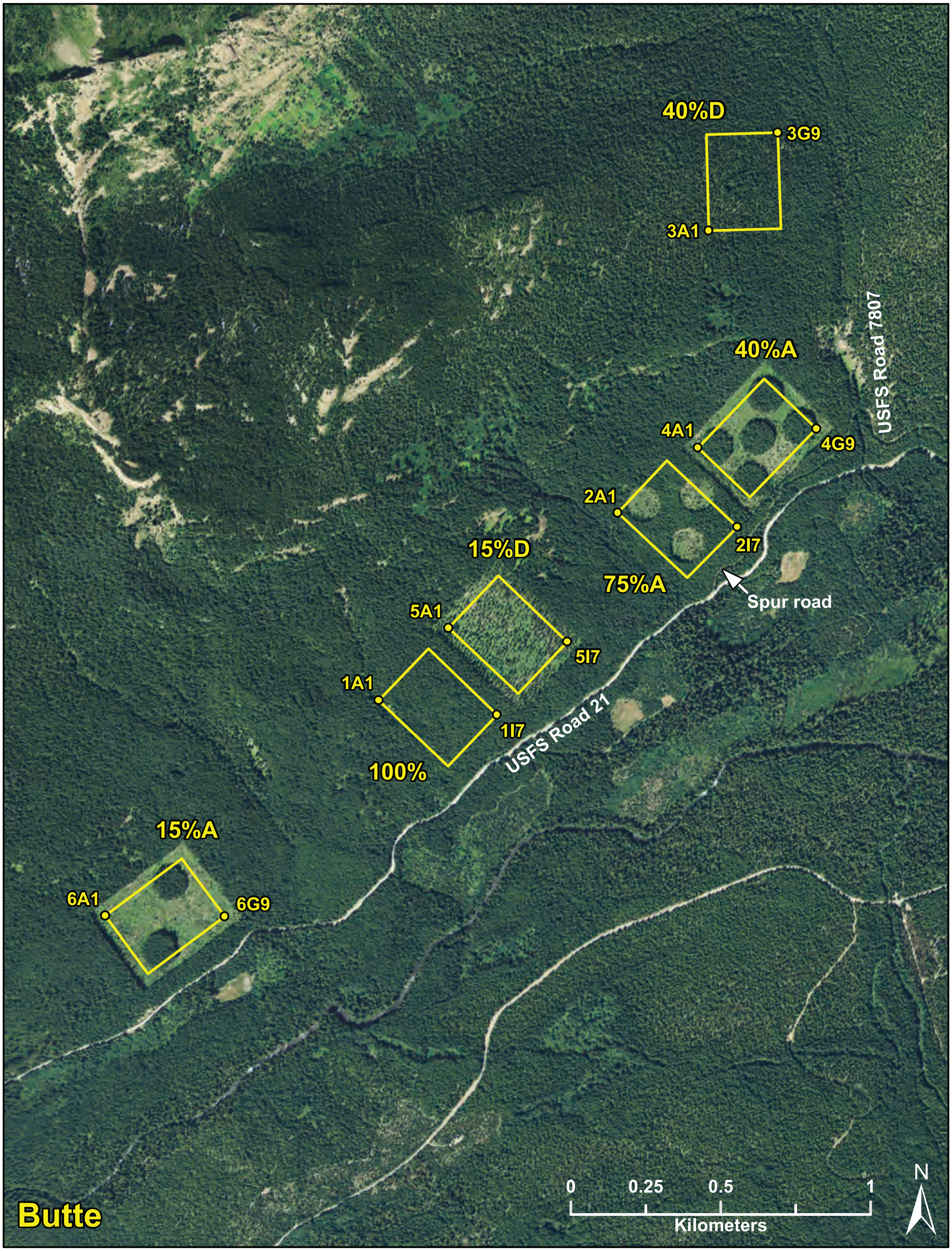

DOG PRAIRIE DEMO
Diamond Lake Ranger District
Umpqua National Forest
UNIT 4 – 40% Aggregated
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
CUT GROUPS
295°
25°
205°
115°
N
scale
0 meters 80

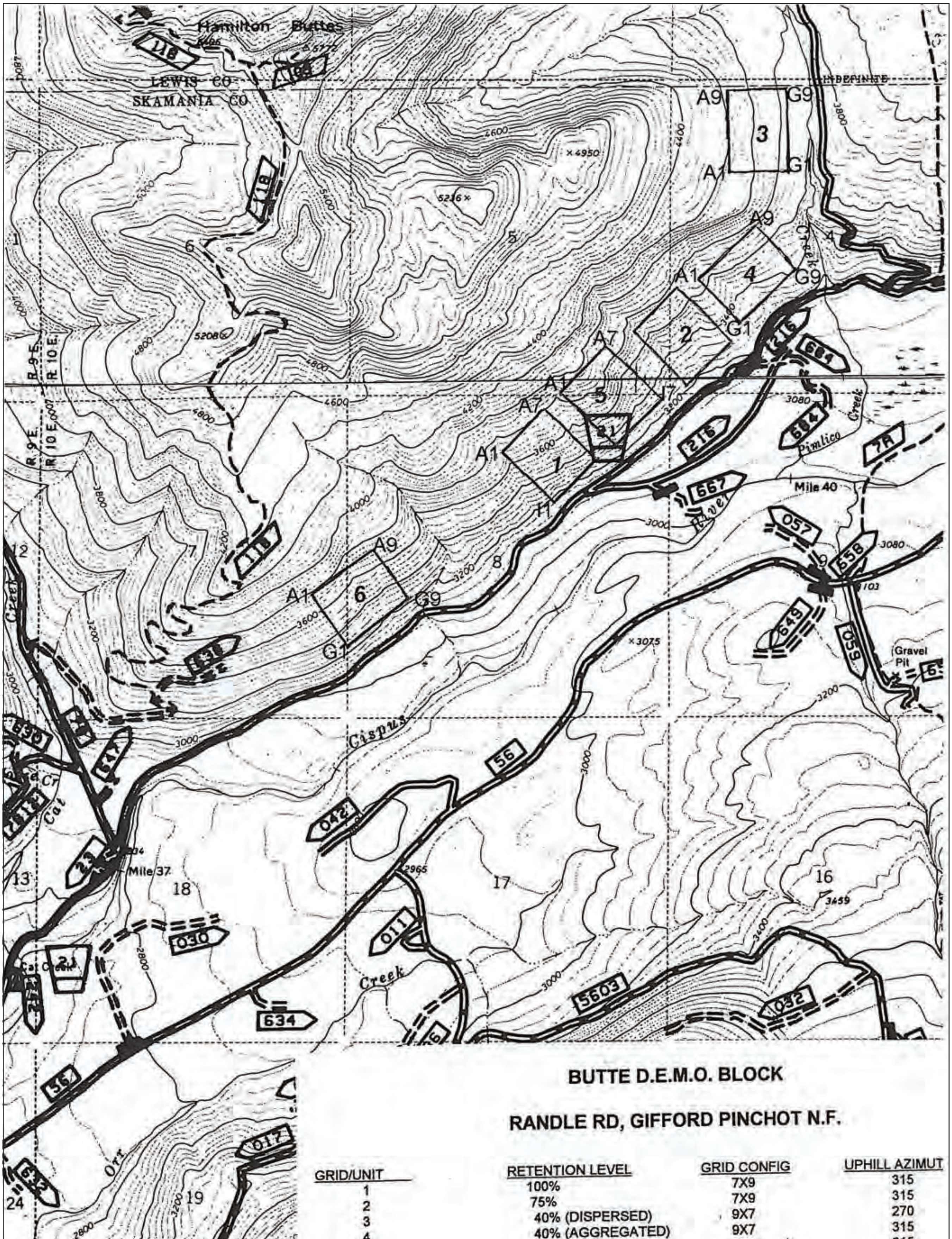

DOG PRAIRIE DEMO
Diamond Lake Ranger District
Umpqua National Forest
UNIT 5 – 15% Dispersed
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
CUT GROUPS
N
300°
30°
210°
120°
scale
0 meters 80


DOG PRAIRIE DEMO
Diamond Lake Ranger District
Umpqua National Forest
UNIT 6 – 15% Aggregated
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
LEAVE GROUPS
360°
270°
90°
180°
scale
meters
0
80
6A1 6A2 6A3 6A4 6A5 6A6 6A7 6A8 6A9
6B1 6B2 6B3 6B4 6B5 6B6 6B7 6B8 6B9
6C1 6C2 6C3 6C4 6C5 6C6 6C7 6C8 6C9
6D1 6D2 6D3 6D4 6D5 6D6 6D7 6D8 6D9
6E1 6E2 6E3 6E4 6E5 6E6 6E7 6E8 6E9
6F1 6F2 6F3 6F4 6F5 6F6 6F7 6F8 6F9
6G1 6G2 6G3 6G4 6G5 6G6 6G7 6G8 6G9

Appendix 4: Locations and Navigational Aids to and Within Treatment Units at the Butte Experimental Block in Washington

Orthophoto is from 2011. Unit labels are (1) 100% = unharvested control, (2) 75%A = 75 percent aggregated retention, (3) 40%D = 40 percent dispersed retention, (4) 40%A = 40 percent aggregated retention, (5) 15%D = 15 percent dispersed retention, and (6) 15%A = 15 percent aggregated retention. Grid points in each treatment unit are identified by 3-character codes indicating treatment number (1 through 6, as listed above), row (letter), and column (number); two corner grid points are labelled here. Orthophotos are followed by topographic maps, detailed driving directions to the treatment units, and diagrams of the sampling grids, which include grid-point identifiers and the locations of aggregates (40%A, 15%A) or gaps (75%A).


40%D
3G9
3A1
USFS Road 7807
40%A
4A1
4G9
2A1
2I7
75%A
Spur road
15%D
5A1
5I7
1A1
1I7
100%
USFS Road 21
15%A
6A1
6G9
0
0.25
0.5
1
Kilometers
N
Butte



BUTTE D.E.M.O. BLOCK

RANDLE RD, GIFFORD PINCHOT N.F.

GRID/UNIT	RETENTION LEVEL	GRID CONFIG	UPHILL AZIMUT
1	100%	7X9	315
2	75%	7X9	315
3	40% (DISPERSED)	9X7	270
4	40% (AGGREGATED)	9X7	315
5	15% (DISPERSED)	7X9	315
6	15% (AGGREGATED)	9X7	325

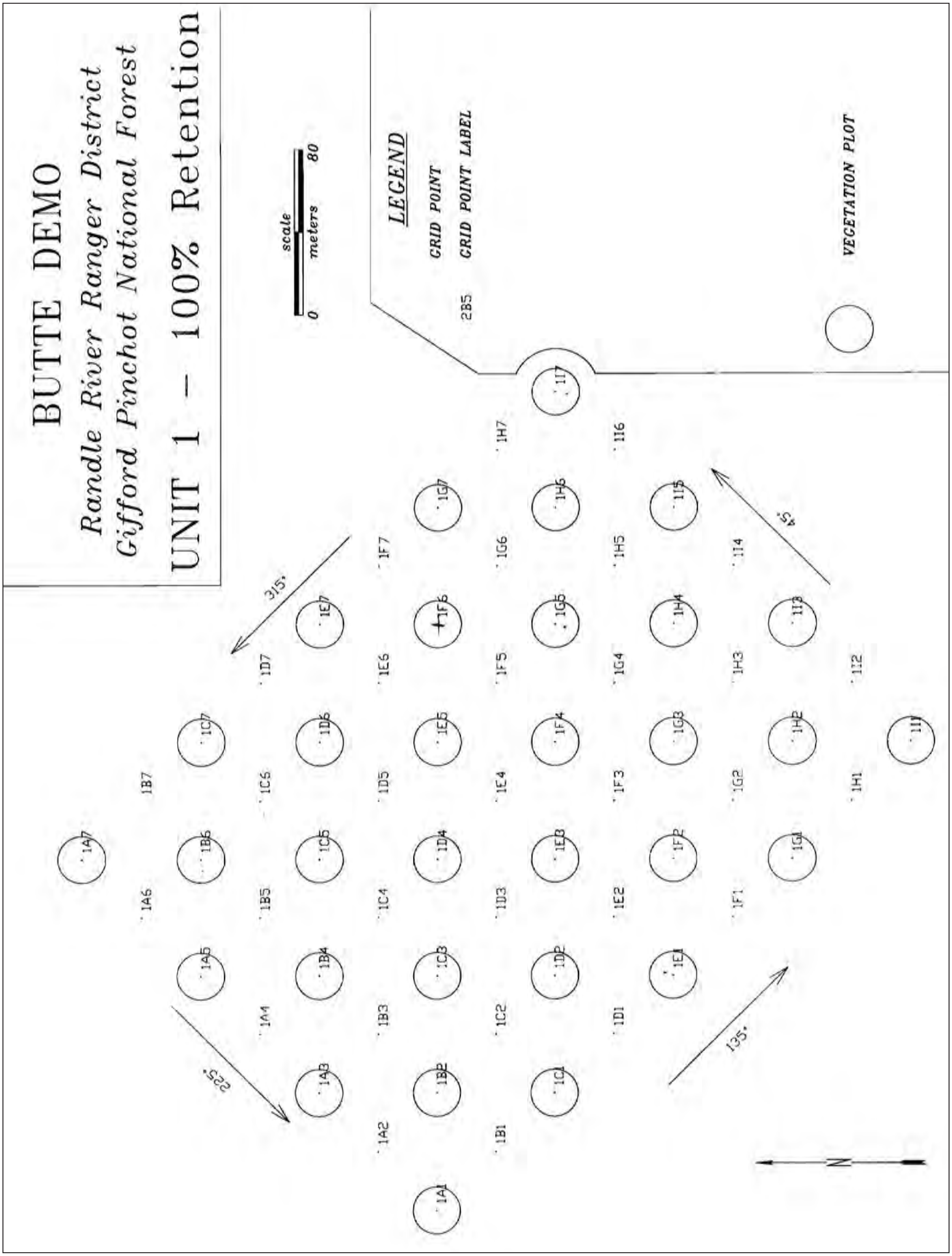
Driving Directions to the Demonstration of Ecosystem Management Options (DEMO) Study Treatment Units in the Butte Experimental Block

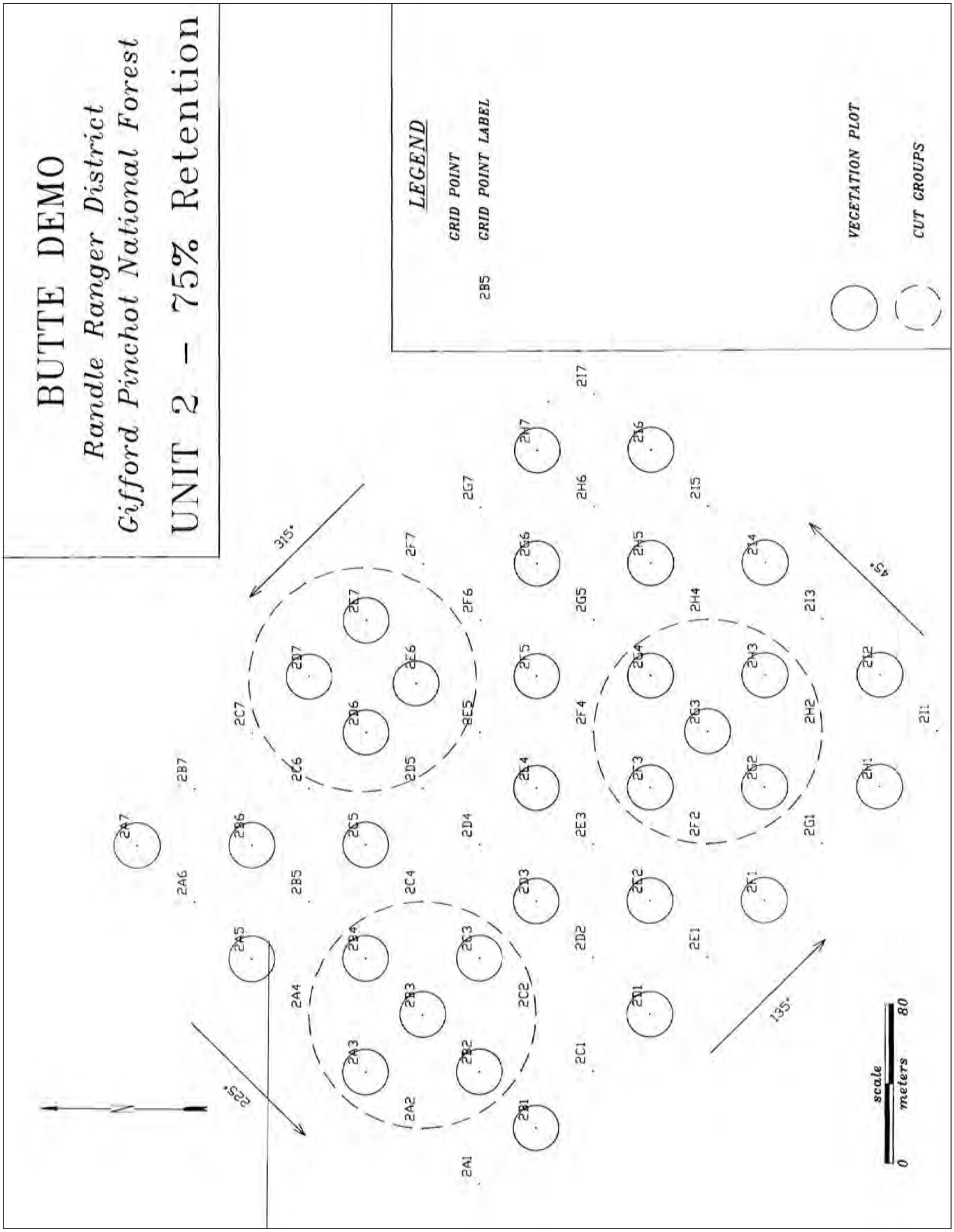
Directions are not provided for 75%A because it was not sampled after the initial posttreatment measurements were made; its location is depicted in the orthophotos and topographic maps.

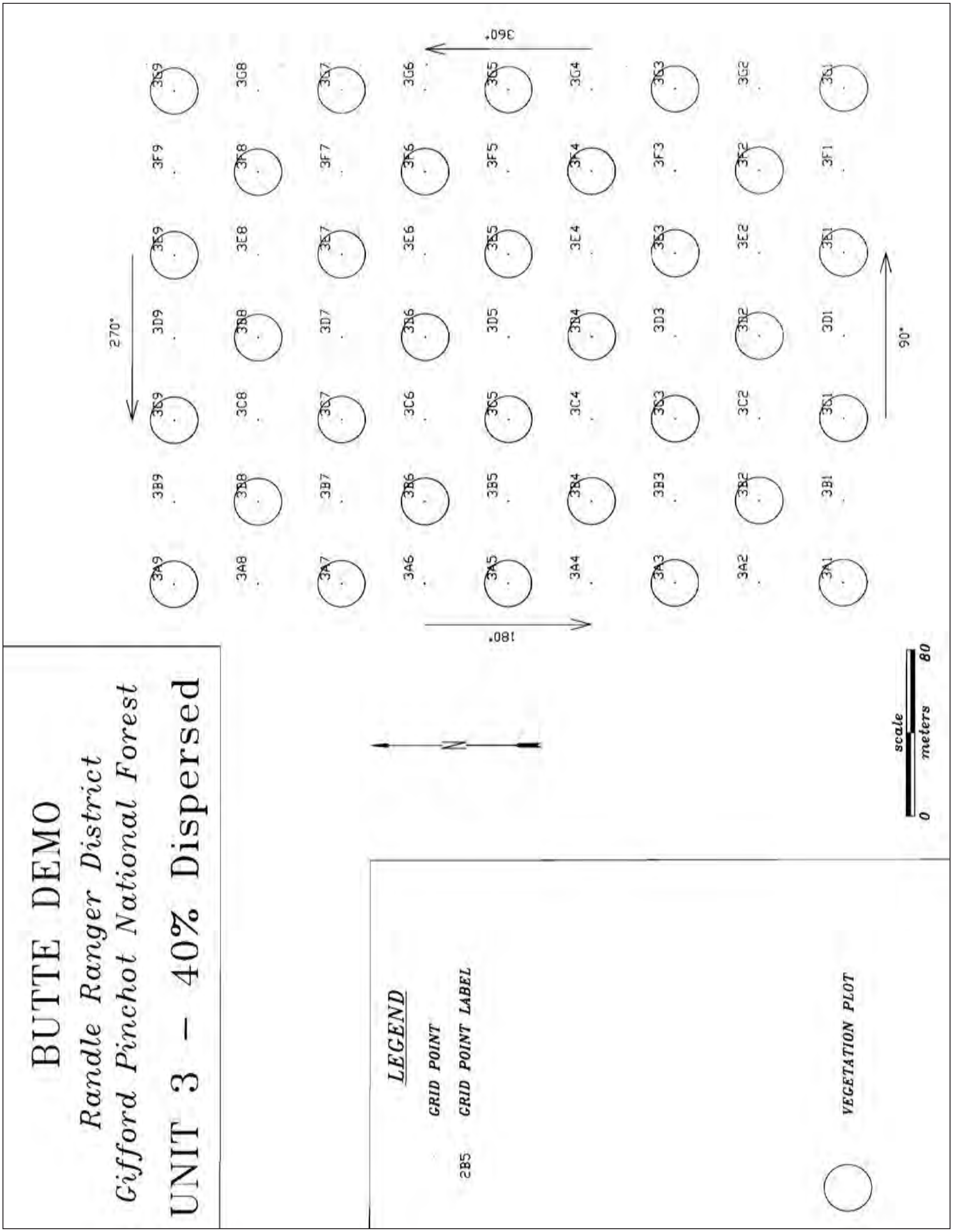
All units are accessed from Road 21, a short distance from Adams Fork Campground. All entry points are marked with DEMO research signs and red flagging around tree boles. Most have white Carsonite posts with a unit number ("U#"). Mileage listed is from the junction of Roads 21 and 56. Adams Fork Campground is 0.1 mile from the junction. Units are listed below in order of increasing distance from the junction.

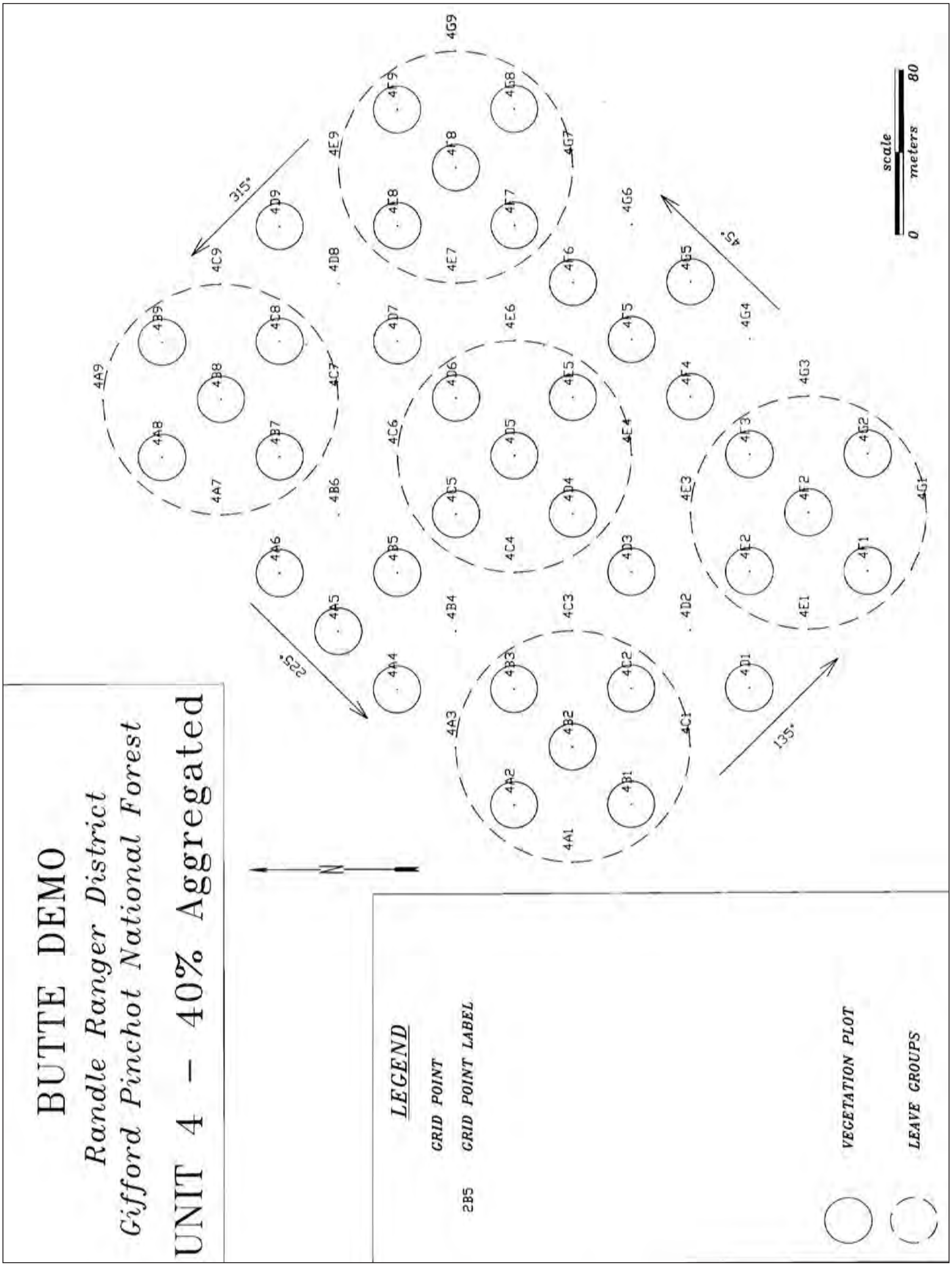
Mileage	Location
0	Junction Road 21/56.
1.0	Milepost 23 on brown road marker.
1.9	NF-22 (signed 7800).
2.0	Milepost 22 (numbers descend with distance from Adams Fork Campground).
3.0	**15%A (BU6).** 30 m before milepost 21. Trail flagged in red over windthrow to unit boundary. Trail ends at unit boundary downslope of 6G4 (lower right edge of aggregate). Dense vegetation between unit boundary and that grid point. Walk along unit boundary (forest edge) to the west; begin at plot 6C1 (cut area) or 6G2 (lower left edge of patch). Note: steep in parts of the lower aggregate with lots of down wood; dense vegetation lower on the slope in the harvested area, including tall bracken and considerable Douglas-fir regeneration. Slow-going in portions of the harvest matrix.
3.1	**100% (BU1).** Wooden, leaning post; no Carsonite post indicating BU1.
3.8	Road 216 to the R (at this point, still below BU1).
4.0	**15%D (BU5).** Carsonite post. Once at the edge of the unit, path to plot 5I7 is flagged with orange- and white-striped tape; plot is upslope of large-diameter 5-m-tall cedar snag. Especially steep, unstable and brushy in parts.

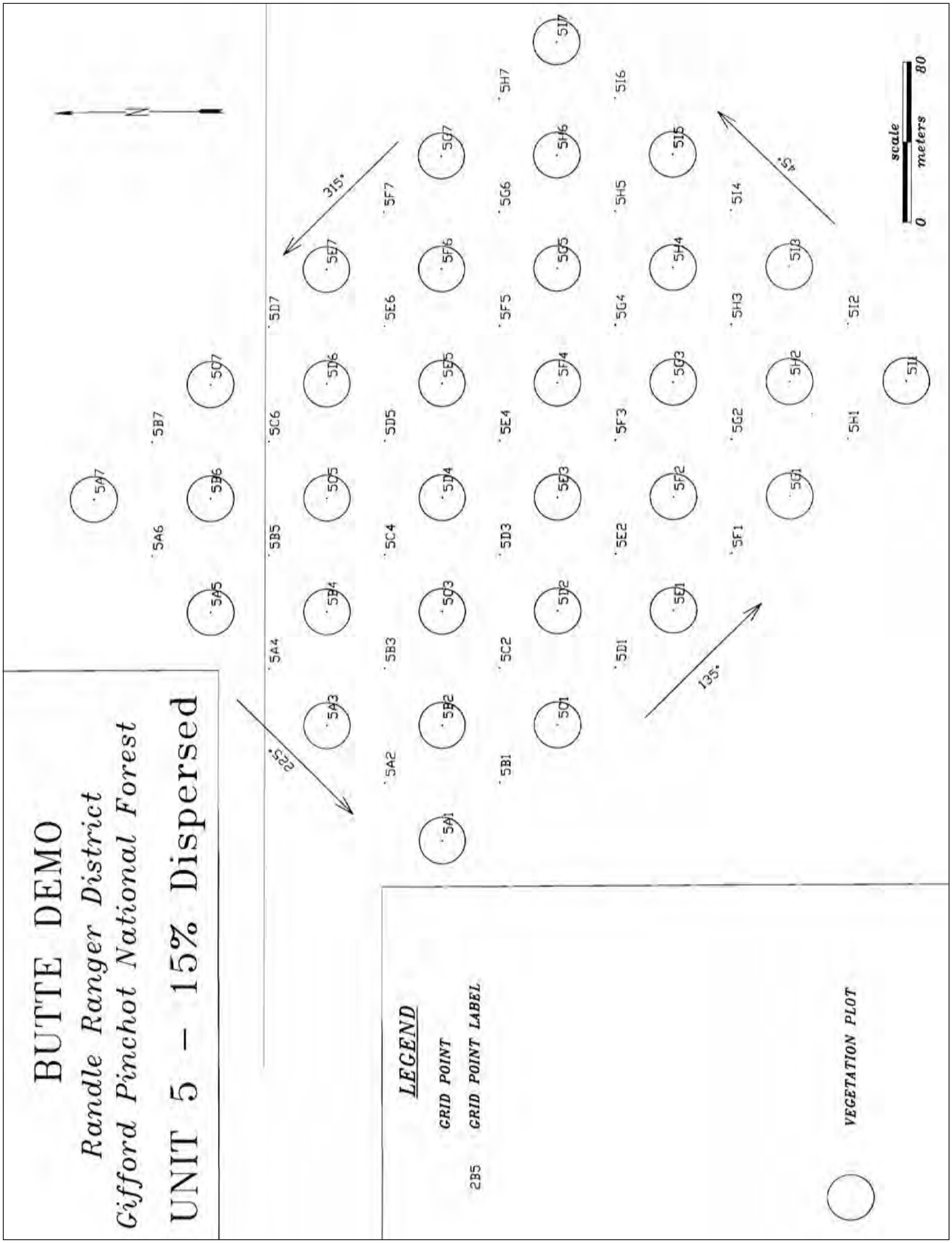
Mileage	Location
4.7	**40%A (BU4).** Carsonite post, high above road. See directions above using spur road. (Note: southwest and center aggregate plus adjacent harvested areas are locations of a previous study of edge gradients. From the center of each aggregate there are sets of 1 × 5 m sample quadrats oriented perpendicular to four radii of the aggregate—these are marked with PVC, rebar, orange flagging, and nails. Try to avoid causing damage).
4.7+	**40%D (BU3).** Cross Pimlico Creek on Road 21, then left onto Road 7807 (signed to Mud Lake). Road is washed out almost just past the gate; may be passable with 4-wheel drive/high clearance. Otherwise hike. Parking area/turnaround on left side of road at the entry point to unit, ~1.5 miles up Road 7807. DEMO sign with red flagging at entry point. Take flagged trail across Pimlico Creek. Trail flagged red for about 300 yards to the southeast corner of the unit (grid point 3G9). Note: although a dispersed unit, there is a small, linear "reserve" in the center, necessary to protect a perennial stream (U.S. Forest Service regulations); blue boundary signs on trees mark the perimeter of the reserve.

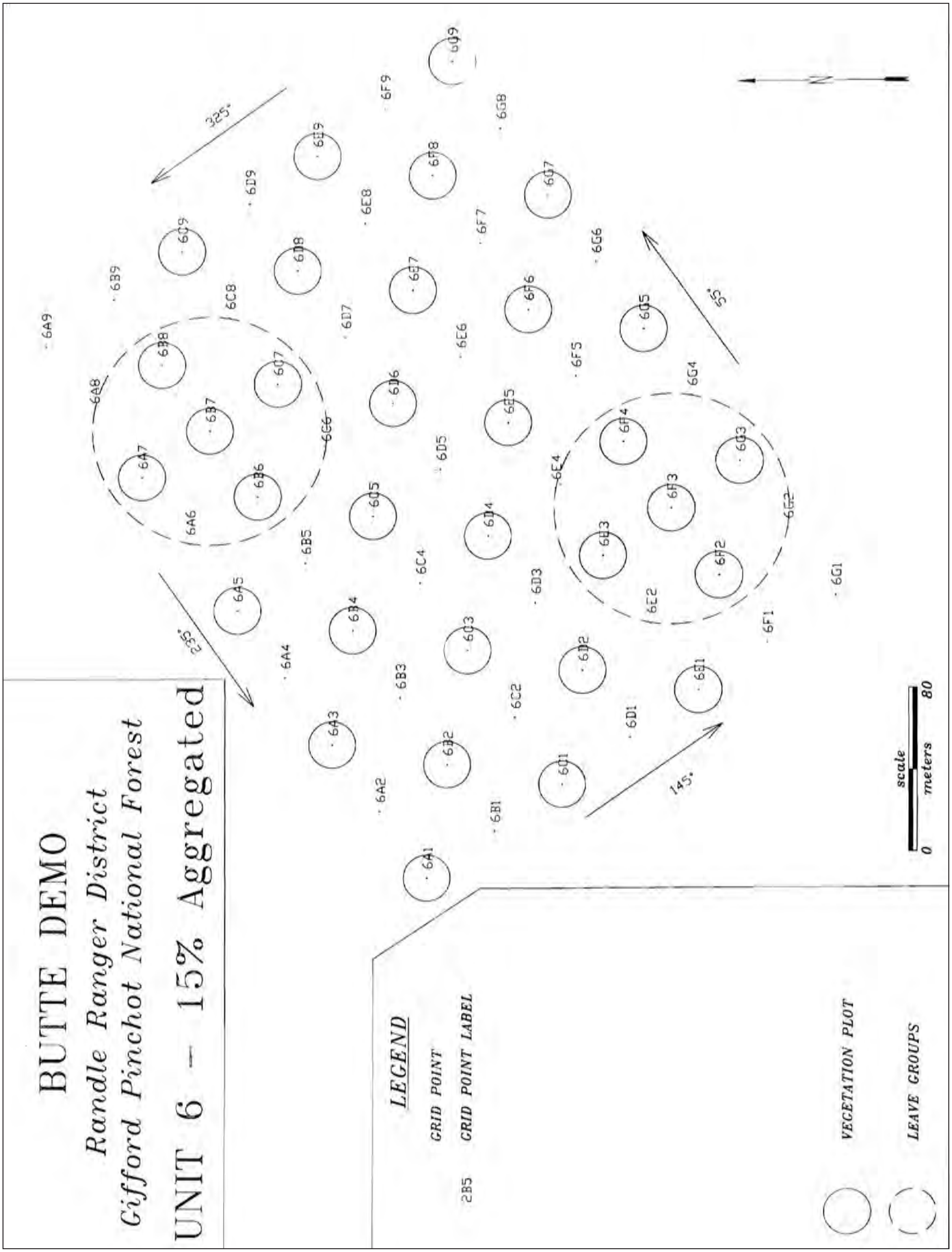

BUTTE DEMO
Randle River Ranger District
Gifford Pinchot National Forest
UNIT 1 – 100% Retention
scale
0 meters 80
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
315°
45°
225°
135°
N


BUTTE DEMO
Randle Ranger District
Gifford Pinchot National Forest
UNIT 2 – 75% Retention
LEGEND
GRID POINT
2B5
GRID POINT LABEL
VEGETATION PLOT
CUT GROUPS
scale
0
80
meters
315°
45°
135°
225°


BUTTE DEMO
Randle Ranger District
Gifford Pinchot National Forest
UNIT 3 – 40% Dispersed
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
scale
0 meters 80
N
360°
270°
180°
90°
3A1 3A2 3A3 3A4 3A5 3A6 3A7 3A8 3A9
3B1 3B2 3B3 3B4 3B5 3B6 3B7 3B8 3B9
3C1 3C2 3C3 3C4 3C5 3C6 3C7 3C8 3C9
3D1 3D2 3D3 3D4 3D5 3D6 3D7 3D8 3D9
3E1 3E2 3E3 3E4 3E5 3E6 3E7 3E8 3E9
3F1 3F2 3F3 3F4 3F5 3F6 3F7 3F8 3F9
3G1 3G2 3G3 3G4 3G5 3G6 3G7 3G8 3G9

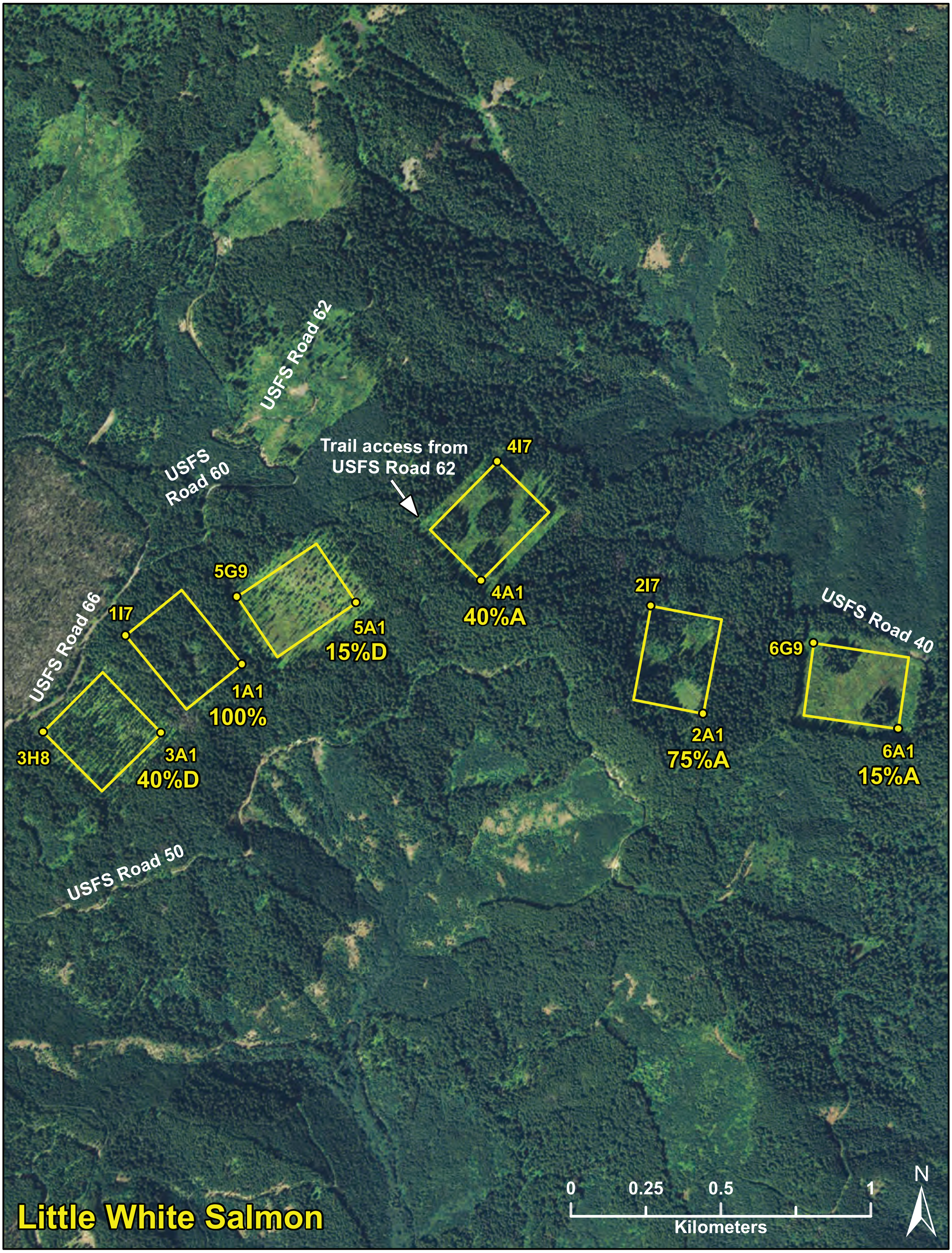

BUTTE DEMO
Randle Ranger District
Gifford Pinchot National Forest
UNIT 4 – 40% Aggregated
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
LEAVE GROUPS
N
315°
225°
135°
45°
scale
0 meters 80


BUTTE DEMO
Randle Ranger District
Gifford Pinchot National Forest
UNIT 5 – 15% Dispersed
N
225°
315°
135°
45°
scale
0
80
meters
LEGEND
GRID POINT
2B5
GRID POINT LABEL
VEGETATION PLOT


BUTTE DEMO
Randle Ranger District
Gifford Pinchot National Forest
UNIT 6 – 15% Aggregated
LEGEND
GRID POINT
2B5
GRID POINT LABEL
VEGETATION PLOT
LEAVE GROUPS
scale
0
80
meters
325°
235°
145°
55°
N

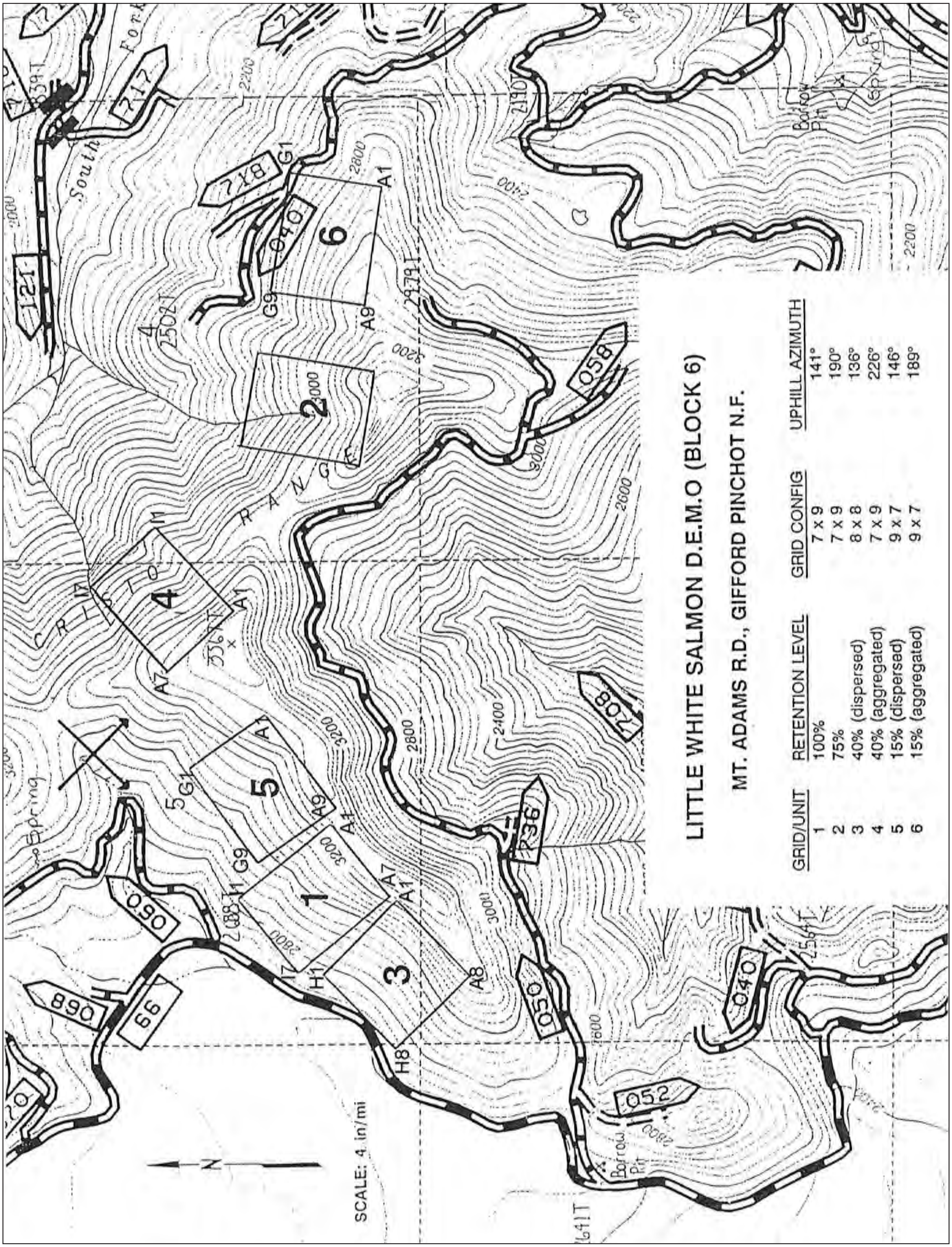
Appendix 5: Locations and Navigational Aids to and Within Treatment Units at the Little White Salmon Experimental Block in Washington

Orthophoto is from 2011. Unit labels are (1) 100% = unharvested control, (2) 75%A = 75 percent aggregated retention, (3) 40%D = 40 percent dispersed retention, (4) 40%A = 40 percent aggregated retention, (5) 15%D = 15 percent dispersed retention, and (6) 15%A = 15 percent aggregated retention. Grid points in each treatment unit are identified by 3-character codes indicating treatment number (1 through 6, as listed above), row (letter), and column (number); two corner grid points are labelled here. Orthophotos are followed by topographic maps, detailed driving directions to the treatment units, and diagrams of the sampling grids, which include grid-point identifiers and the locations of aggregates (40%A, 15%A) or gaps (75%A).



USFS Road 62
USFS Road 60
Trail access from USFS Road 62
4I7
4A1
40%A
5G9
5A1
15%D
1I7
1A1
100%
USFS Road 66
3H8
3A1
40%D
2I7
2A1
75%A
USFS Road 40
6G9
6A1
15%A
USFS Road 50
0
0.25
0.5
1
Kilometers
N
Little White Salmon


LITTLE WHITE SALMON D.E.M.O.
MT. ADAMS R.D., GIFFORD PINCHOT N.F.
OKLAHOMA CAMPGROUND
3
1
5
4
2
6
N
MOSS CREEK CAMPGROUND
WILLARD
COOK
TO HWY 14 (3 MILES)
SCALE: 1 in/mi


LITTLE WHITE SALMON D.E.M.O (BLOCK 6)
MT. ADAMS R.D., GIFFORD PINCHOT N.F.
GRID/UNIT RETENTION LEVEL GRID CONFIG UPHILL AZIMUTH
1 100% 7 x 9 141°
2 75% 7 x 9 190°
3 40% (dispersed) 8 x 8 136°
4 40% (aggregated) 7 x 9 226°
5 15% (dispersed) 9 x 7 146°
6 15% (aggregated) 9 x 7 189°
SCALE: 4 in/mi
N

Driving Directions to the Demonstration of Ecosystem Management Options (DEMO) Study Treatment Units in the Little White Salmon Experimental Block.

Directions are not provided for 75%A because it was not sampled after the initial posttreatment measurements were made; its location is depicted in the orthophotos and topographic maps.

100% (LW1), 40%D (LW3), 40%A (LW4), and 15%D (LW5)

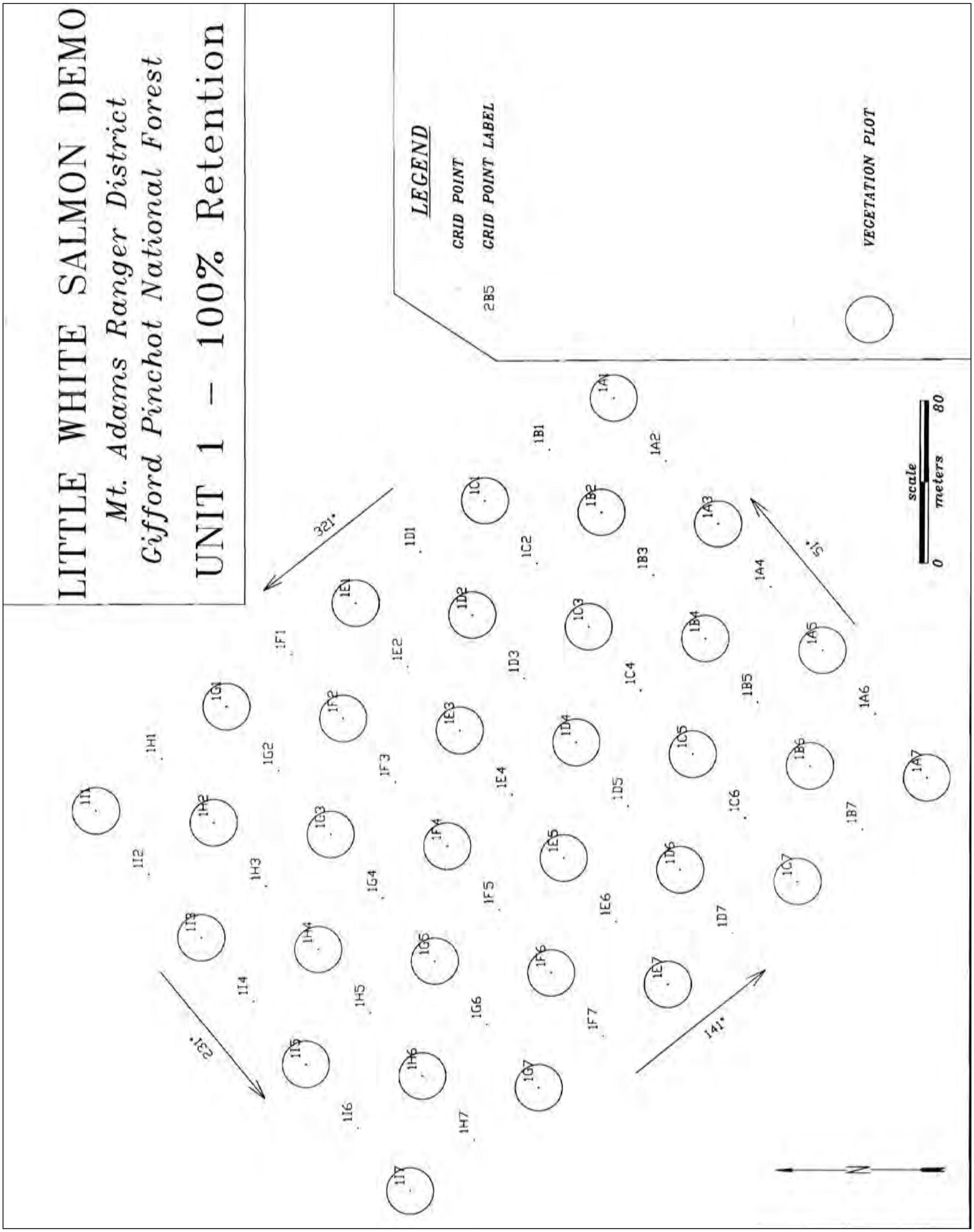
These four units are accessed from Road 66. It is a long drive plus hiking time from Wind River Experimental Forest to LW4 (1.5 hours each way). Be prepared to set trip meter to 0 at Cook-Underwood Road.

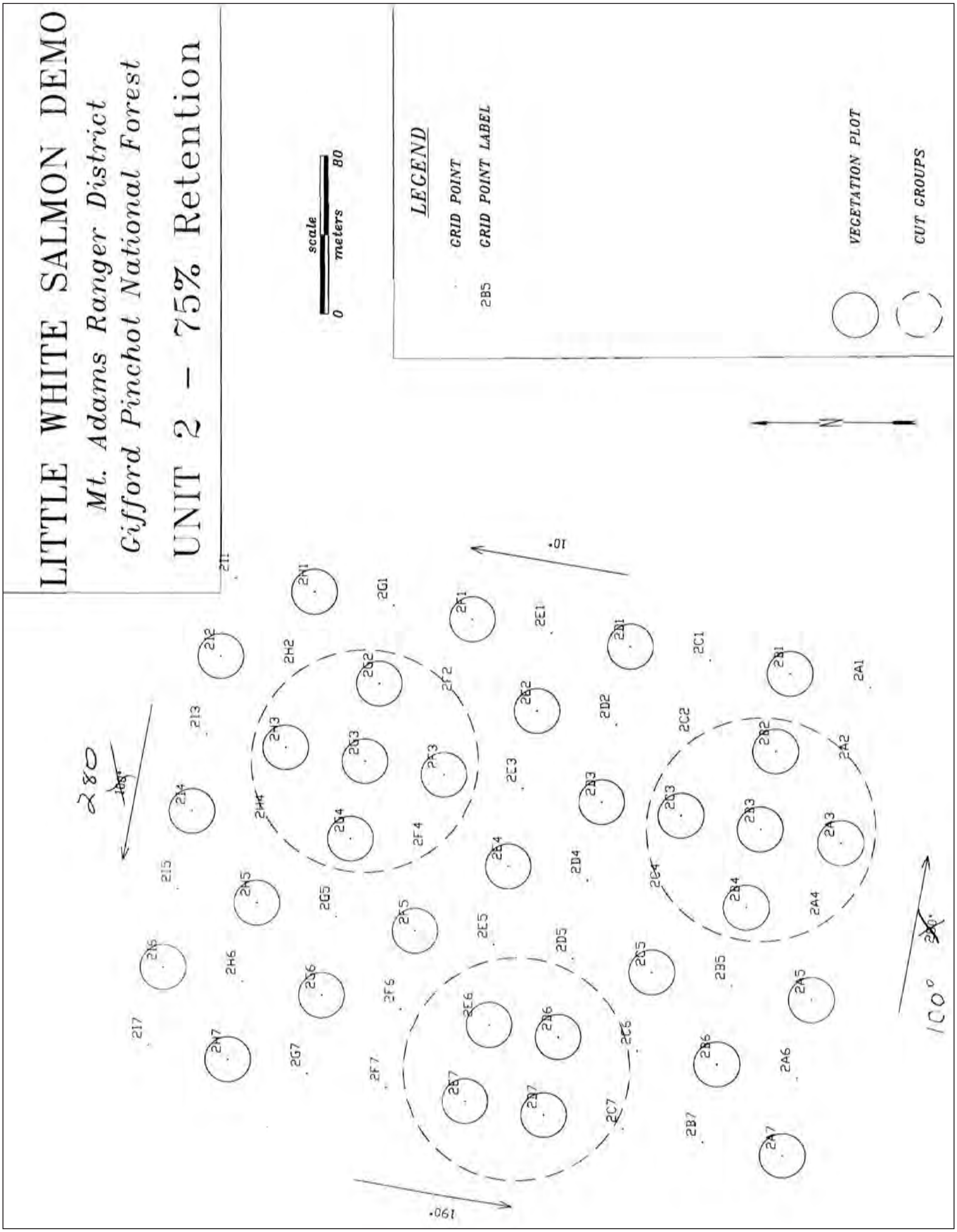
Mileage	Location
—	From Wind River Experimental Forest, head south on Wind River Road; in Carson, make a left onto Hot Spring Road, then a left onto Highway 14 (Columbia River Gorge).
—	On Highway 14, travel about 7 miles to Cook-Underwood Road; left onto Cook-Underwood Road.
0	At Cook-Underwood Road, set trip meter to 0.
4.9	Left onto Willard Road.
6.3	Straight on Oklahoma Road (T-intersection with another arm of Willard Road).
7.4	Junction of Oklahoma Road and NF-66; turn left onto Road 66 and travel 7.5 miles to units.
14.9	Turn right onto Road 60 to park.
	40%D (LW3). Four red flags mark entry to unit.
	100% (LW1). Three red flags at roadside mark trail to northwest corner of unit; flagged in red along ridgeline from the road.
15.0	**15%D (LW5).** Drive 0.1 miles up Road 60 from the intersection with Road 66. Red flagging on roadside (right) marks the trail. Hike about 300 yards to lower edge of unit; DEMO research sign on tree at edge. (Light pink flagging to plot 5G5).
15.6	**40%A (LW4).** Accessed from Road 62. Drive 0.6 miles past LW5 access point to intersection with Road 62. Right onto Road 62. Road is heavily rutted; drive with wheels on raised middle and edge of road bed. Edges of road may need to be brushed. Drive about 0.5 mile to large opening at end of Road 62. Trail to LW4 is on the right. Hike down, then up brushed ridgeline to connect to west corner of LW4 (plot 4A7). Dense vine maple between unit boundary and upper aggregate; walk to aggregate to locate first plot and work from there.

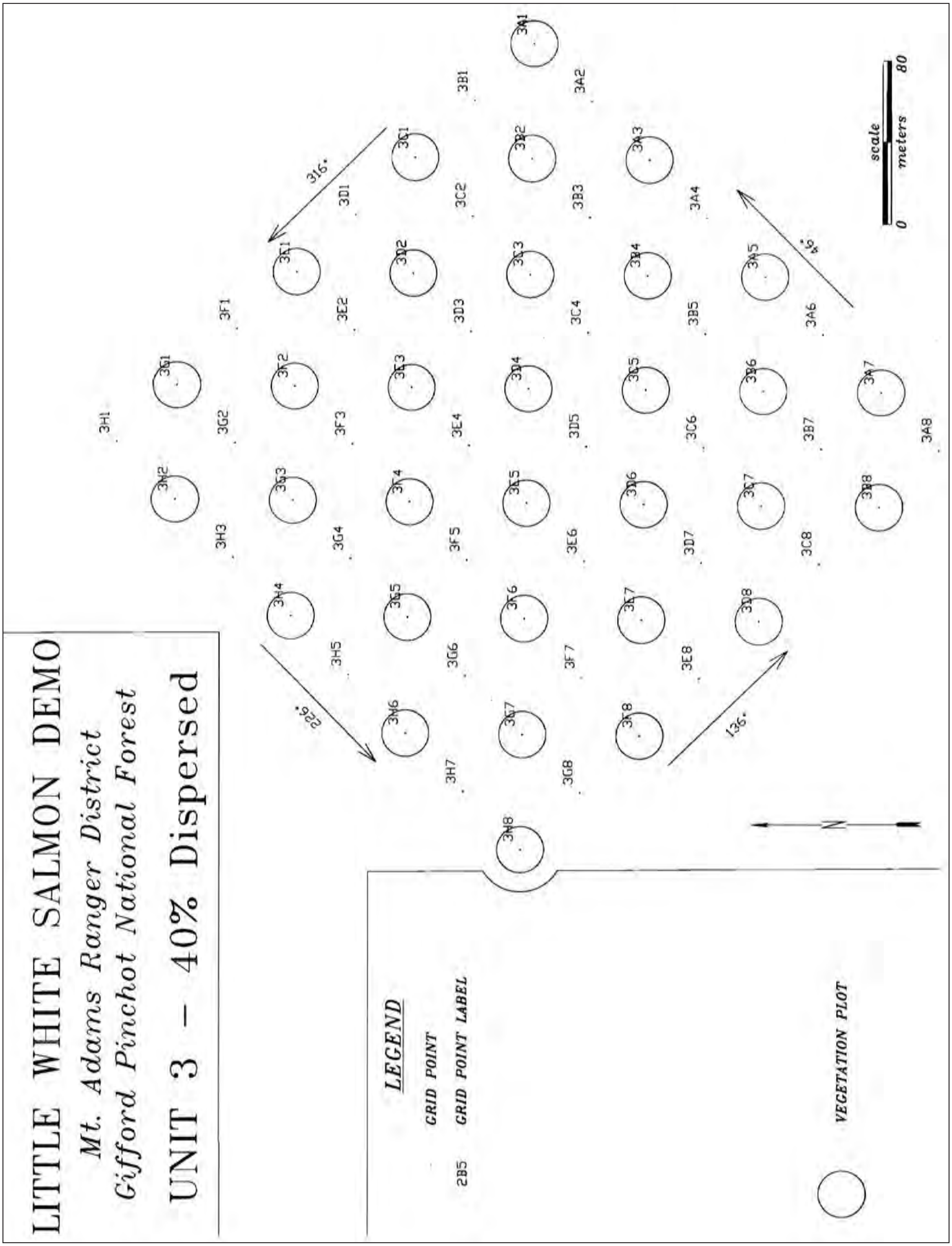
15%A (LW6)

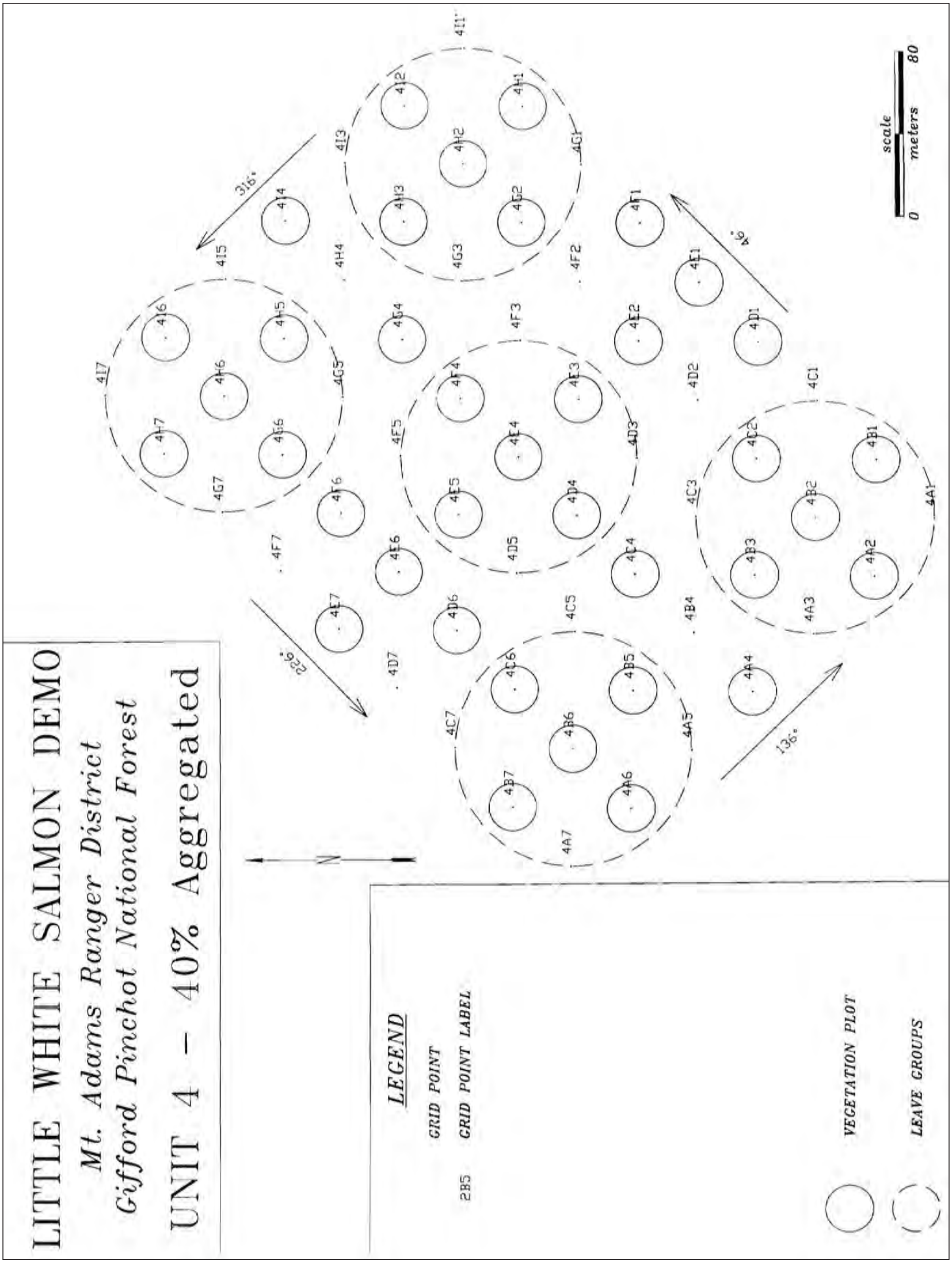
It is a long drive time from Wind River Experimental Forest to this isolated unit. Be prepared to set trip meter to 0 at Cook-Underwood Road.

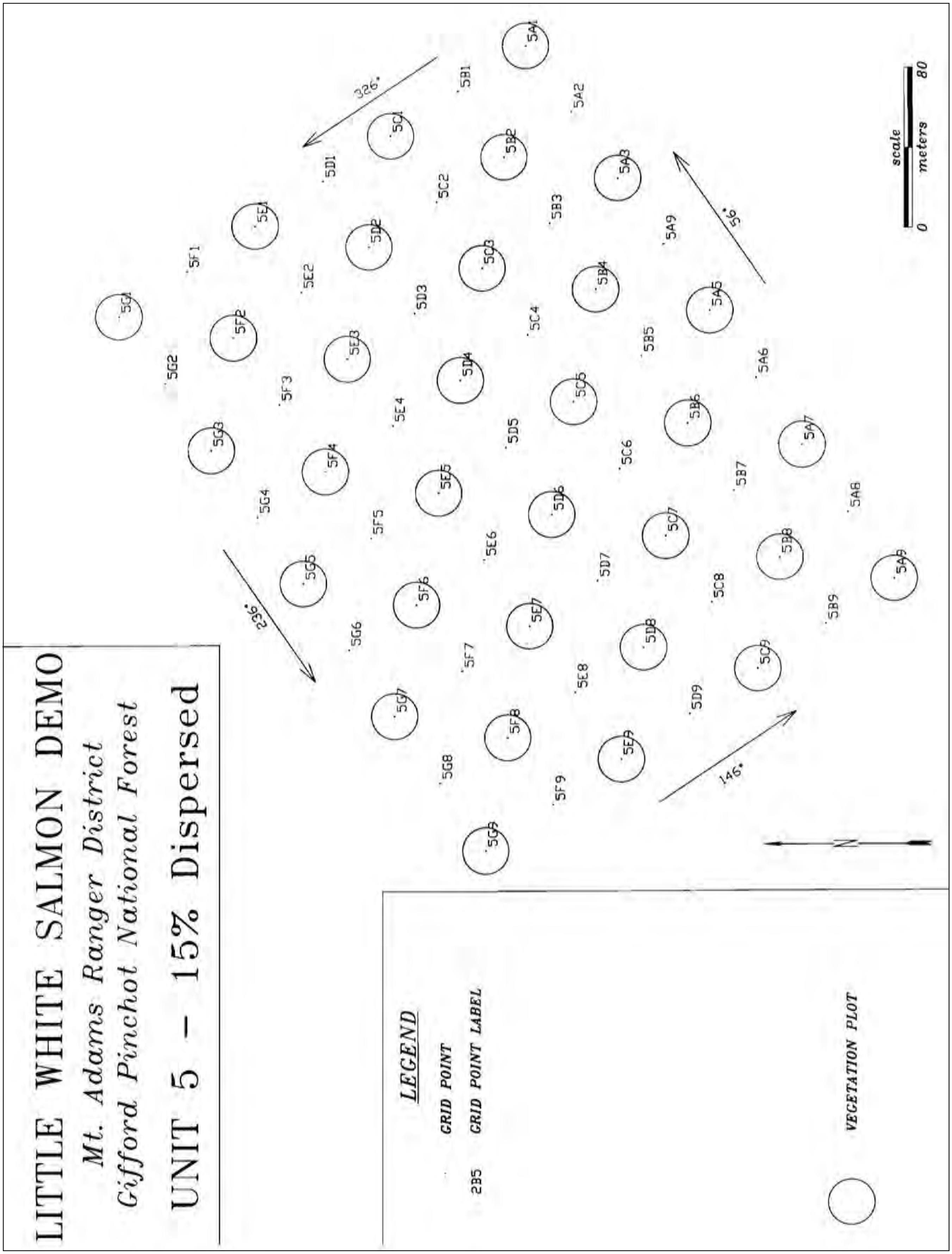
Mileage	Location
—	From Wind River Experimental Forest, head south on Wind River Road; in Carson, make a left onto Hot Spring Road, then a left onto Highway 14 (Columbia River Gorge).
—	On Highway 14, travel ~7 miles to Cook-Underwood Road; left onto Cook-Underwood Road.
0	At Cook-Underwood Road, set trip meter to 0.
4.9	Left onto Willard Road.
6.3	Straight on Oklahoma Road (T-intersection with another arm of Willard Road)
7.4	Pass intersection with NF-66; continue straight on Oklahoma.
11.3	Cross Little White Salmon River and make a left (triangle intersection). No road sign, but probably Road 8031. Stay to the right (red flagging). Pass two roads on the left but stay right (on main road).
11.6	Sharp right on Road 020 into forest before gravel pit (flagged red on right side of road).
12.5	Right at intersection onto Road 040; brown Carsonite post flagged red.
13.8	Stop at grassy opening below cut bank (northeast corner of unit, plot 6G1). Turn vehicle around and park here; road not fully cleared beyond this point. Hike down road through mature forest bordering east edge of unit to opposite end for easy access to lower aggregate. Watch for red flagging on left side of road. Flagged upslope to plot 6G7 which is an edge point of the aggregate. Large Douglas-fir down along the contour below aggregate center (plot 6F7). Dense vine maple in harvest matrix; some windthrow in the aggregate. Aggregate in upper corner of unit appears even more compromised by windthrow along east edge.

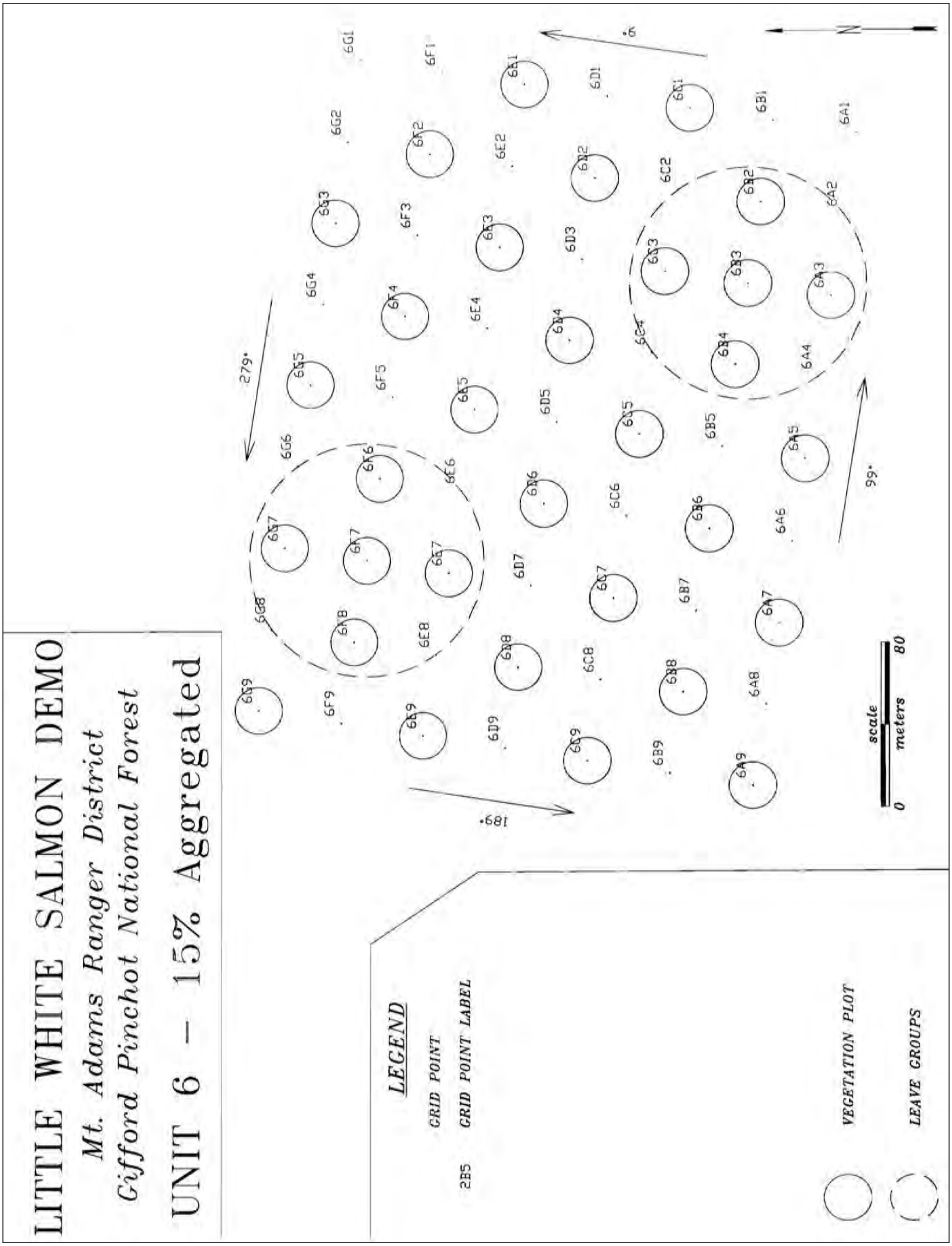

LITTLE WHITE SALMON DEMO
Mt. Adams Ranger District
Gifford Pinchot National Forest
UNIT 1 – 100% Retention
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
scale
0
80
meters


LITTLE WHITE SALMON DEMO
Mt. Adams Ranger District
Gifford Pinchot National Forest
UNIT 2 – 75% Retention
scale
0 meters 80
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
CUT GROUPS
N
10°
280
100°
190°


LITTLE WHITE SALMON DEMO
Mt. Adams Ranger District
Gifford Pinchot National Forest
UNIT 3 – 40% Dispersed
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
scale
0
80
meters

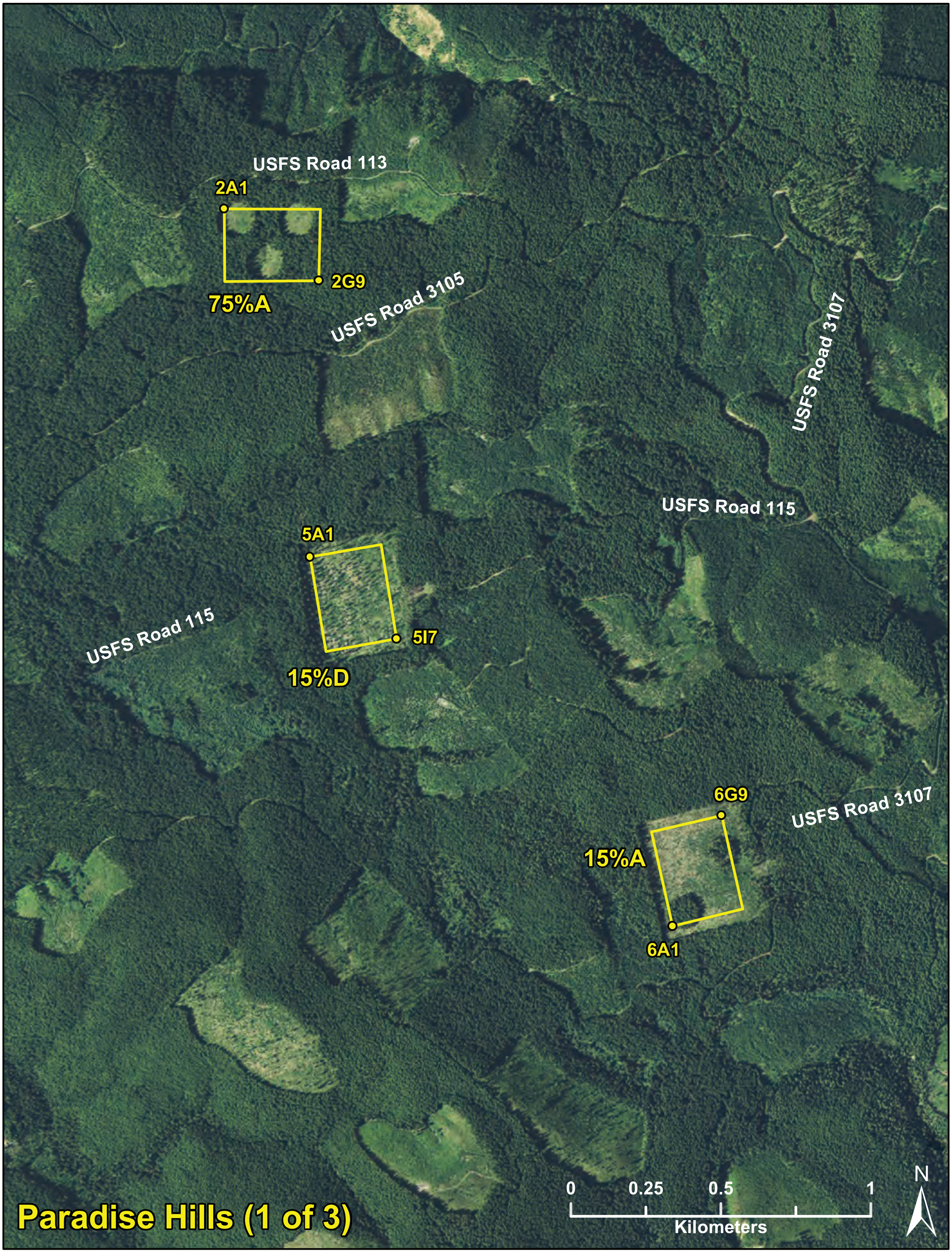

LITTLE WHITE SALMON DEMO
Mt. Adams Ranger District
Gifford Pinchot National Forest
UNIT 4 – 40% Aggregated
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
LEAVE GROUPS
scale
0 meters 80
N
316°
226°
136°
46°

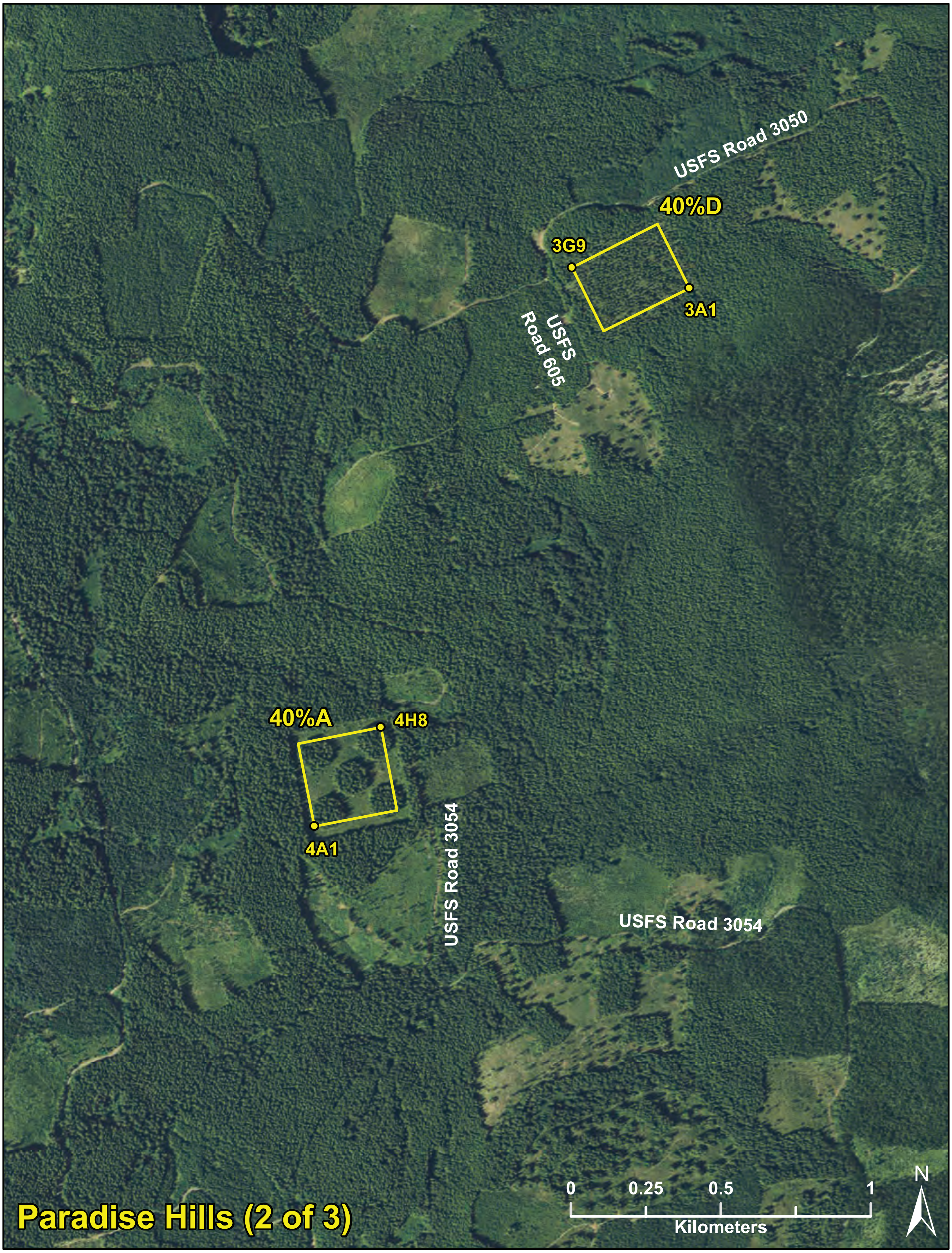

LITTLE WHITE SALMON DEMO
Mt. Adams Ranger District
Gifford Pinchot National Forest
UNIT 5 – 15% Dispersed
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
scale
0 80
meters
326°
56°
236°
146°
5A1 5A2 5A3 5A4 5A5 5A6 5A7 5A8 5A9
5B1 5B2 5B3 5B4 5B5 5B6 5B7 5B8 5B9
5C1 5C2 5C3 5C4 5C5 5C6 5C7 5C8 5C9
5D1 5D2 5D3 5D4 5D5 5D6 5D7 5D8 5D9
5E1 5E2 5E3 5E4 5E5 5E6 5E7 5E8 5E9
5F1 5F2 5F3 5F4 5F5 5F6 5F7 5F8 5F9
5G1 5G2 5G3 5G4 5G5 5G6 5G7 5G8 5G9

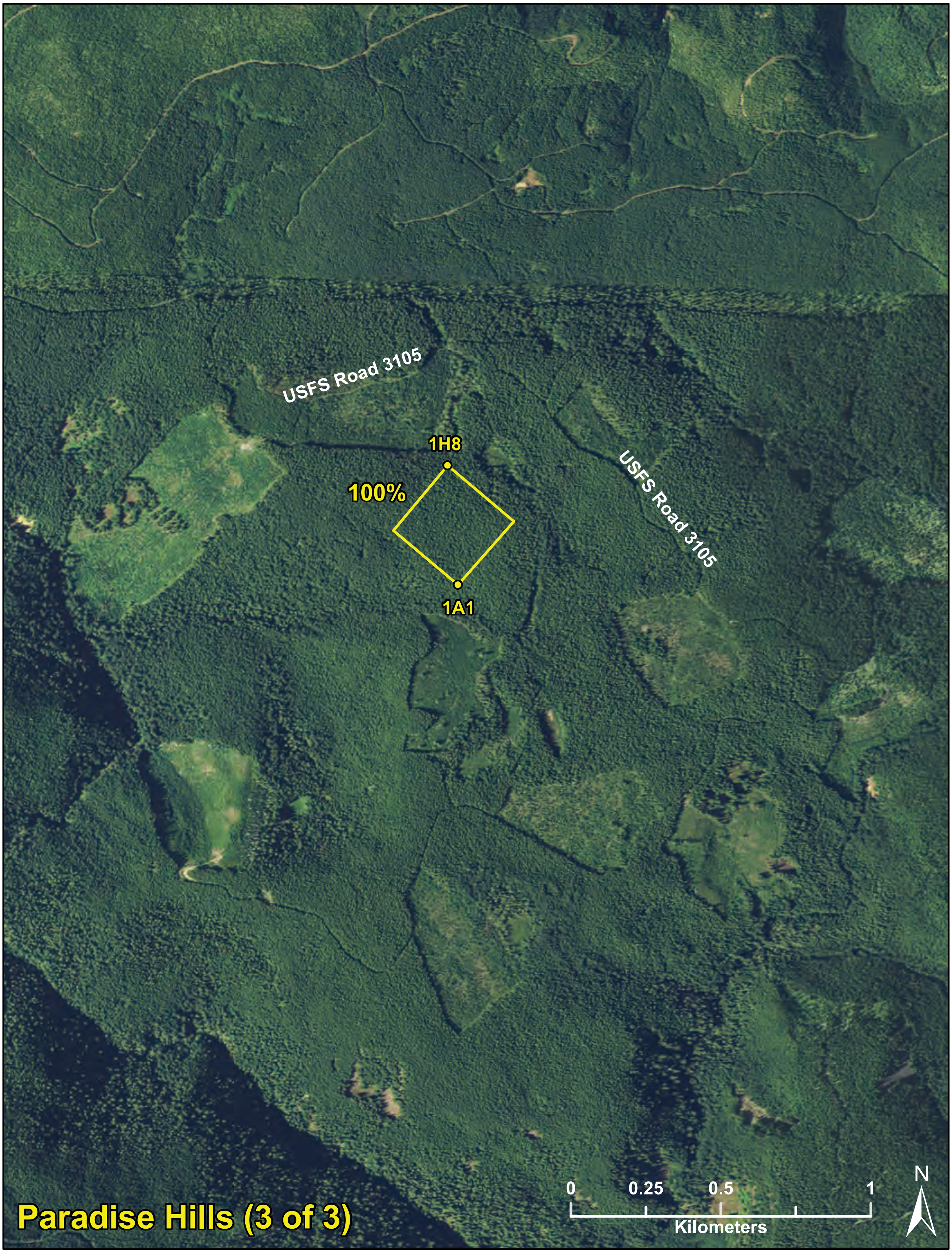

LITTLE WHITE SALMON DEMO
Mt. Adams Ranger District
Gifford Pinchot National Forest
UNIT 6 – 15% Aggregated
LEGEND
2B5
GRID POINT
GRID POINT LABEL
VEGETATION PLOT
LEAVE GROUPS
scale
meters
0
80
N
9°
99°
189°
279°
6A1
6A2
6A3
6A4
6A5
6A6
6A7
6A8
6A9
6B1
6B2
6B3
6B4
6B5
6B6
6B7
6B8
6B9
6C1
6C2
6C3
6C4
6C5
6C6
6C7
6C8
6C9
6D1
6D2
6D3
6D4
6D5
6D6
6D7
6D8
6D9
6E1
6E2
6E3
6E4
6E5
6E6
6E7
6E8
6E9
6F1
6F2
6F3
6F4
6F5
6F6
6F7
6F8
6F9
6G1
6G2
6G3
6G4
6G5
6G6
6G7
6G8
6G9

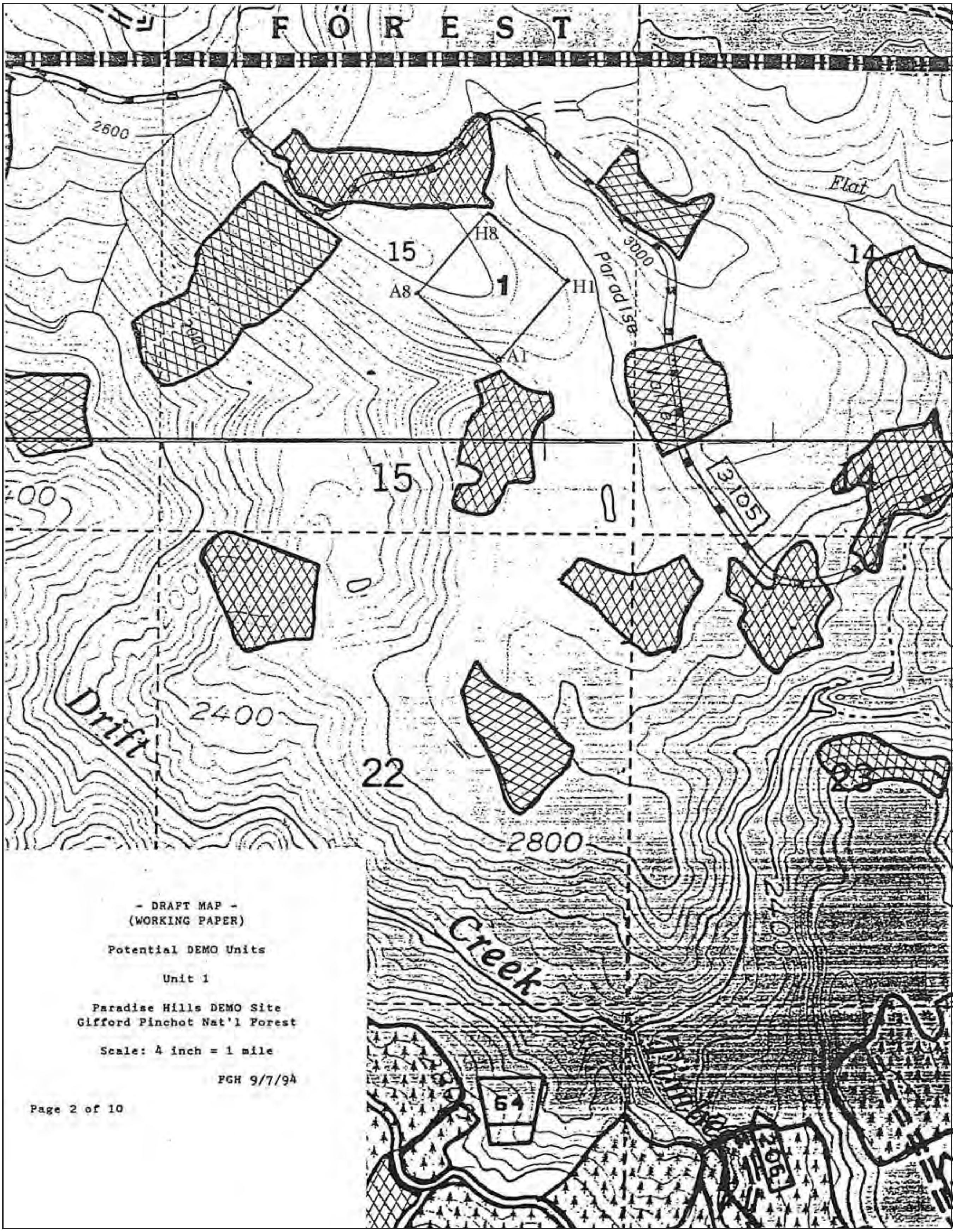
Appendix 6: Locations and Navigational Aids to and Within Treatment Units at the Paradise Hills Experimental Block in Washington

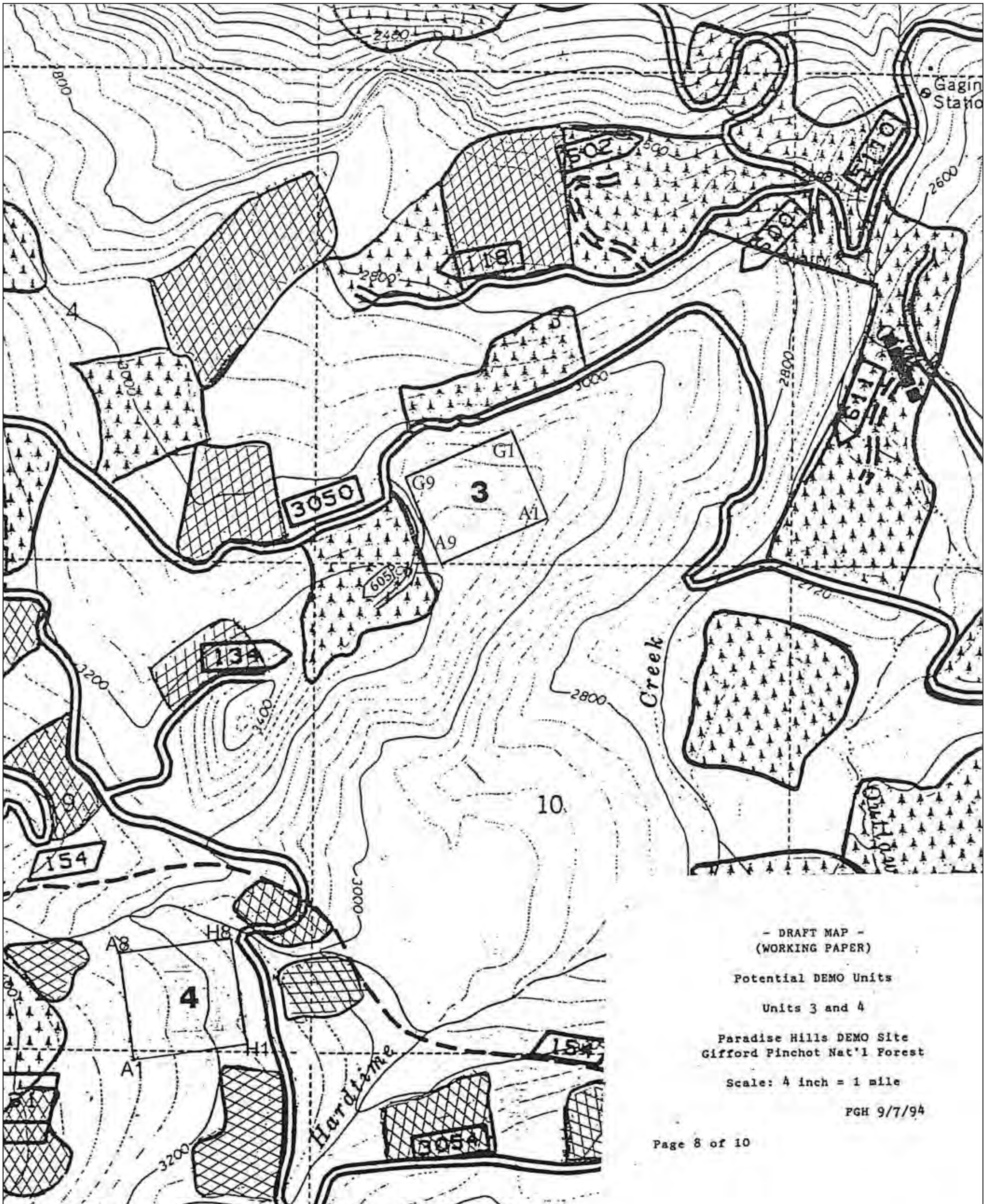
Orthophotos are from 2011. Unit labels are (1) 100% = unharvested control, (2) 75%A = 75% aggregated retention, (3) 40%D = 40% dispersed retention, (4) 40%A = 40% aggregated retention, (5) 15%D = 15% dispersed retention, and (6) 15%A = 15% aggregated retention. Grid points in each treatment unit are identified by 3-character codes indicating treatment number (1 through 6, as listed above), row (letter), and column (number); two corner grid points are labelled here. Orthophotos are followed by topographic maps, detailed driving directions to the treatment units, and diagrams of the sampling grids, which include grid-point identifiers and the locations of aggregates (40%A, 15%A) or gaps (75%A).

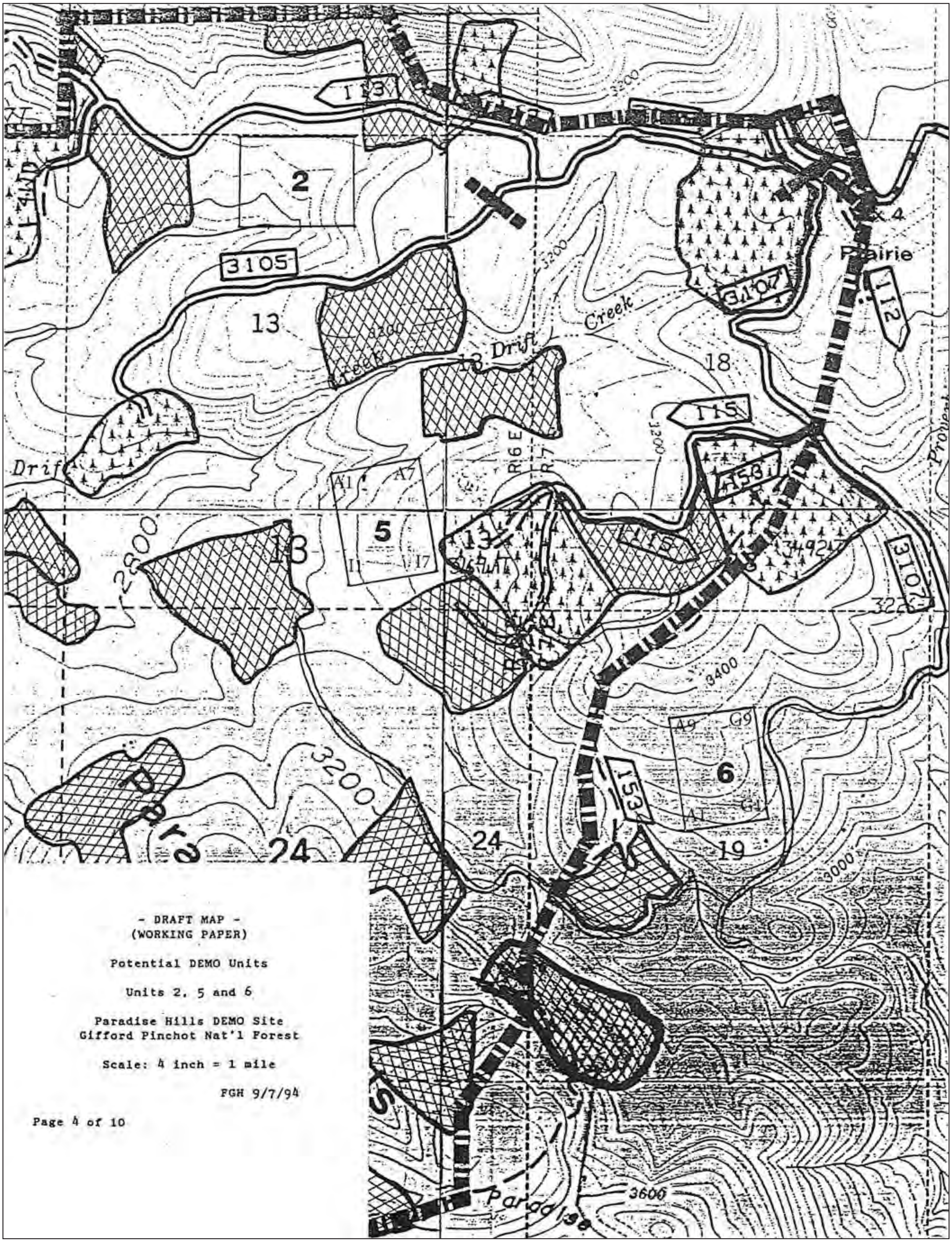

USFS Road 113
2A1
2G9
75%A
USFS Road 3105
USFS Road 3107
USFS Road 115
5A1
5I7
15%D
USFS Road 115
6G9
USFS Road 3107
15%A
6A1
0
0.25
0.5
1
Kilometers
N
Paradise Hills (1 of 3)


USFS Road 3050
40%D
3G9
3A1
USFS
Road 605
40%A
4H8
4A1
USFS Road 3054
USFS Road 3054
0
0.25
0.5
1
Kilometers
N
Paradise Hills (2 of 3)


USFS Road 3105
1H8
100%
USFS Road 3105
1A1
Paradise Hills (3 of 3)
0
0.25
0.5
1
Kilometers
N


FOREST
2600
Flat
15
H8
A8
1
H1
A1
3000
14
15
3105
2400
Drift
22
23
2800
Creek
2400
64
306
- DRAFT MAP -
(WORKING PAPER)
Potential DEMO Units
Unit 1
Paradise Hills DEMO Site
Gifford Pinchot Nat'l Forest
Scale: 4 inch = 1 mile
FGH 9/7/94
Page 2 of 10


- DRAFT MAP -
(WORKING PAPER)
Potential DEMO Units
Units 3 and 4
Paradise Hills DEMO Site
Gifford Pinchot Nat'l Forest
Scale: 4 inch = 1 mile
PGH 9/7/94
Page 8 of 10
3050
3
G1
G9
A1
A9
4
A8
H8
H1
Creek
Hardtime
10
154
134
118
502
2800
3000
3200
3400
2400
2600


- DRAFT MAP -
(WORKING PAPER)
Potential DEMO Units
Units 2, 5 and 6
Paradise Hills DEMO Site
Gifford Pinchot Nat'l Forest
Scale: 4 inch = 1 mile
FGH 9/7/94
Page 4 of 10
2
5
6
3105
3107
113
115
112
153
13
18
19
24
Drift
Creek
Prairie
Paradise
3200
3400
3600
2800
3000

Driving Directions to the Demonstration of Ecosystem Management Options (DEMO) Study Treatment Units in the Paradise Hills Experimental Block

Directions are not provided for 75%A because it was not sampled after the initial posttreatment measurements were made; its location is depicted in the orthophotos and topographic maps.

A U. S. Forest Service (USFS) gate key is needed to access PH1 (100%) and PH4 (40%A). There are gates to PH5 (15%D) and PH6 (15%A), but the district has been leaving these open. In 2015, however, gates that were supposed to be open were closed (and vice versa).

100% (PH1)

Road is heavily rutted, narrow, and likely impassable. Plan on a long day with a 1-mile hike along the road. Be prepared to set trip meter to 0 at Road 31.

Mileage	Location
—	From Wind River Experimental Forest, head north on Wind River Road 30. Drive about 12 miles to Paradise Creek Campground (right side of the road just past milepost 20). From the campground, it is 3.5 miles to Road 31 (left).
0	Left onto Road 31 (major intersection with a brown sign “Road closed to wheeled vehicles Dec 1–Apr 1”). Set trip meter to 0.
4.7	Pass intersection with Road 3103 on right (not signed).
5.7	Junction of 3105 and 3107; right onto 3105 (red flagging; brown Carsonite road sign still present).
6.3	Reach USFS gate. Should be closed (need key) but was open in 2015.
8.6	Road deteriorates in area of plantation. Park where road runs southwest before large turn to the northwest. Hike up road (1+ mile). Tree flagged and spray-painted red at entry point to PH1. Enter from the north through timber (older forest) paralleling plantation.

40%D (PH3)

Be prepared to set trip meter to 0 at Paradise Creek Campground (just past milepost 20). Open and easy to work in. Grid point labeled 3A9 on grid map should be 3E9.

Mileage	Location
—	From Wind River Experimental Forest, head north on Wind River Road 30 about 12 miles to Paradise Creek Campground (right side of the road just past milepost 20). Set trip meter to 0.
0	Paradise Creek Campground.
6.7	Turn left onto Curly Creek Road (paved, major intersection).
7.0	Left onto Road 3050. Note: Road 3050 has many deep potholes—drive slowly.
8.1	Large trees down over road but vehicle passage possible (should have been cleared in 2016).
9.6	Junction with Road 605 to the left (steeply uphill)—heavily rutted road/skid road that forms the western boundary of PH3. Tall brown post/sign on left, blue recreation sign/arrow pointing up Road 605, brown Carsonite post at junction with a mostly unreadable “605.” Park here on Road 3050 or 605 and walk <0.1 mile up to DEMO sign and white Carsonite post. Flagged with orange/white striped flagging to grid corner post 3G9.

40%A (PH4)

Be prepared to set trip meter to 0 at Paradise Creek Campground (just past milepost 20).

Mileage	Location
—	From Wind River Experimental Forest, head north on Wind River Road 30 about 12 miles to Paradise Creek Campground (right side of the road just past milepost 20). Set trip meter to 0.
0	Paradise Creek Campground.
5.2	Left onto first paved road past Old Man Pass (beyond Old Man Pass Snow Park); wide opening at the top of the hill. Stay to the left to exit paved road to another snow park; stay to the left on graveled road through U.S. Forest Service gate (should be locked but was not locked in 2015).
5.4	Cross Old Man Loop Trail.
8.1	Arrive at middle of lower edge of PH4 (slash at landing where logs were yarded out of the unit).
8.2	Park on the right where road curves to the left. Walk down the road a short distance to grid access trail (and plot 4H7). Trail is flagged with orange and white striped flagging (four flags at roadside). Old trail still present—flagged to patch edge (plot 4H7). Grid corner is 4H8.

15%D (PH5)

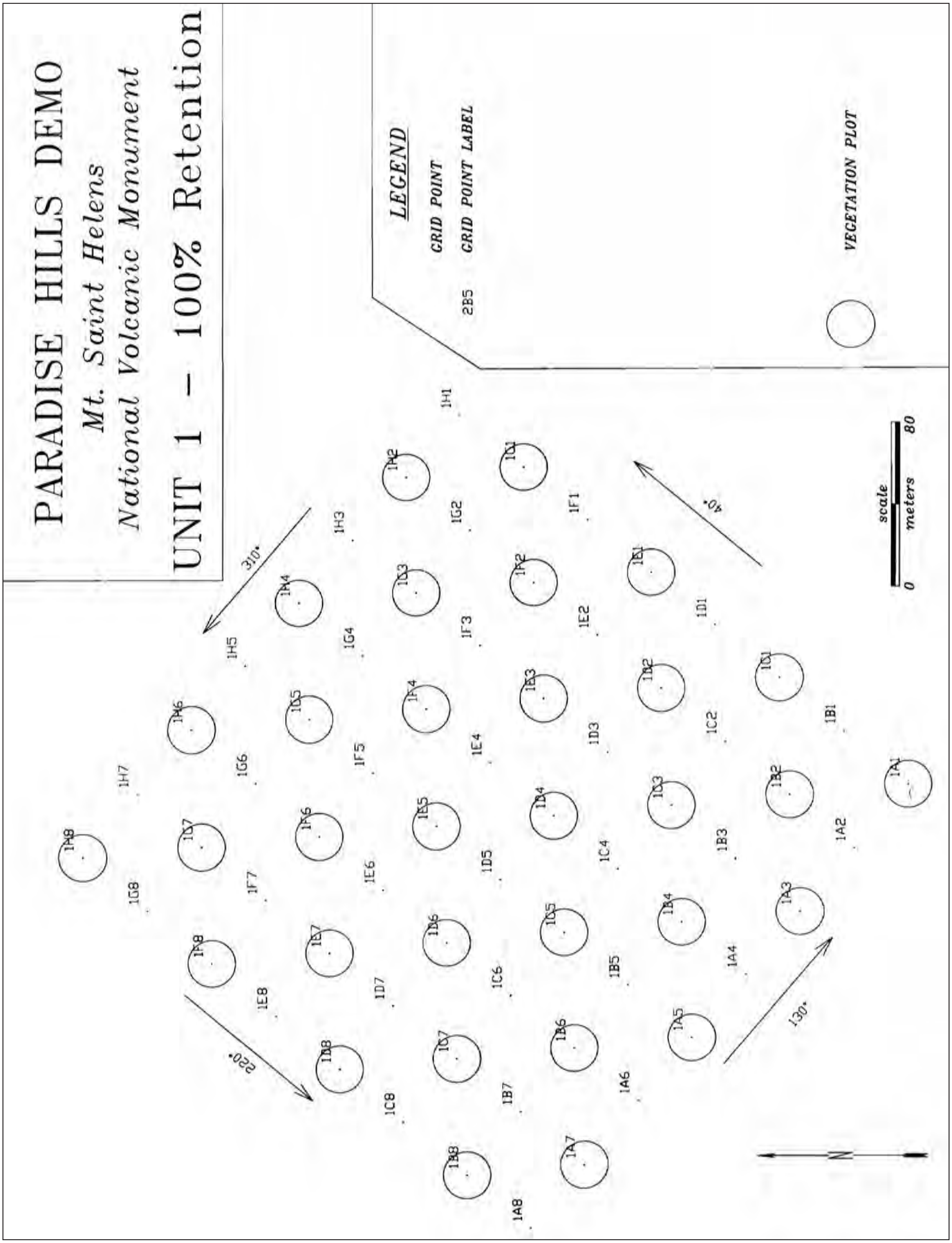
Follow driving directions for PH1 (above) until 5.7 miles. Be prepared to set trip meter to 0 at Road 31. Unit is very dense with regeneration; navigating will require careful use of a compass. Many residual trees have fallen both in the unit and at its eastern edge (entry point) making it difficult to traverse.

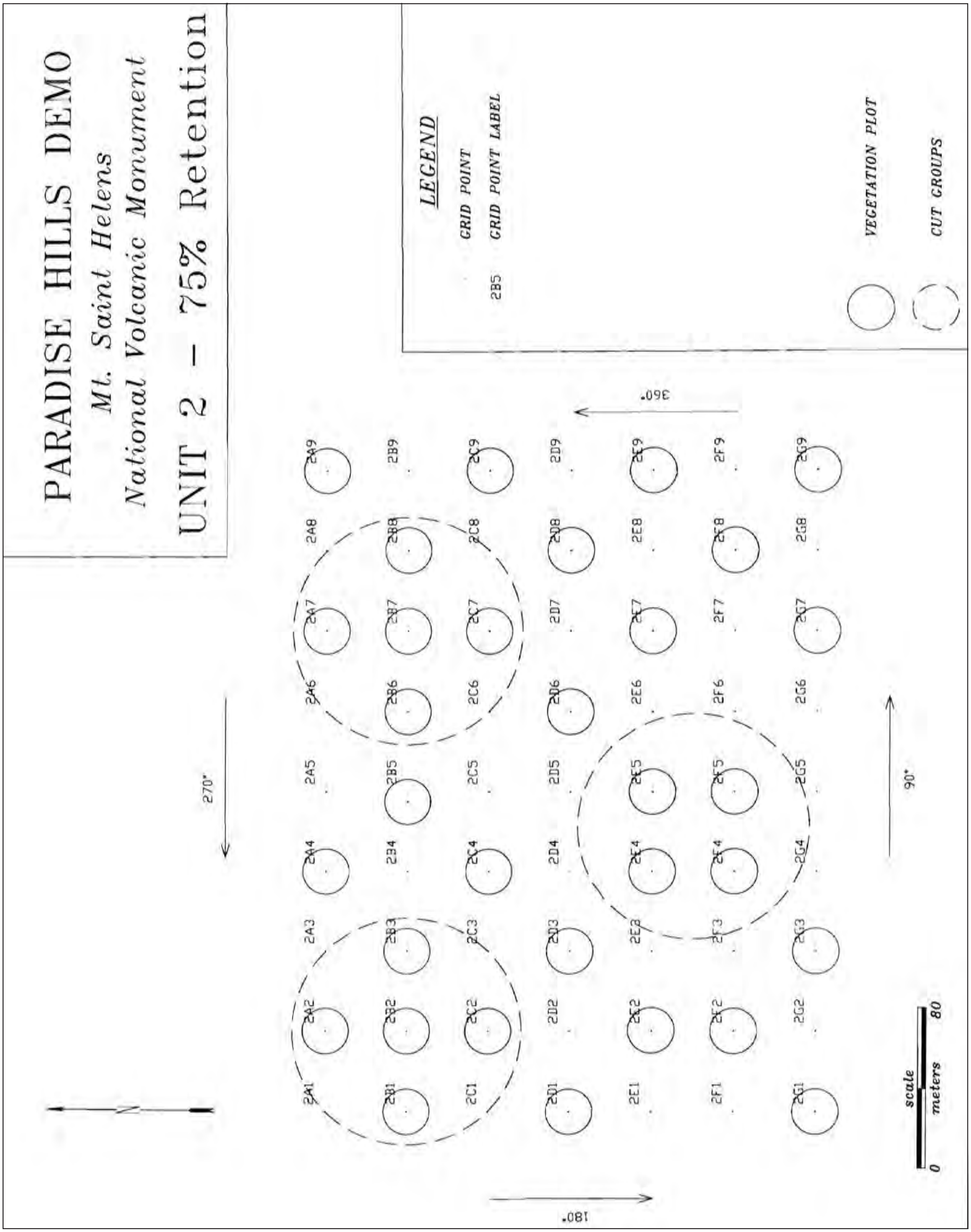
Mileage	Location
—	From Wind River Experimental Forest, head north on Wind River Road 30. It is about 12 miles to Paradise Creek Campground (right side of the road just past milepost 20). From the campground it is 3.5 miles to Road 31 (left).
0	Left onto Road 31: major intersection with a brown sign “Road closed to wheeled vehicles Dec 1–Apr 1.” Set trip meter to 0.
4.7	Pass intersection with Road 3103 on right (not signed)
5.7	Junction of 3105 and 3107; stay to the left on Road 3107. Red flagging says “DEMO 5 & 6.” In 2015, the gate was locked on the way in but open on the way out (should not be locked).
6.6	Triangle intersection with sign to Paradise Hills trail. Turn right onto Road 115 (brown Carsonite road sign is misnumbered).
7.6	Arrive in mature forest on east edge of PH5 (steep/brushy on the way down). Brown DEMO sign at edge of opening. Walk to large opening east of PH5; watch for red flagging on the right. To avoid major tree fall, follow flagging into mature forest. Trail trends to the northwest, then southwest, then into the unit plot 5E7.

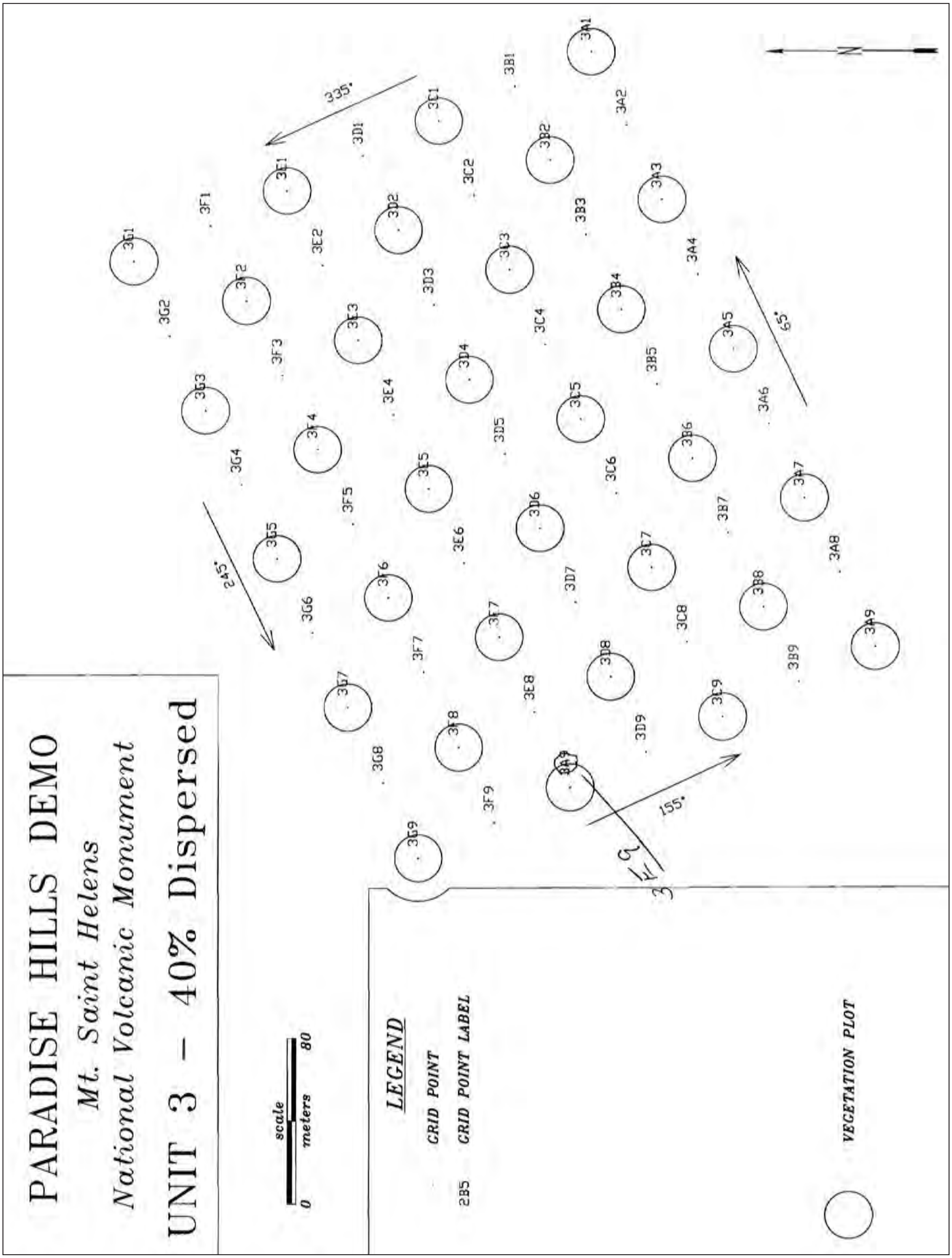
15%A (PH6)

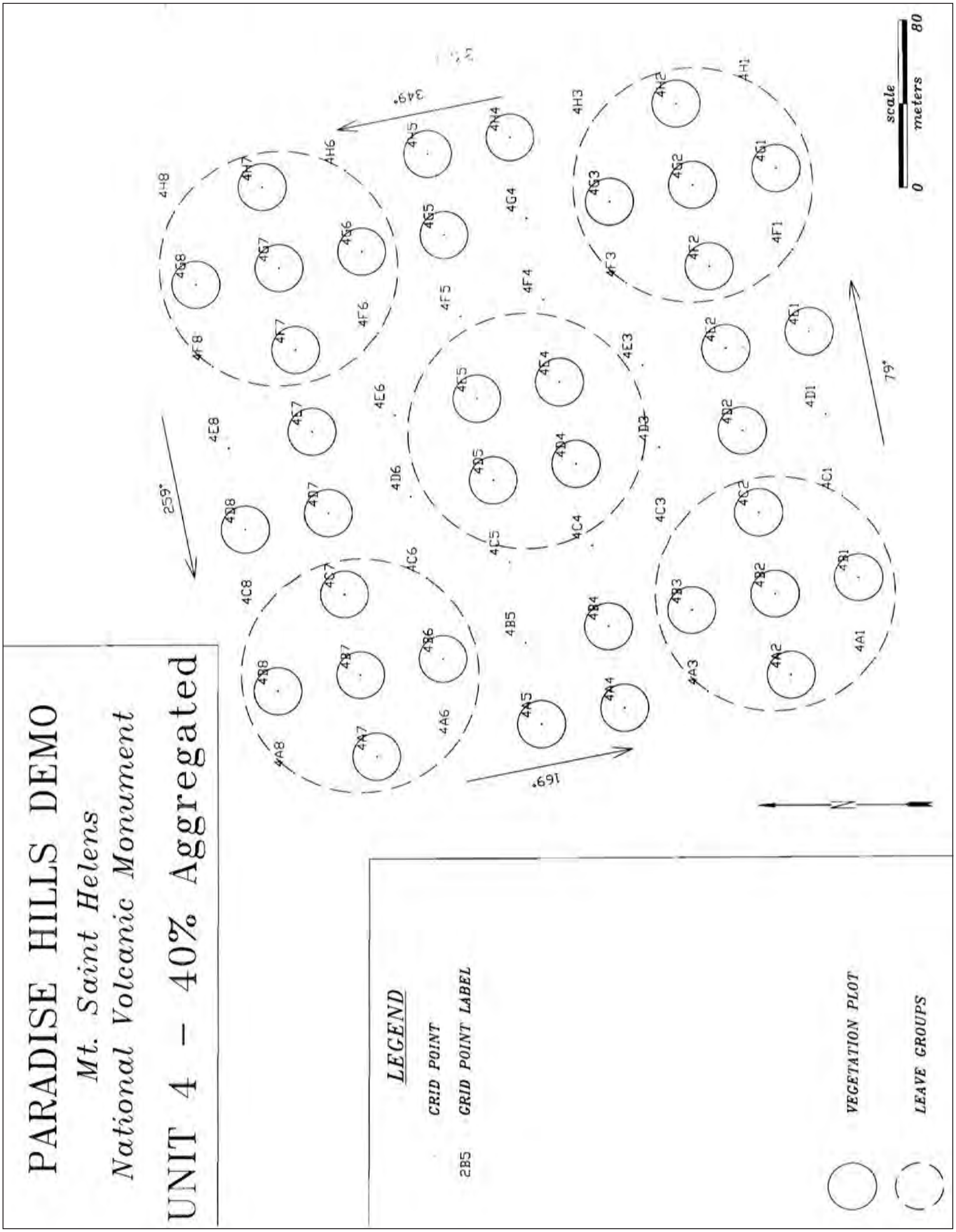
Follow driving directions for PH1 until 5.7 miles. Be prepared to set trip meter to 0 at Road 31. Dense advanced regeneration in the harvest matrix. Northeast aggregate is falling apart: many down trees with tip-up mounds.

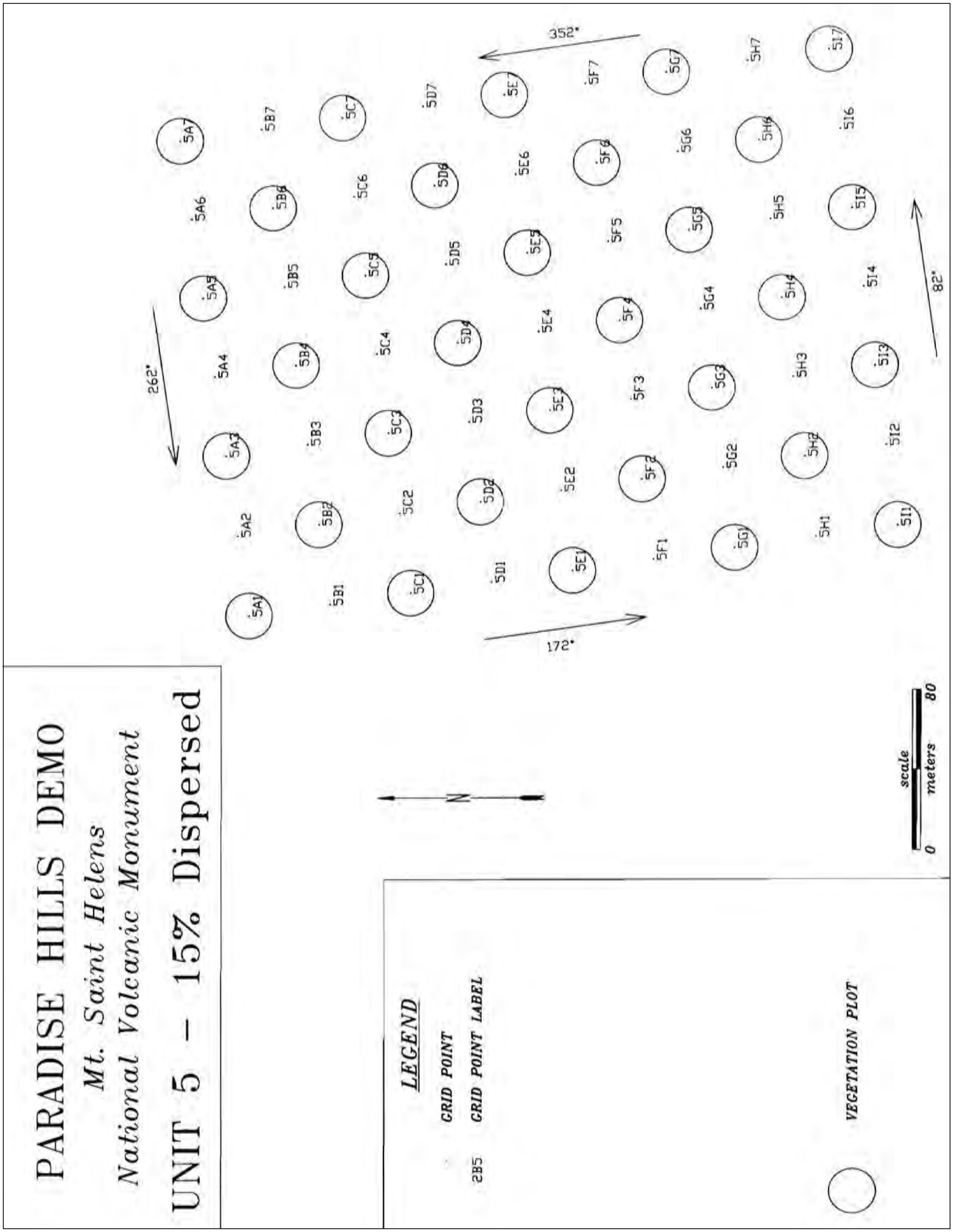
Mileage	Location
—	From Wind River Experimental Forest, head north on Wind River Road 30. It is about 12 miles to Paradise Creek Campground (right side of the road just past milepost 20). From the campground, it is 3.5 miles to Road 31 (left).
0	Left onto Road 31: major intersection with a brown sign “Road closed to wheeled vehicles Dec 1–Apr 1.” Set trip meter to 0.
4.7	Pass intersection with Road 3103 on right (not signed).
5.7	Junction of 3105 and 3107; stay to the left on Road 3107: red flagging says “DEMO 5 & 6.” In 2015, the gate was locked on the way in but open on the way out (should not be locked).
6.6	Triangle intersection with sign to Paradise Hills trail. Stay on Road 3107 to left.
7.0	Reach a “Y”—stay to the right. Brushy in places after this point. Route is flagged in red at this point.
7.7	Arrive near access point and park along creekside on the right. Just down the road is a white Carsonite sign, “DEMO 6” with red flagging: this is the access point to the northeast aggregate and grid point 6G6 (flagged red). Access to the “9” grid line is easy along the forest edge to the north.

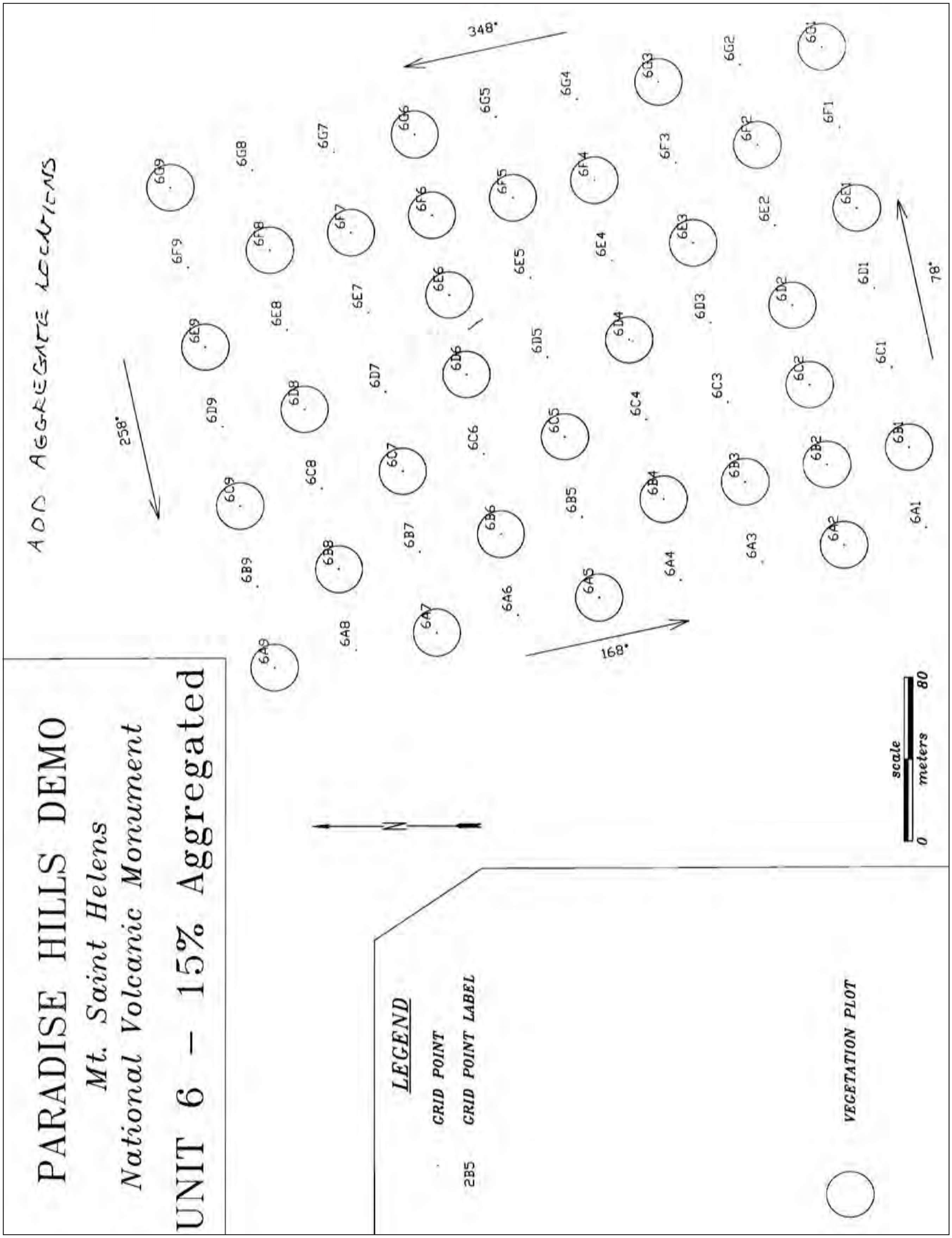

PARADISE HILLS DEMO
Mt. Saint Helens
National Volcanic Monument
UNIT 1 – 100% Retention
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
scale
0 meters 80
310°
40°
220°
130°
N


PARADISE HILLS DEMO
Mt. Saint Helens
National Volcanic Monument
UNIT 2 – 75% Retention
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
CUT GROUPS
270°
90°
360°
180°
scale
meters
0
80
2A1 2A2 2A3 2A4 2A5 2A6 2A7 2A8 2A9
2B1 2B2 2B3 2B4 2B5 2B6 2B7 2B8 2B9
2C1 2C2 2C3 2C4 2C5 2C6 2C7 2C8 2C9
2D1 2D2 2D3 2D4 2D5 2D6 2D7 2D8 2D9
2E1 2E2 2E3 2E4 2E5 2E6 2E7 2E8 2E9
2F1 2F2 2F3 2F4 2F5 2F6 2F7 2F8 2F9
2G1 2G2 2G3 2G4 2G5 2G6 2G7 2G8 2G9


PARADISE HILLS DEMO
Mt. Saint Helens
National Volcanic Monument
UNIT 3 – 40% Dispersed
scale
meters
0
80
LEGEND
GRID POINT
2B5
GRID POINT LABEL
VEGETATION PLOT
N
335°
65°
245°
155°

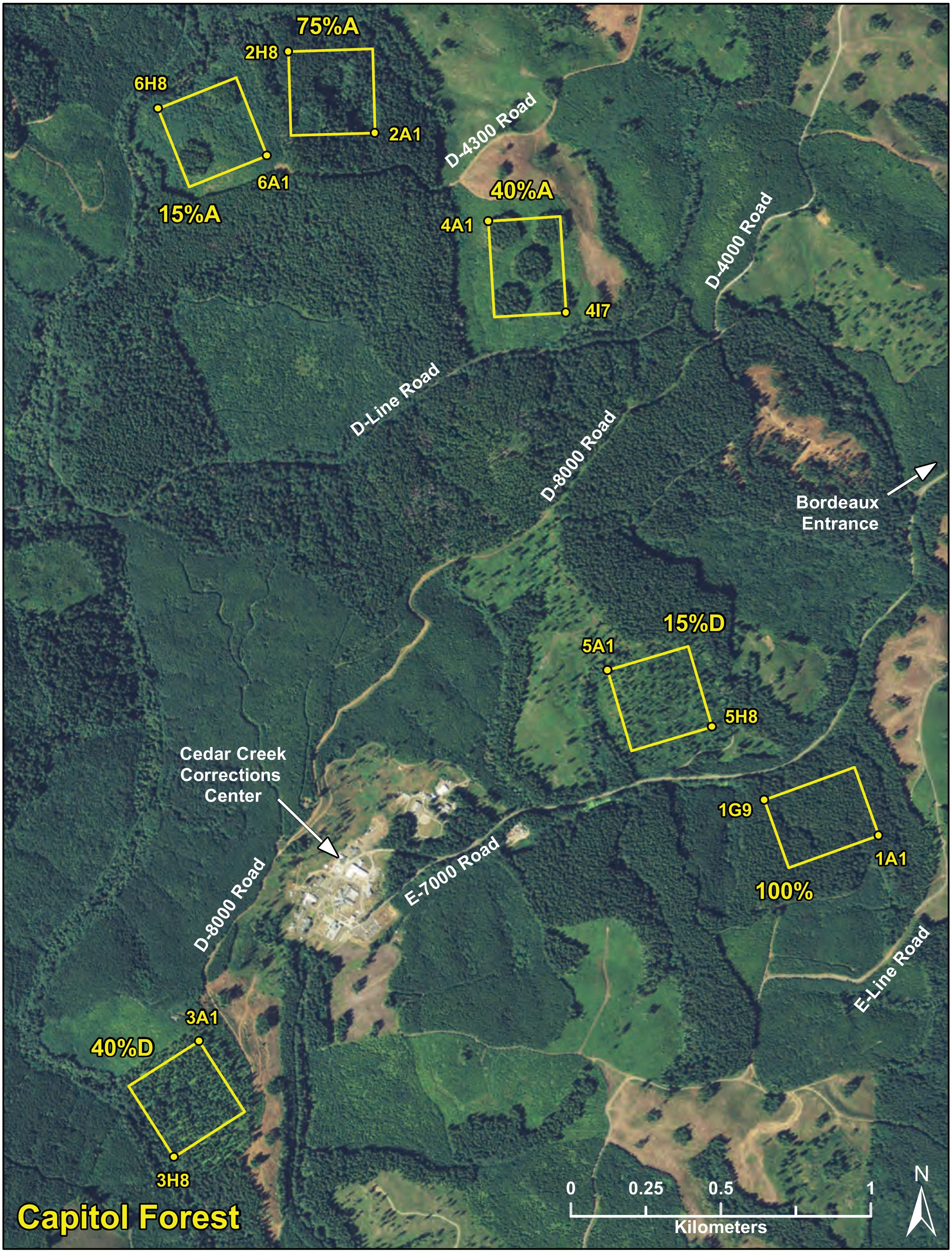

PARADISE HILLS DEMO
Mt. Saint Helens
National Volcanic Monument
UNIT 4 – 40% Aggregated
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
LEAVE GROUPS
scale
meters
0
80
N
349°
259°
169°
79°

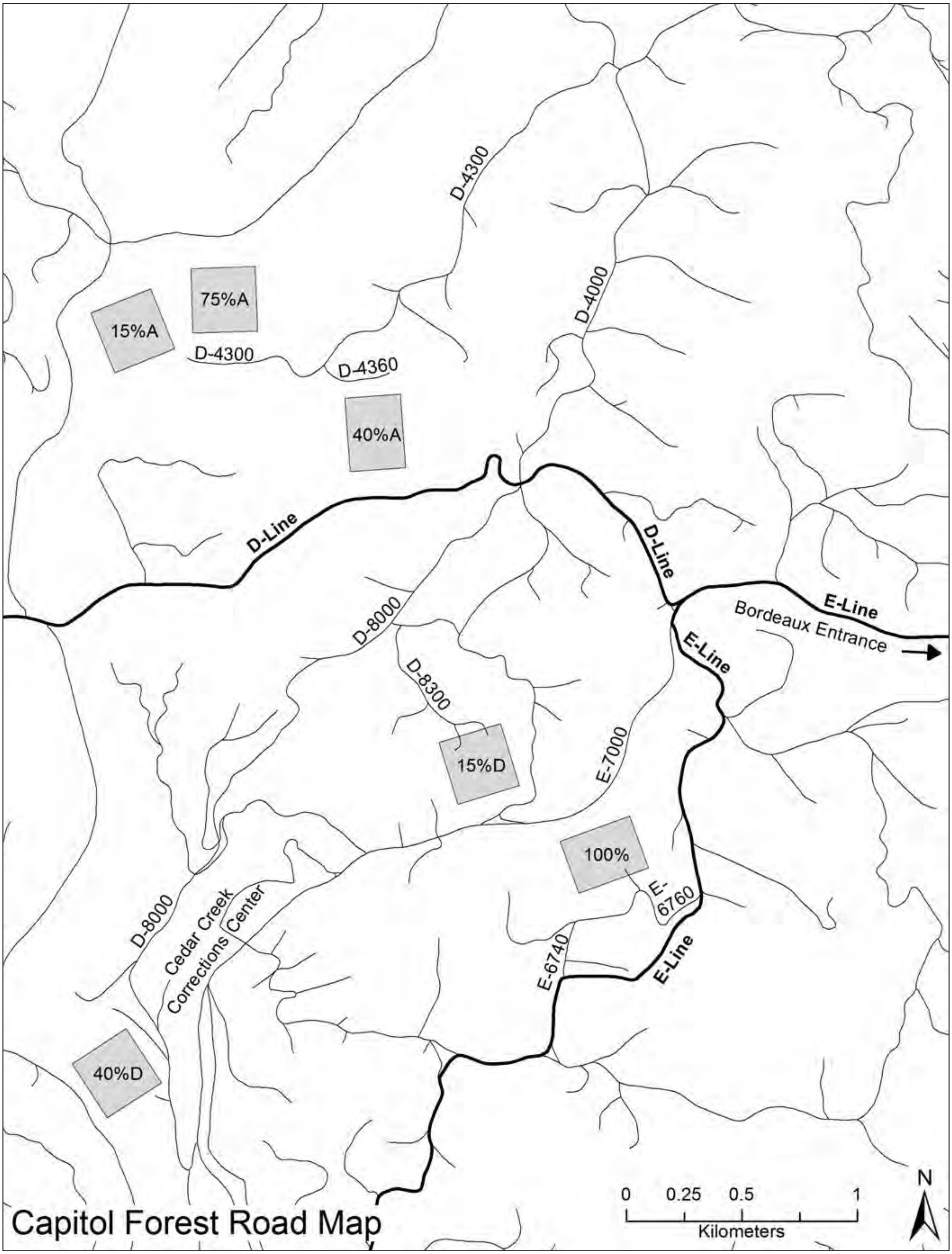

PARADISE HILLS DEMO
Mt. Saint Helens
National Volcanic Monument
UNIT 5 – 15% Dispersed
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
scale
meters
0
80
352°
262°
172°
82°


PARADISE HILLS DEMO
Mt. Saint Helens
National Volcanic Monument
UNIT 6 – 15% Aggregated
ADD AGGREGATE LOCATIONS
348°
258°
168°
78°
N
scale
meters
0
80
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT

Appendix 7: Locations and Navigational Aids to and Within Treatment Units at the Capitol Forest Experimental Block in Washington

Orthophoto is from 2011. Unit labels are (1) 100% = unharvested control, (2) 75%A = 75% aggregated retention, (3) 40%D = 40% dispersed retention, (4) 40%A = 40% aggregated retention, (5) 15%D = 15% dispersed retention, and (6) 15%A = 15% aggregated retention. Grid points in each treatment unit are identified by 3-character codes indicating treatment number (1 through 6, as shown above), row (letter), and column (number); two corner grid points are labelled here. Orthophotos are followed by road maps and diagrams of the sampling grids, which include grid-point identifiers and the locations of aggregates (40%A, 15%A) or gaps (75%A).


75%A
2H8
2A1
6H8
6A1
15%A
D-4300 Road
40%A
4A1
4I7
D-4000 Road
D-Line Road
D-8000 Road
Bordeaux
Entrance
15%D
5A1
5H8
Cedar Creek
Corrections
Center
1G9
1A1
100%
E-7000 Road
D-8000 Road
E-Line Road
3A1
40%D
3H8
0
0.25
0.5
1
Kilometers
N
Capitol Forest

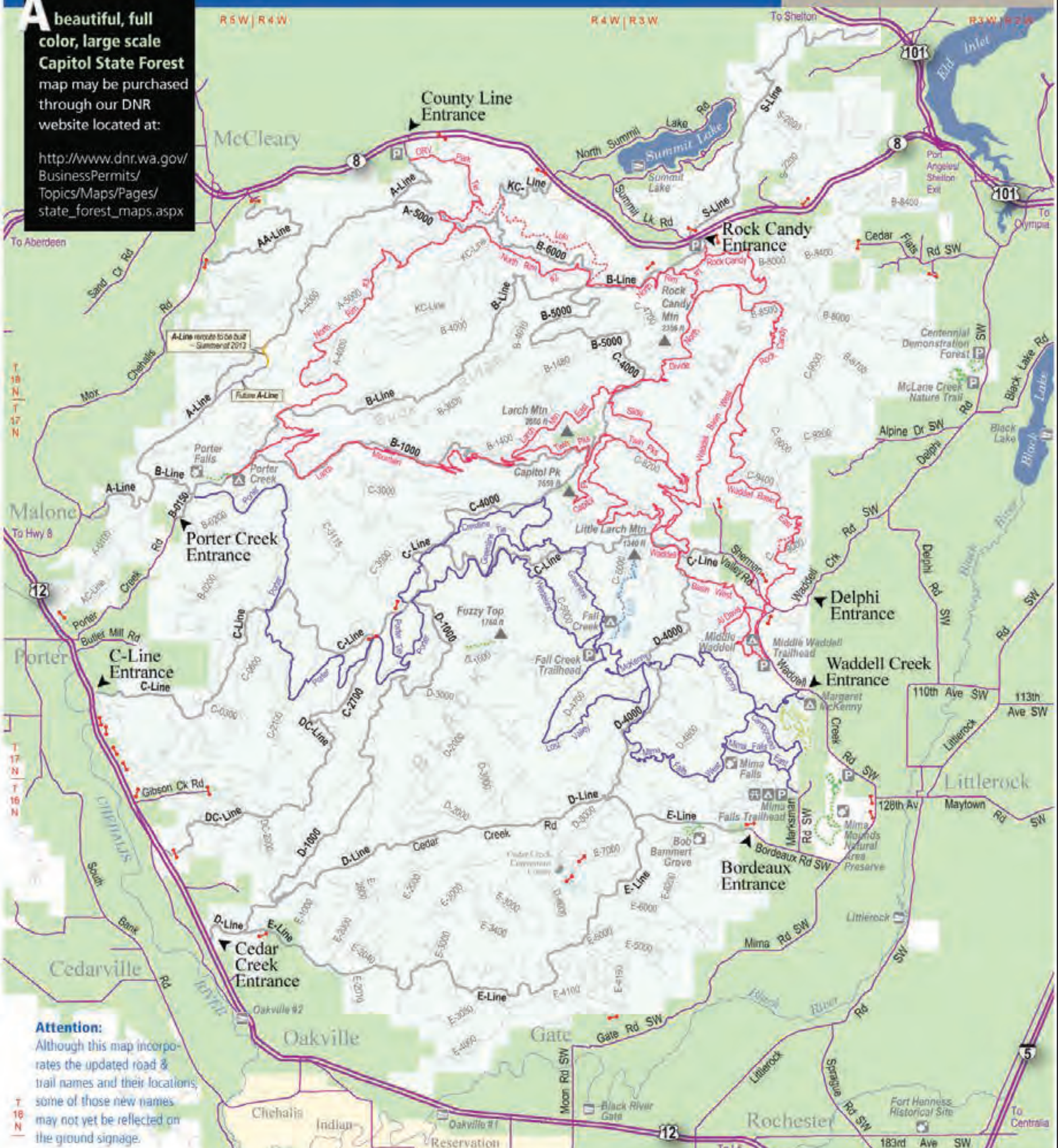

D-4300
15%A
75%A
D-4300
D-4360
D-4000
40%A
D-Line
D-Line
E-Line
Bordeaux Entrance
E-Line
D-8000
D-8300
15%D
E-7000
100%
E-
6760
D-8000
Cedar Creek
Corrections Center
E-6740
E-Line
40%D
0
0.25
0.5
1
Kilometers
N
Capitol Forest Road Map

Recreation and Trails Map

Capitol State Forest

A beautiful, full color, large scale Capitol State Forest map may be purchased through our DNR website located at:

http://www.dnr.wa.gov/BusinessPermits/Topics/Maps/Pages/state_forest_maps.aspx



Attention:
Although this map incorporates the updated road & trail names and their locations, some of those new names may not yet be reflected on the ground signage.

Roads
- Major Highway
- County or City Rd
- Primary Forest Rd
- Secondary Forest Rd

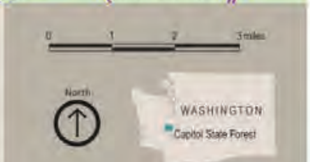
Trails
- ATV / Motorcycle
- Motorcycle Only (single track)
- Hiking Only
- Horse Only
- Hike / Mtn Bike / Horse
- Hike / Mtn Bike

Points
- Campground
- Picnic Site
- Point of Interest
- Parking or Trailhead
- Boat Launch
- Gate
- Mountain Peak

On the Roads
- CAUTION: Few roads are paved and all have soft shoulders.
- Logging trucks, heavy equipment, and other vehicles use these roads. Be ready to yield the right-of-way.
- DRIVE WITH CAUTION. On forest management roads, keep speed under 25 mph.
- Speed limit in camp and picnic sites is 5 mph.
- Please do not litter.
- Motorcycles, horses, and mountain bikes are allowed behind gated roads shown on this map *unless* roads are posted or abandoned.

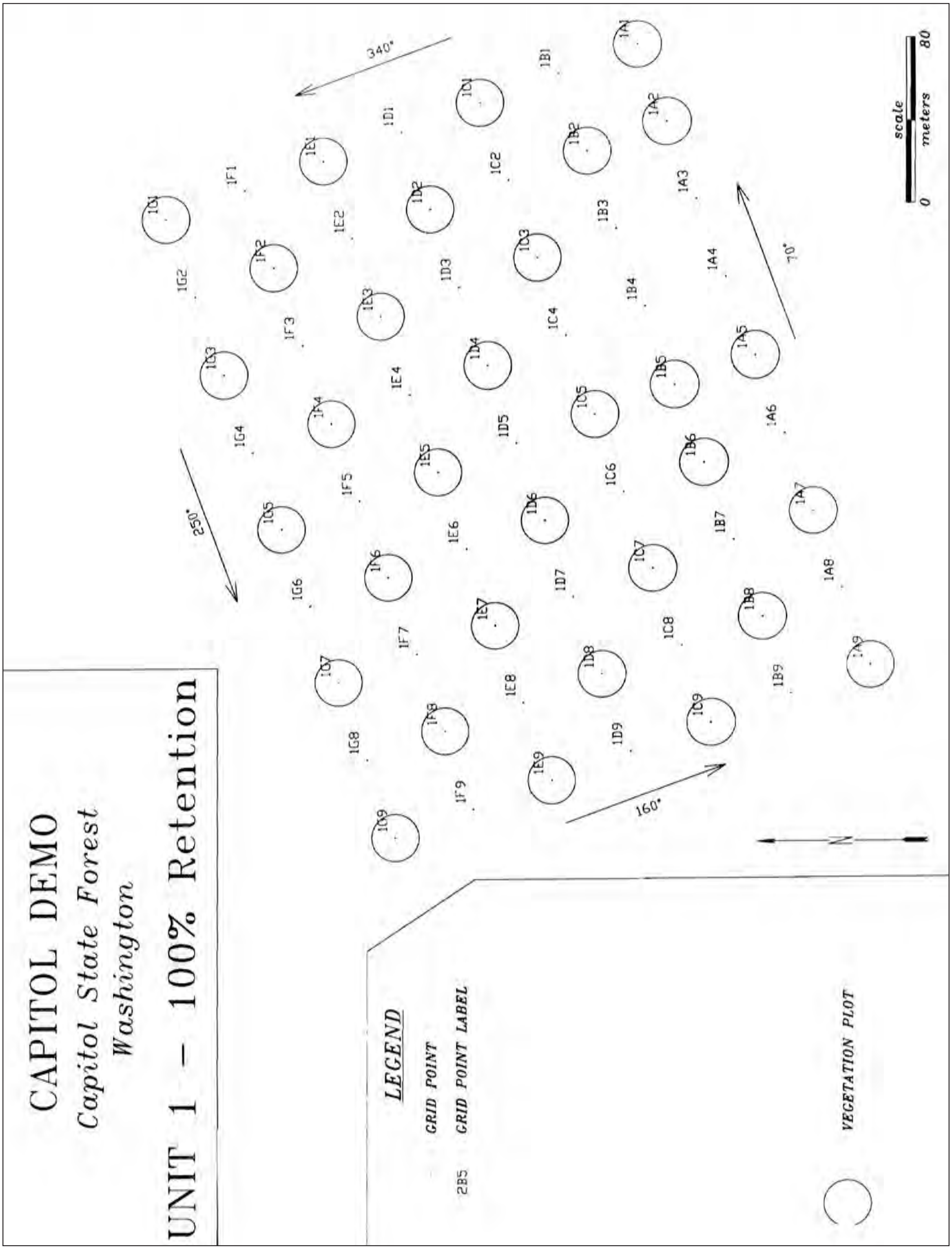
On the Trails
- Stay on signed, approved trails.
- Unsigned trails are CLOSED.
- Respect the rights of others on trails.
- Do not ride in streams or on road berms.
- Watch for unmarked hazards on trails.
- Off-road vehicles (ORVs) must have vehicle license or ORV permit tag, and U.S. Forest Service-approved spark arrestor.
- Trails are closed to ORVs and horses Dec. 1 to April 30.

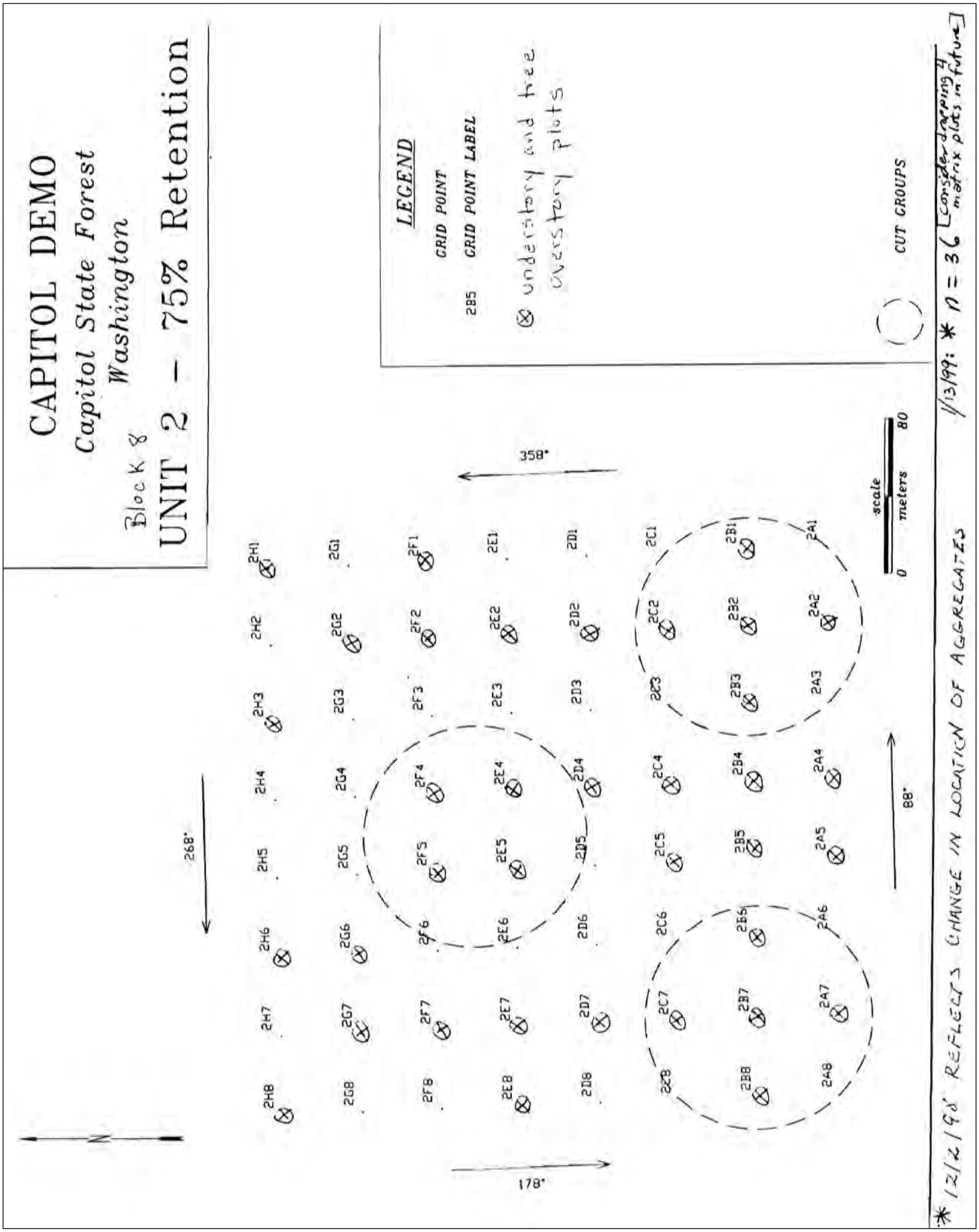
In the Campsites
- Respect sites designed for people with disabilities.
- Camp only in designated campgrounds and campsites open May 1 through Nov 30.
- Do not alter or remove vegetation.
- Limit fires to campsite fireplaces.
- Do not burn pallets or treated woods.
- Maintain quiet from 10 pm to 6 am.
- Do not shoot in or near recreation sites, trails or roads. Check for hikers or other quiet users.
- ORV use not permitted in campgrounds.
- Use of fireworks is strictly prohibited.
- Campsites are available first-come, first-served. No reservations.
- Limit stay to 7 days per calendar year.

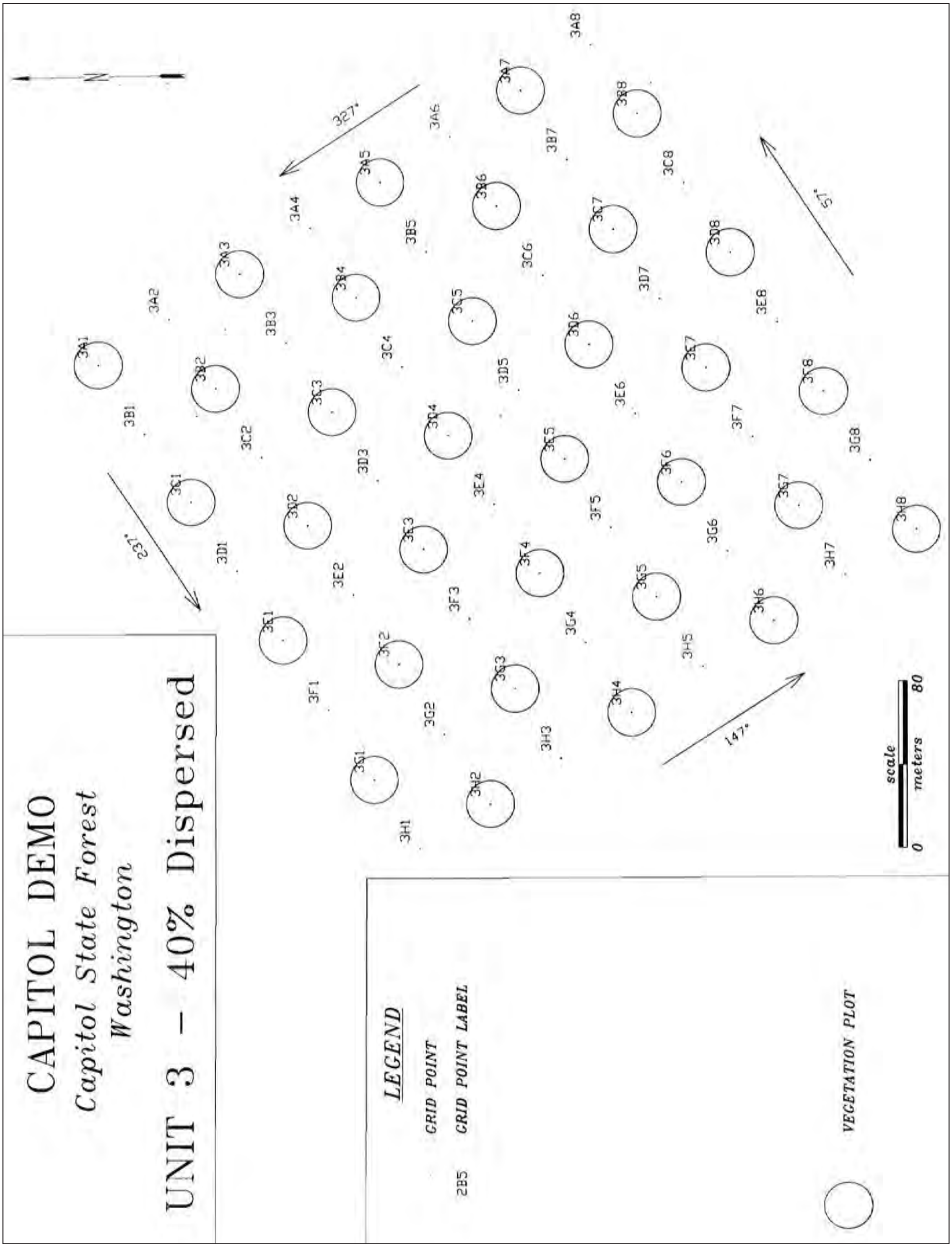


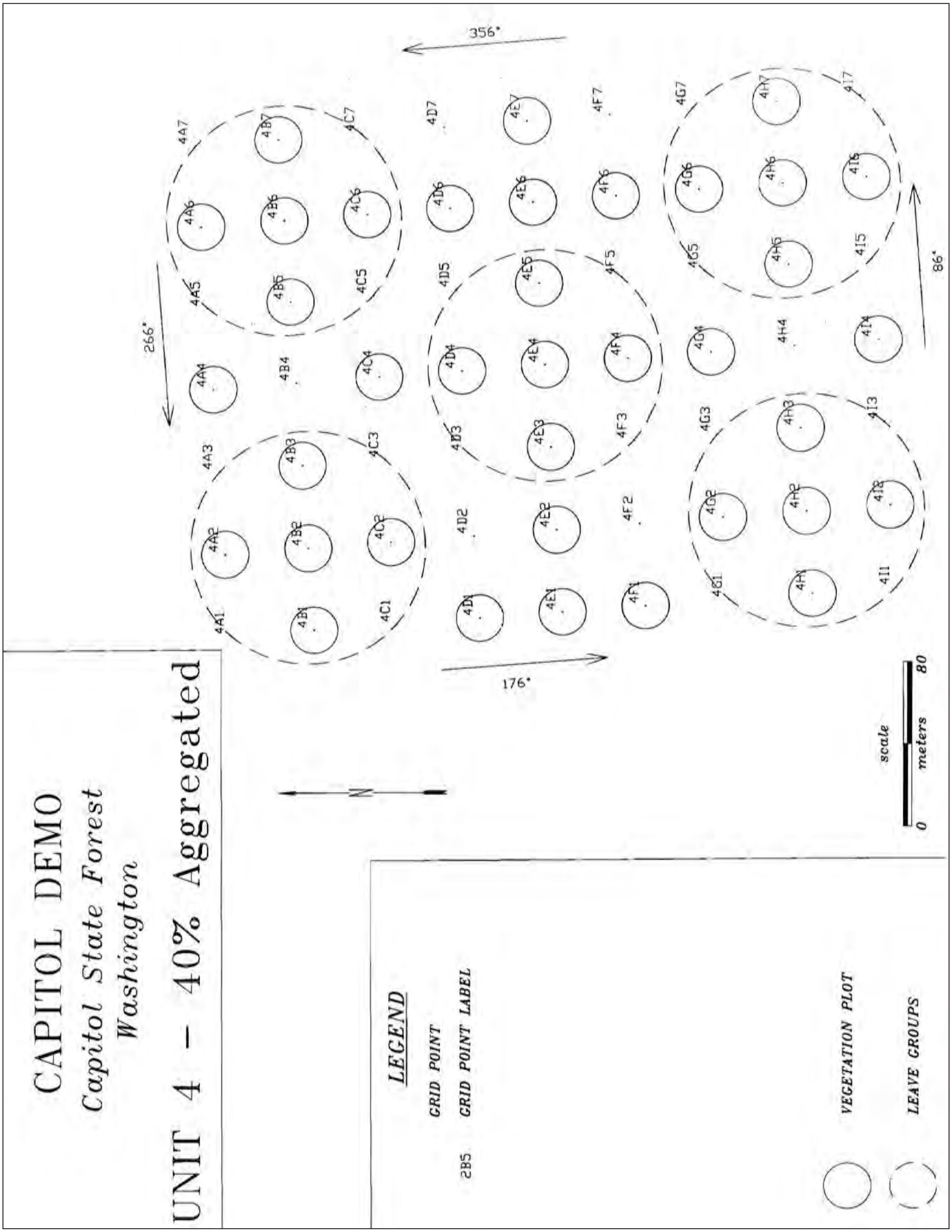
WASHINGTON STATE DEPARTMENT OF **Natural Resources**

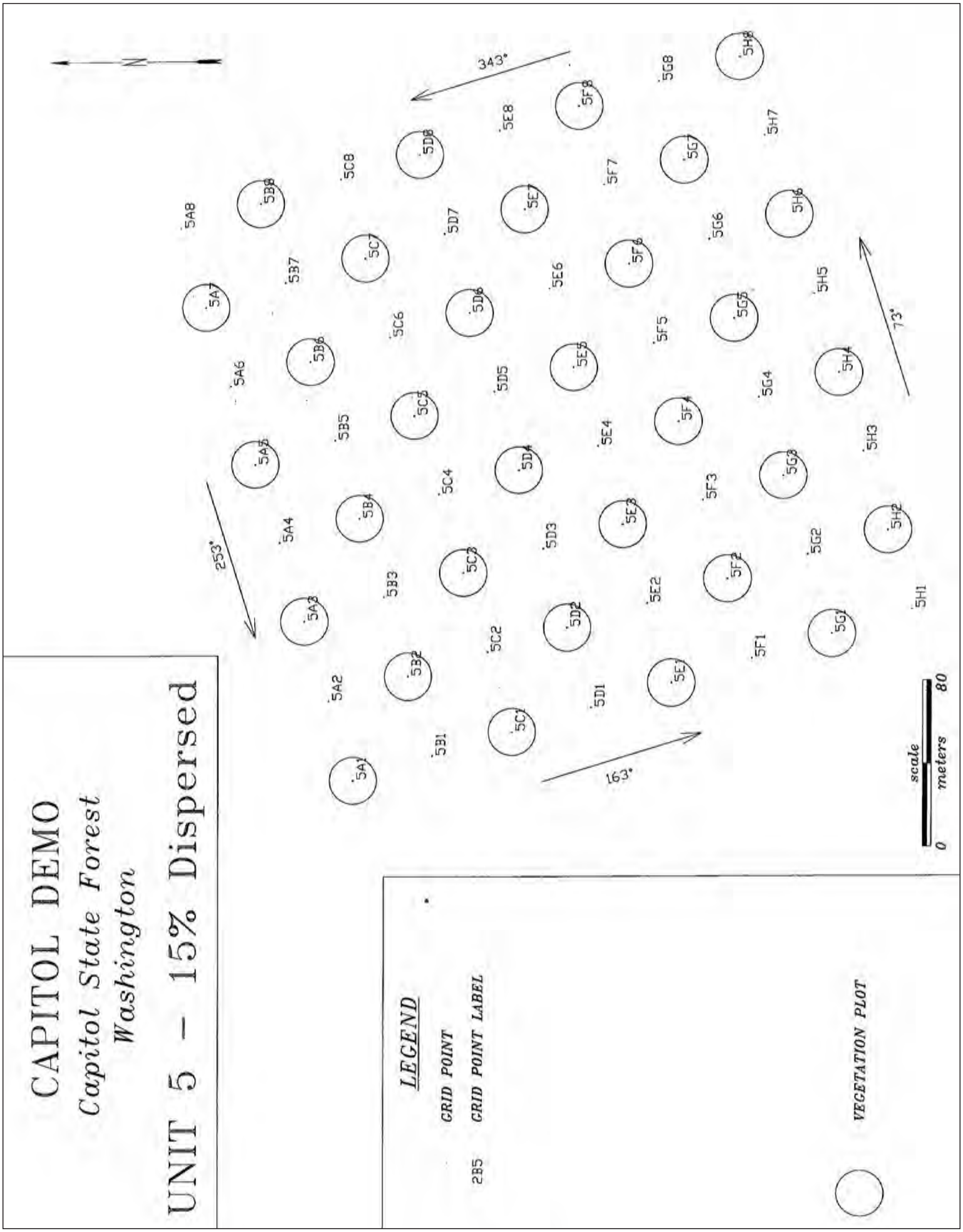
Produced by DNR - Resource Mapping Section, 8/20/12

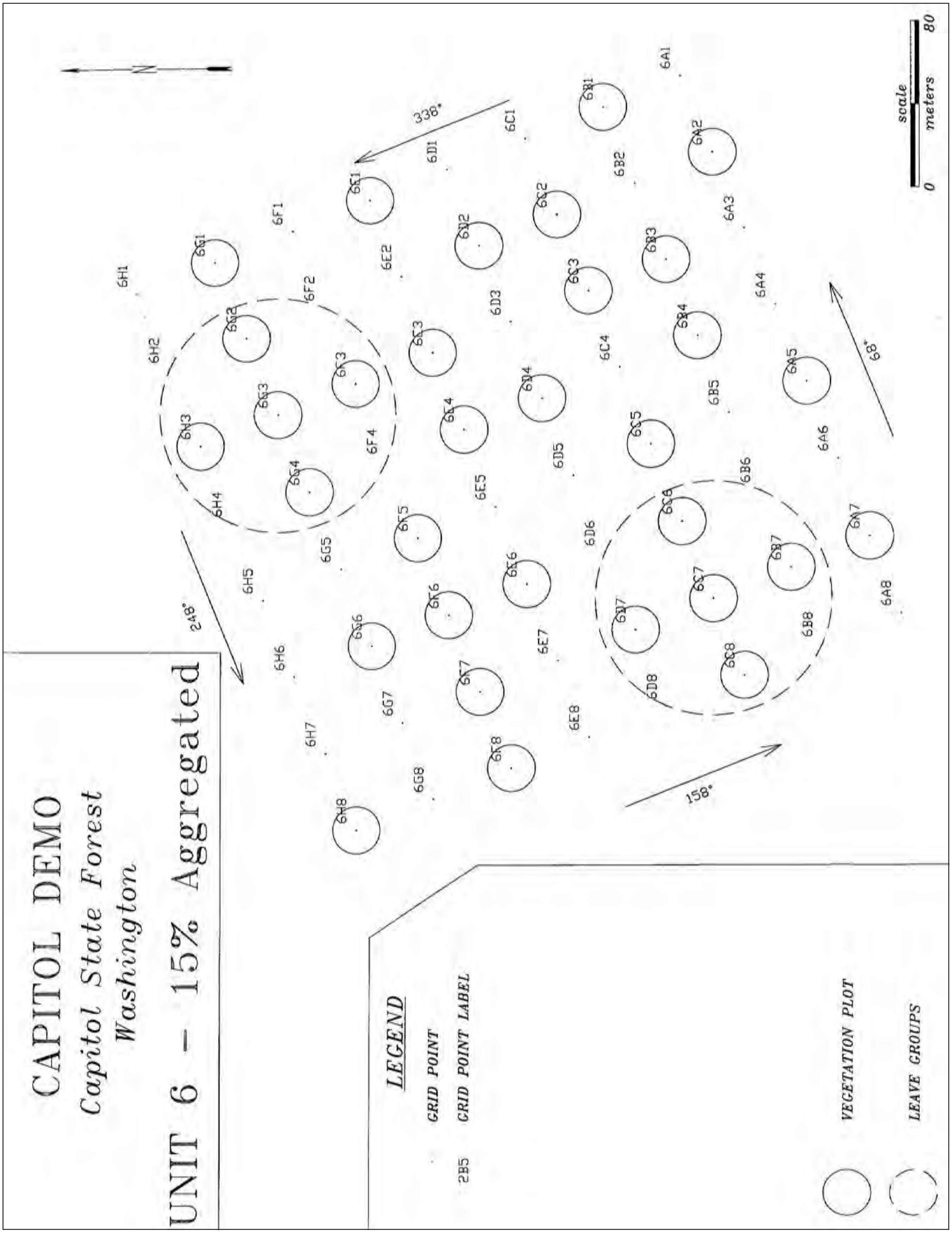

CAPITOL DEMO
Capitol State Forest
Washington
UNIT 1 – 100% Retention
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
scale
0 80
meters
340°
250°
160°
70°
N


CAPITOL DEMO
Capitol State Forest
Washington
Block 8
UNIT 2 — 75% Retention
LEGEND
GRID POINT
2B5 GRID POINT LABEL
understory and tree overstory plots
CUT GROUPS
scale
meters
0
80
358°
268°
178°
88°
N
2H1 2H2 2H3 2H4 2H5 2H6 2H7 2H8
2G1 2G2 2G3 2G4 2G5 2G6 2G7 2G8
2F1 2F2 2F3 2F4 2F5 2F6 2F7 2F8
2E1 2E2 2E3 2E4 2E5 2E6 2E7 2E8
2D1 2D2 2D3 2D4 2D5 2D6 2D7 2D8
2C1 2C2 2C3 2C4 2C5 2C6 2C7 2C8
2B1 2B2 2B3 2B4 2B5 2B6 2B7 2B8
2A1 2A2 2A3 2A4 2A5 2A6 2A7 2A8
*12/2/98 REFLECTS CHANGE IN LOCATION OF AGGREGATES
1/13/99: * n = 36 [Consider dropping 4 matrix plots in future]


CAPITOL DEMO
Capitol State Forest
Washington
UNIT 3 – 40% Dispersed
N
327°
57°
237°
147°
3A1 3A2 3A3 3A4 3A5 3A6 3A7 3A8
3B1 3B2 3B3 3B4 3B5 3B6 3B7 3B8
3C1 3C2 3C3 3C4 3C5 3C6 3C7 3C8
3D1 3D2 3D3 3D4 3D5 3D6 3D7 3D8
3E1 3E2 3E3 3E4 3E5 3E6 3E7 3E8
3F1 3F2 3F3 3F4 3F5 3F6 3F7 3F8
3G1 3G2 3G3 3G4 3G5 3G6 3G7 3G8
3H1 3H2 3H3 3H4 3H5 3H6 3H7 3H8
scale
0
80
meters
LEGEND
GRID POINT
2B5
GRID POINT LABEL
VEGETATION PLOT


CAPITOL DEMO
Capitol State Forest
Washington
UNIT 4 - 40% Aggregated
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
LEAVE GROUPS
scale
meters
0
80
356°
266°
176°
86°
N


CAPITOL DEMO
Capitol State Forest
Washington
UNIT 5 – 15% Dispersed
LEGEND
GRID POINT
2B5 GRID POINT LABEL
VEGETATION PLOT
scale
0
meters
80
N
343°
73°
253°
163°


CAPITOL DEMO
Capitol State Forest
Washington
UNIT 6 – 15% Aggregated
LEGEND
GRID POINT
GRID POINT LABEL
2B5
VEGETATION PLOT
LEAVE GROUPS
scale
meters
0
80
N
338°
248°
158°
68°

Appendix 8: Locations of the Four Corner Grid Points in Each DEMO Treatment Unit (Albers WA-OR NAD83)

Block/ treatment	Grid point	Northing	Easting	Block/ treatment	Grid point	Northing	Easting
		- - - - - *Meters* - - - - -				- - - - - *Meters* - - - - -	
Watson Falls:				Dog Prairie:			
100%	1A1	1024227	417579	100%	1A1	1016986	412494
	1A7	1024126	417798		1A7	1016872	412706
	1I1	1023938	417444		1I1	1016705	412342
	1I7	1023834	417663		1I7	1016592	412553
75%A	2A1	1023378	401956	75%A	2A1	1017075	412103
	2A7	1023507	402159		2A7	1016978	412324
	2I1	1023109	402130		2I1	1016781	411975
	2I7	1023235	402330		2I7	1016685	412195
40%D	3A1	1030471	415708	40%D	3A1	1017759	410825
	3A7	1030316	415891		3A7	1017768	411063
	3I1	1030225	415501		3I1	1017439	410836
	3I7	1030071	415686		3I7	1017449	411077
40%A	4A1	1024252	417941	40%A	4A1	1017163	411795
	4A7	1024182	418171		4A7	1017070	412014
	4I1	1023944	417849		4I1	1016874	411665
	4I7	1023875	418079		4I7	1016777	411885
15%D	5A1	1022839	402559	15%D	5A1	1016835	412775
	5A9	1023045	402805		5A7	1016721	412985
	5G1	1022656	402713		5I1	1016556	412621
	5G9	1022860	402959		5I7	1016439	412831
15%A	6A1	1023040	402171	15%A	6A1	1017593	410423
	6A9	1023216	402438		6A9	1017607	410742
	6G1	1022839	402303		6G1	1017353	410434
	6G9	1023015	402570		6G9	1017367	410753

Appendix 8 (continued)

Block/ treatment	Grid point	Northing	Easting	Block/ treatment	Grid point	Northing	Easting
		- - - - - *Meters* - - - - -				- - - - - *Meters* - - - - -	
Butte:				Little White Salmon:			
100%	1A1	1368676	477542	100%	1A1	1311762	467887
	1A7	1368849	477708		1A7	1311611	467700
	1I1	1368457	477773		1I1	1312009	467685
	1I7	1368628	477937		1I7	1311857	467499
75%A	2A1	1369302	478339	75%A	2A1	1311597	469423
	2A7	1369476	478503		2A7	1311643	469191
	2I1	1369086	478571		2I1	1311911	469484
	2I7	1369254	478738		2 I7	1311956	469249
40%D	3A1	1370244	478642	40%D	3A1	1311533	467616
	3A9	1370564	478634		3A8	1311339	467419
	3G1	1370250	478883		3H1	1311735	467421
	3G9	1370570	478873		3H8	1311536	467224
40%A	4A1	1369519	478607	40%A	4A1	1312039	468683
	4A9	1369750	478827		4A7	1312210	468513
	4G1	1369354	478780		4I1	1312269	468908
	4G9	1369583	479002		4I7	1312437	468738
15%D	5A1	1368918	477775	15%D	5A1	1311966	468267
	5A7	1369093	477940		5A9	1311786	468003
	5I1	1368699	478007		5G1	1312164	468134
	5I7	1368872	478171		5G9	1311986	467869
15%A	6A1	1367958	476630	15%A	6A1	1311547	470073
	6A9	1368149	476885		6A9	1311592	469758
	6G1	1367765	476772		6G1	1311785	470107
	6G9	1367956	477029		6G9	1311832	469792

Appendix 8 (continued)

Block/ treatment	Grid point	Northing	Easting	Block/ treatment	Grid point	Northing	Easting
		- - - - - *Meters* - - - - -				- - - - - *Meters* - - - - -	
Paradise Hills:				Capitol Forest:			
100%	1A1	1328412	441811	100%	1A1	1429381	362511
	1A8	1328593	441596		1A9	1429274	362210
	1H1	1328624	441997		1G1	1429608	362430
	1H8	1328809	441777		1G9	1429500	362129
75%A	2A1	1329305	444456	75%A	2A1	1431720	360832
	2A9	1329303	444776		2A8	1431712	360552
	2G1	1329063	444457		2H1	1432000	360824
	2G9	1329065	444771		2H8	1431992	360544
40%D	3A1	1330931	450811	40%D	3A1	1428697	360246
	3A9	1330789	450525		3A8	1428461	360397
	3G1	1331145	450704		3H1	1428546	360011
	3G9	1331001	450420		3H8	1428310	360162
40%A	4A1	1329139	449561	40%A	4A1	1431427	361209
	4A8	1329415	449506		4A7	1431442	361448
	4H1	1329193	449836		4I1	1431107	361230
	4H8	1329469	449784		4I7	1431122	361469
15%D	5A1	1328145	444742	15%D	5A1	1429931	361607
	5A7	1328186	444978		5A8	1430011	361875
	5I1	1327830	444795		5H1	1429662	361687
	5I7	1327873	445029		5H8	1429743	361955
15%A	6A1	1326916	445950	15%A	6A1	1431645	360472
	6A9	1327229	445879		6A8	1431541	360212
	6G1	1326973	446183		6H1	1431905	360369
	6G9	1327284	446114		6H8	1431802	360109

Note: Locations of all grid points, including interpolated interior points, are available under the TP108 study code in the Oregon State University Forest Science Data Bank (http://andlter.forestry.oregonstate.edu/data/abstract.aspx?dbcode=TP108).

Appendix 9: Bearings (in Degrees) of Rows and Columns of the Systematic Grid in Each DEMO Treatment Unit

	Treatment											
	100%		75%A		40%D		40%A		15%D		15%A	
From grid point:	**1A1**	**1A1**	**2A1**	**2A1**	**3A1**	**3A1**	**4A1**	**4A1**	**5A1**	**5A1**	**6A1**	**6A1**
To grid point:	**1A7**	**1G1**	**2A7**	**2G1**	**3A7**	**3G1**	**4A7**	**4G1**	**5A7**	**5G1**	**6A7**	**6G1**
Watson Falls	113	203	56	146	128	218	105	195	49	139	56	146
Dog Prairie	120	210	115	205	90	180	115	205	120	210	90	180
Butte	45	135	45	135	0	90	45	135	45	135	55	145
Little White Salmon	231	321	280	10	226	316	316	46	236	326	279	9
Paradise Hills	310	40	90	180	245	335	349	79	82	172	348	78
Capitol Forest	250	340	268	358	147	237	86	176	73	163	248	338

Note: See appendixes 2 through 7 for grid maps showing the locations of aggregates, vegetation plots, and other features in each treatment unit.

Appendix 10: Bearings (in Degrees) of Permanent Vegetation Transects in Each DEMO Treatment Unit

		Treatment					
Block	**Transect[a]**	**100%**	**75%A**	**40%D**	**40%A**	**15%D**	**15%A**
Watson Falls	A	68.5	11.5	83.5	60.5	4.5	11.5
	B	158.5	101.5	173.5	150.5	94.5	101.5
	C	248.5	191.5	263.5	240.5	184.5	191.5
	D	338.5	281.5	353.5	330.5	274.5	281.5
Dog Prairie	A	75	70	45	70	75	45
	B	165	160	135	160	165	135
	C	255	250	225	250	255	225
	D	345	340	315	340	345	315
Butte	A	0	90	45	90	0	10
	B	90	180	135	180	90	100
	C	180	270	225	270	180	190
	D	270	0	315	0	270	280
Little White Salmon	A	6	55	1	1	6	54
	B	96	145	91	91	96	144
	C	186	235	181	181	186	234
	D	276	325	271	271	276	324
Paradise Hills	A	85	45	20	34	37	33
	B	175	135	110	124	127	123
	C	265	225	200	214	217	213
	D	355	315	290	304	307	303
Capitol Forest	A	25	43	12	41	28	23
	B	115	133	102	131	118	113
	C	205	223	192	221	208	203
	D	295	313	282	311	298	293

[a] The four transects per plot (A through D, fig. 7) are offset 45 degrees from the grid system in each unit (see app. 9).

Appendix 11: Descriptions of Vegetation Databases Archived in the Oregon State University Forest Science Data Bank

Discipline	Entity	Description
Vegetation studies: Pretreatment (Study ID: TP104)		
URL: http://andlter.forestry.oregonstate.edu/data/abstract.aspx?dbcode=TP104		
	1	Physical and site characteristics (U-A1)
	2	Transect bearings and rebar placement (U-A2) (data are in TP108, entity 2)
	3	Percent overstory canopy cover: moosehorn densiometer (U-A)
	4	Herb layer cover and height, numbers of tree seedlings (U-B)
	5	Ground surface conditions (U-C)
	6	Tall shrub and understory tree layer: cover (U-D1)
	7	Tall shrub and understory tree layer: height (U-D2)
	8	Coarse woody debris (U-E)
	9	Density of understory trees (U-F)
	10	Preharvest tree diameters (O-A)
	11	Snag measurements (O-B)
	12	Tree heights (O-C)
	13	DEMO grid point data
	14	Percent overstory canopy cover: truck mirrors (U-H)
	15	Preharvest disturbance: stumps and skid roads (U-I)
	16	Preharvest disturbance: tree falls and tree breakage (U-J)
	17	Epiphytic lichen biomass

Appendix 11 (continued)

Discipline	Entity	Description
Vegetation studies: Posttreatment (Study ID: TP108)		
URL: http://andlter.forestry.oregonstate.edu/data/abstract.aspx?dbcode=TP108		
	1	General plot characteristics (U-A1)
	2	Transect bearings, rebar distances, grid point conditions, and associated notes (U-A2)
	3	Bryophyte and lichen species' presence/absence and substrate associations in harvested and uncut plots (U-B1)
	4	Bryophyte and lichen total cover in harvested and uncut plots (U-B1)
	5	Herb layer in harvested plots: presence/absence, number of tree seedlings (U-B2)
	6	Herb layer in harvested plots: cover, number of tree seedlings (U-B2)
	7	Herb layer in uncut plots: cover, height, number of tree seedlings (U-B3)
	8	Ground surface conditions (U-C)
	9	Tall shrub and understory trees: cover (U-D1)
	10	Tall shrub and understory trees: height (U-D2)
	11	Coarse woody debris (U-E)
	12	Natural regeneration (1998, 1999) (U-F)
	13	Overstory trees (O-A, O-E, and O-G)
	14	Snags (O-B, O-F, and O-F2)
	15	Tree heights, post-harvest (O-C)
	16	Percent overstory canopy cover: truck mirrors (U-H)
	17	Disturbance assessment: cover (U-I1)
	18	Disturbance assessment: slash depth (U-I2)
	19	Planted trees (U-G, U-G2)
	20	Plot photo comments[a]
	21	Tree mortality (O-D)
	24	Natural regeneration (2003-2016) (U-F2)
	25	Height and leader growth of tagged natural regeneration (U-F3)

Note: Codes in parentheses refer to overstory (O-) and understory (U-) field forms.
[a] Image files are available on request from the Oregon State University Forest Science Data Bank

Appendix 12: Descriptions of Wildlife Databases Archived in the Oregon State University Forest Science Data Bank

Discipline	Entity	Description
Wildlife studies: Pre- and posttreatment (Study ID: WE015)		
URL: http://andlter.forestry.oregonstate.edu/data/abstract.aspx?dbcode=WE015		
	1	Arboreal rodents
	2	Arboreal rodent dissection data
	3	Flying squirrel winter den sites in south-central Oregon Cascades: tree characteristics
	4	Flying squirrel winter den sites in south-central Oregon Cascades: tracking observations
	5	Flying squirrel winter den sites in south-central Oregon Cascades: tree density
	6	Flying squirrel winter den sites in south-central Oregon Cascades: vertical canopy structure
	7	Bat ultrasonic surveys 1994, 1995, 1996
	8	Bat trapping data 1996
	9	Echolocation bat data 1998, blocks 5,7,8 (post treatment)
	10	Insectivore pitfall data
	11	Small rodents pitfall data
	12	Amphibian pitfall data
	13	Bird surveys
	14	Bird territorial mapping, pre- and post-treatment

Appendix 13: Descriptions of Arthropod Databases Archived in the Oregon State University Forest Science Data Bank

Discipline	Entity	Description
Arthropod studies: Pretreatment (Study ID: TS016)		
URL: http://andlter.forestry.oregonstate.edu/data/abstract.aspx?dbcode=TS016		
	1	DEMO pre-harvest invertebrates (arthropods)[a]
	2	Descriptions of species in TS01601
Arthropod studies: Posttreatment (Study ID: TS018)		
URL: http://andlter.forestry.oregonstate.edu/data/abstract.aspx?dbcode=TS018		
	1	Abundance of bark arthropods (non-arachnids)
	2	Abundance of bark arthropods (arachnids)
	3	Biomass of bark arthropods (non-arachnids)
	4	Biomass of bark arthropods (arachnids)
	5	Abundance of litter arthropods (carabids)
	6	Abundance of litter arthropods (arachnids)

[a] Posttreatment data on foliage-dwelling arthropods are not archived in the Oregon State University Forest Science Data Bank.

Appendix 14: Descriptions of Ectomycorrhizal Fungi Databases Archived in the Oregon State University Forest Science Data Bank

Discipline	Entity	Description
Fungi studies: Pre- and posttreatment (Study ID: TP109)		
URL: http://andlter.forestry.oregonstate.edu/data/abstract.aspx?dbcode=TP109		
	1	DEMO mushroom collections[a]
	2	DEMO truffle collections[a]

[a] All pretreatment data are archived in the Oregon State University Data Bank, but only posttreatment data for 1998 from the Butte experimental block are archived.

Appendix 15: Descriptions of Microclimate Databases Archived in the Oregon State University Forest Science Data Bank

Discipline	Entity	Description
Microclimatic studies: Posttreatment (Study ID: MS034)		
URL: http://andlter.forestry.oregonstate.edu/data/abstract.aspx?dbcode=MS034		
	1	Site descriptions
	2	Transmitted light and percent open sky estimated using the Gap Light Analyzer (GLA) and digital hemispherical photos
	3	Volumetric soil moisture (%) measured using Time Domain Reflectometry (TDR)
	4	Cover of plant growth forms, ground-surface conditions, and slash; slash depth
	5	Air and soil temperature using iButton temperature data loggers

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