Humboldt Redwood™

January 29, 2013

Mr. Matthias St. John
California Regional Water Quality Control Board
North Coast Region
5550 Skylane Blvd, Suite A
Santa Rosa, CA 95403

Subject: Enrollment of portions of THP 1-12-064 HUM in the Freshwater Creek WWDR, "Tier II"

Dear Mr St. John:

HRC is requesting Tier II enrollment under Watershed-Wide Waste Discharge Requirement (WWDR) Order No. R1-2006-0041 for portions of THP 1-12-064 HUM. The enrollment is comprised of 134.6 acres of group selection/selection and 1.8 acres of right of way, (69.1 clear-cut equivalent acres). Total acres currently enrolled or proposed for enrollment under Order No. R1-2006-0041 Tier II is shown in the Attached Pre-Harvest Planning Report. The Erosion Control Plan (ECP), Form 200 and an annual waste discharge enrollment fee have already been submitted for this THP.

Landslide risks associated with this plan were evaluated in compliance with the Freshwater Creek and Elk River WWDR Permit Acreage Enrollment and Compliance Monitoring Program Quality Assurance Project Plan (Version 2.0, September 1, 2006) approved by the Executive Officer of the North Coast Regional Water Quality Control Board, as part of THP preparation. The Licensed Geologist performed this analysis in the Geology report included in the plan. This approach uses commonly accepted standards for geologic practices in forest management (Sidle et al. 1985, Soeters and Van Western 1996, and Sidle and Ochiai 2006) to assess factors known to contribute to landslides, such as steepness of slope, slope convergence, hydrology, geologic features, and visibly unstable areas. Overlapping and complementary scientific techniques combining state-of-the-art digital elevation model (DEM) slope stability models, field investigation, and terrain analysis were used in this assessment.

The Upper Little Fresh THP is located in the southwestern reaches of the Freshwater Creek Watershed on slopes above and along Little Freshwater Creek. The plan area spans a geologic contact and is consequently underlain by sediments associated with both the middle to late Cenozoic aged Wildcat Group and the Paleocene-Eocene aged Yager terrane of the Franciscan Complex Coastal Belt. In this region of the Freshwater Creek Watershed the Wildcat Group sediments unconformably overlie Yager terrane bedrock. The plan area

is generally devoid of recent or historically active landslides and no faults are mapped in its' immediate vicinity.

The services of a California State licensed Professional Geologist were retained during the layout of this THP. A letter report titled 'Reviewed Geologic Information and Disclosure of Known Unstable Areas' that documents the Project Geologist observations and conclusions is attached to Section 5 of the THP. The THP was also reviewed by California Geologic Survey (CGS) staff, which is documented in a Pre-Harvest Investigation (PHI) report found on the CALFIRE web site. Based on the level of review provided in the letter report, CGS PHI report, and the HRC GeoScience Departments recent evaluation, it is our opinion that Units 1 through 8 of the Upper Little Fresh THP meets the requirements for Tier II enrollment.

The THP proposes an uneven-age silviculture retaining 75 sqft of basal area. Sub-merchantable trees and those with specific wildlife value characteristics (e.g., cavities, large limbs, broken tops, snags, etc.) will be retained within the harvest area to the extent feasible. Cable and ground based yarding is approved for the unit. Post-harvest no site preparation will occur.

Greater detail regarding this landslide hazard assessment is provided in the attached *THP Unit Review for Tier 2 Enrollment*. The licensed geologist involved with the Tier 2 landslide risk evaluation has concluded the proposed harvest operation, if implemented as planned and approved, will result in a negligible increase in potential for post-harvest landsliding; and thereby meets the applicable Zero Delivery of landslide related sediment performance standards of NCRWQCB Orders R1-2006-0041 and R1-2008-0071.

Please do not hesitate to contact me should you have any questions or comments regarding this application for enrollment into WWDR (Order No. R1-2006-0041).

Respectfully,

Jon Woessner,
Area Manager RPF #2571
Humboldt Redwood Company, LLC

Attachments:
Professional Certification of Design
THP Unit Review for Tier II enrollment
Pre-harvest Planning Report
Maps

Upper Little Fresh

Topographic Map

T4N R1E Sec. 15, 16, 21, 22 HB&M

USGS Quad (s) : MCKINNEY CREEK

Map Scale: 1 inch = 1000 feet

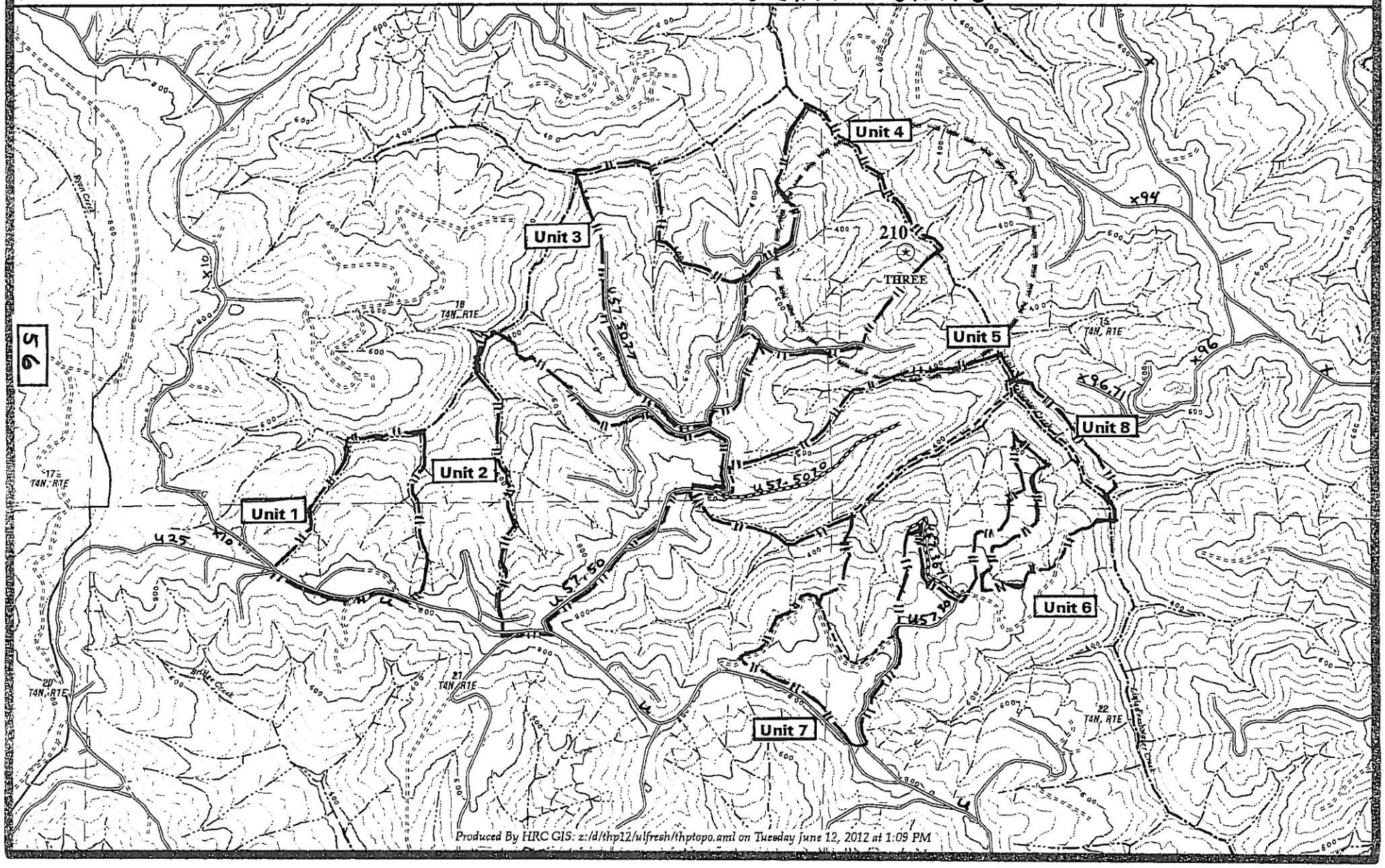
Contour Interval: 40 feet

Property Line
Harvest Boundary
Permanent Road
Seasonal Road
Proposed Seasonal Road
Class I Watercourse
Class II Watercourse
Class III Watercourse
NSO Site
1000' NSO Buffer

--- UNIT SEPARATION

Tier 2 - Units 3-8

TOPOGRAPHIC / UNITS



Produced By HRC GIS: z:/d/thp12/ulfresh/thptopo.aml on Tuesday June 12, 2012 at 1:09 PM

Table 1. Proposed 2013 Harvest in Freshwater Creek

THP Name	THP Number	Unit Number	Silviculture CC	ROW	shr	SEL	CC Equivalent	Hazard Low	High*
Upper Little Fresh	12-064	1				20	10.0	19.94	0.2
Upper Little Fresh	12-064	2				45.3	22.7	44.9	1.5
Upper Little Fresh	12-064	3				29.3	14.7	19.7	36.9
Upper Little Fresh	12-064	4				29.8	14.9	20.2	36.9
Upper Little Fresh	12-064	5		1.2		28.4	14.8	9.2	78.3
Upper Little Fresh	12-064	6&8		0.6		36.1	18.4	33.8	11.1
Upper Little Fresh	12-064	7				11	5.5	11	0.0
Next Beck's thing	12-084	T1		0.4		46.7	23.6	45	8.1
Next Beck's thing	12-084	T2		15.3		273.2	144.3	270.1	70.7
Another Whiskey	11-007	1				4.5	2.3	1	13.4
Another Whiskey	11-007	6 tier 2				45.1	22.6	42.8	8.8
Another Whiskey	11-007	6 tier 1				12.2	6.1	11.7	1.9
Another Whiskey	11-007	7				61.6	30.8	50.1	44.2
							330.4		

*The acres represented here have been converted to High Hazard Acres by multiplying by 3.8404

TBD - Planning is either in the approval or preperation stage. Acreages are not finalized yet. They will be finalized prior to enrollment

Highlight indicates a THP and Specific Unit to be enrolled prior to establishing an enforceable Zero Discharge Monitoring Plan (Tier I). Weighted Acreage Totals are listed below to demonstrate compliance with the Staff Landslide Model limit of 144 Harvest Acres in Freshwater Creek. Other THP Units will be enrolled after approval of the aforementioned Monitoring Plan

No Highlight Indicates a THP and Specific Unit to be enrolled after establishment of an enforcable Zero Discharge Monitoring Plan (Tier II).

Total Clear Cut Equivilant Acres enrolled or submitted for enrollment	330.4

Table 3. Summary of THPs by Yarding System and Site Preparation for Freshwater Creek

THP Name	THP Number	Unit Number	Yarding System Ground Based	Yarder	Helicopter	Site Preparation Mechanical	Broadcast
Upper Little Fresh	12-064	1	2	18		0	0
Upper Little Fresh	12-064	2	0	34.1			
Upper Little Fresh	12-064	3	2.7	26.6			
Upper Little Fresh	12-064	4	2.9	26.9			
Upper Little Fresh	12-064	5	1.2	9.2			
Upper Little Fresh	12-064	6&8	11.6	25.1			
Upper Little Fresh	12-064	7	11	0			
Next Becks thing	12-084	5	0.4	46.1			
Next Beck's thing	12-084	T2	111.9	117.4			
Another Whiskey	11-007	1	4.5				
Another Whiskey	11-007	6 tier 2	2.9	44.2			
Another Whiskey	11-007	6 Tier 1	10.2	2			
Another Whiskey	11-007	7	1.3	54.9			

GEOLOGY

Reviewed Geologic Information and Disclosure of Known Unstable Areas

The Upper Little Fresh THP is proposed under the Prescriptions adopted from the Freshwater Creek Watershed Analysis (Palco, 2003). Throughout the layout of the plan, the Forester has implemented the "Hillslope Management Check List" to identify very high risk areas of mass wasting that require licensed geologic review for harvesting. No areas within the operational portions of the plan are proposed for harvest where identified as very high risk of mass wasting. Figure 1a is a reproduction of CGS (1999) "Geologic and Geomorphic Features Related to Landsliding, Freshwater Creek, Humboldt County, California". Figure 2 is a compilation of Maps A-4 and A-5 from Appendix A of Freshwater Creek Watershed Analysis (Palco, 2003). Figure 3 is the Forester's compilation of identified unstable areas and unstable areas mapped from adjacent THPs within the units of the Upper Little Fresh THP.

For this plan, we reviewed the following THPs: Ridge Meander (09-010), Little 34 (08-048), Little Main (05-085), Little C (02-292), and Little 22 (01-208). Previous mapping (from the above listed THPs) of recently active, shallow landslides within the THP area is generally limited to streamside slopes or road related failures. Previous mapping has been compiled on Figure 3. Previous mapping of deep-seated landslides (from the above listed THPs) uses the watershed analysis mapping of deep-seated landslides (Map-A-5). Previously mapped unstable areas within the proposed units, classified as dormant historic or younger, will be disclosed in the Unit section below.

Unit 1: No shallow landslides (Map A-4) are mapped within the unit. Deep-seated landslides (Map A-5) with low to moderate reactivation hazard rating are mapped within the watercourses defining the eastern and western harvest boundaries. During our field review we observed 30-50% slopes, in situ old growth stumps, and straight growing second growth trees. CGS (1999) maps debris slide slopes adjacent the watercourses defining the eastern and western harvest boundaries of Unit 1 and extensively throughout Freshwater Creek watershed. No other landslides are mapped within Unit 1. No unstable areas were identified by the Forester within Unit 1.

Unit 2: No shallow landslides (Map A-4) are mapped within Unit 2. A deep-seated landslide (Map A-5) with low to moderate reactivation hazard rating is mapped adjacent the western harvest boundary. During our field review we did not observe indicators of potential instability at this location. CGS (1999) maps debris slide slopes adjacent the watercourses defining the northeastern and western harvest boundaries within Unit 2. The majority of the debris slide slopes mapped by CGS (1999) are within Class II RMZ buffers. The Forester did not observe any potentially unstable areas within the unit.

Unit 3: No shallow landslides (Map A-4) are mapped within Unit 3. Map A-5 identifies a deep-seated landslide with low to moderate reactivation hazard rating in the central portion of the unit. During our field evaluation we did not observe indicators of potential instability at this location. CGS (1999) maps debris slide slopes underlying the majority of the unit. CGS (2003) mapped a historically active fill slope failure within the unit on the U57.5077 Road. Based on tree age CGS (2003) estimated the landslide occurred in the late 1990s. No merchantable timber is present on the fill slope failure and no sediment delivered to a watercourse. CGS (2003) recommends the berm constructed on the outboard edge of the road and associated drainage structures be maintained at this location. The Forester did not observe any additional potentially unstable areas within the unit.

Unit 4: Map A-4 shows a non-road related landslide that did not deliver to a watercourse. During our field evaluation we observed a dormant historic debris slide measuring approximately 100 feet long, 50 feet wide and 6 feet deep. The head scarp extends 30 feet upslope of the Class II Riparian Mitigation Zone (RMZ). An in situ old growth stump is back filled by the deposit adjacent the watercourse. No merchantable timber is present on the body of the slide. Merchantable trees adjacent the landslide have been marked for green tree retention ("L" trees) and will not be harvested. Map A-5 does not show a deep-seated landslide hazard present within the unit. CGS (1999) mapped debris slide slopes adjacent the watercourses within the unit. During our field evaluation we observed a dormant historic debris slide down slope of the U57.508130 Road within debris slide slopes mapped by CGS (1999). The landslide measures approximately 60 feet long, 30 feet wide and 3 feet deep. No merchantable timber is present on the landslide. Merchantable trees adjacent the landslide have been marked with an "L" and will be retained post harvest. The Forester identified a recent landslide **(4-1)** within a Class III watercourse located near the northwestern portion of the unit. No merchantable timber is present on the landslide. Geology flagging coupled with Do Not Cut flagging encompasses the landslide to retain merchantable timber adjacent the extent of the landslide.

Unit 5: Map A-4 shows one non-road related shallow landslide in the down slope (northeastern) portion of the unit. During our field evaluation we did not observe a landslide at the mapped location. Map A-5 does not show a deep-seated landslide hazard present within the unit. CGS (1999) maps debris slide slopes throughout the majority of the unit. Previous mapping by SGD (2002) for the Little C THP identifies unstable slopes outside the northern harvest boundary (Figure 3). During our field review we observed potentially unstable streamside slopes adjacent watercourses defining the unit boundaries. The unstable streamside slopes are encompassed within the RMZ harvest exclusion zones.

Unit 6: Map A-4 identifies a non-road related landslide that delivered sediment to a watercourse. This landslide is mapped at a break in slope near the location of a proposed road approximately 300 feet upslope of the nearest watercourse. During our field evaluation we observed an area of blown down trees densely covered in under brush. We counted a dozen blown down trees and encountered several more grown over by the brush. The area is approximately 100 feet long and 50 feet wide. We did not observed indicators of instability within the area. Map A-5 does not show a deep-seated landslide hazard present within the unit. CGS (1999) identifies debris slides slopes encompassing four of the six watercourses that extend into the unit. HartCrowser (2002) maps a headwall swale at the upslope extent of small Class III watercourse within Unit 6. During our field evaluation we observed slopes ranging between 50-60% with distinct amphitheatre shape topography. Trees within and adjacent the headwall swale have been marked with an "L" and will be retained post harvest.

Unit 7: This unit is a small area of gently inclined slopes at the top of the ridge separating the Elk River and Freshwater Creek watersheds. No watercourses extend into the unit and none of the previous mapping reviewed has identified unstable or potentially unstable slopes in the area.

Unit 8: This unit is a narrow strip of ground extending approximately 1000 feet along Class I reaches of Little Freshwater Creek. The unit extends approximately 150 feet upslope of the watercourse and is completely encompassed within the Class I RMZ. The first 50 feet adjacent the watercourse is within the harvest exclusion zone for the Class I RMZ. Upslope of the no cut a minimum of 50% canopy cover must be retained. The Forester informed us greater than 70% canopy will be retained. This will equate to approximately 300 Square feet of basal area retention post harvest. Map A-4 does not identify shallow landslides in the unit. Map A-5 identifies an area of low to moderate hazard for reactivation upslope of the unit but not extending into the unit.

CGS (1999) identifies debris slide slopes within the upslope extent of the unit. During our field evaluation we observed potentially unstable streamside slopes encompassed within the harvest exclusion zone for the Class I RMZ.

Summary

Areas identified as very high prescription have been identified utilizing Maps A-4, A-5, CGS (1999), adjacent THP geology reports, and the Freshwater Hillslope Management Checklist. These areas have been evaluated and excluded from harvest where confirmed as potentially unstable. Please note that the entire THP area, with the exception of Units 5 and 6, has been partially harvested throughout the last ten to fifteen years. No timber harvesting will occur on unstable areas as mitigated by the layout of the plan.

References:

CGS, 1999, Geologic and Geomorphic Features Related to Landsliding, Freshwater Creek, Humboldt County, California: Department of Conservation, Division of Mines and Geology, Open-File Report (OFR) 99-10.

CGS, 2003, Engineering Geologic Review of Timber Harvest Plan 1-02-292HUM (Little C) Pacific Lumber Company. Pre Harvest Inspection by California Geologic Survey, submitted to Ross Johnson, Deputy Director, Resource Management, Dated February 4, 2003.

HartCrowser, 2001, Geologic Evaluation (Revised), Little 22 Timber Harvesting Plan, T4N, R1E, Sections 15 and 22, HB&M, Humboldt County, California. Unpublished consultants report to the Pacific Lumber Company dated September 21, 2001.

SGD, 2002, Reviewed Geologic Information and Disclosure of Known Unstable Areas, unpublished report submitted in Section V of the Little C THP (1-02-292HUM), dated November 27, 2002.

Palco (The Pacific Lumber Company), 2003, Freshwater Creek Watershed Analysis, dated December 2003.

Upper Little Fresh THP

Watercourses
- class 1
- class 2
- class 3

Roads
- Paved Roads
- Rocked Roads
- Dirt Roads
- Proposed Roads
- Reconstruction
- Decommissioned Roads

THP Boundary
- Upper Little Fresh

see figure 1b for full map key

HRC Geology Department	N	Feet 269 1,000 500 0 1,000	**Figure 1a: Geology and Geomorphic Features Related to Landsliding** modified from Falls, 1999
Drawn by: swatkins			
Date: 6/22/2012			

CGS Freshwater LS pts

air photo. observed

- 1942
- 1948
- 1954
- 1962
- 1966
- 1974
- 1984
- 1996
- 1997
- 1998
- 1999

CGS Freshwater structure

structure

- anticline, approx. loc.
- fault, approx. loc.
- fault, concealed
- thrust fault, approx. loc.
- thrust fault, concealed
- ?thrust fault, queried
- lineament

CGS Freshwater lines

- inner gorge
- torrent track

CGS Freshwater LS

failure mode, activity

- debris flow, historic
- debris slide, dormant
- debris slide, historic
- earthflow, dormant
- earthflow, historic
- translational/rotational, dormant
- translational/roatational, historic
- debris slide slopes

CGS Freshwater symbols

LS line

- active to historically active
- dormant

CGS Freshwater contacts

Contact

- approimately located
- certain location
- queried location

CGS Freshwater geology

Q Recent Alluvium: Holocene (less than 10,000 years old). Interbedded gravel, sand, silt and clay within active stream channel and adjoining flood plain. Dike-protected pastures may be underlain by bay mud at northwestern end of flood plain.

Qfa Falor Formation (Knudsen, 1993): Late Pleistocene to late Pliocene (approximately 0.4 to 1.6 m.y.). Reddish-yellow pebbly conglomerate, sandstone and silt. Contains abundant animal and plant remains locally. May lie in gradational contact with Wildcat Group Upper Unit of Knudsen (1993). Fluvial and shallow marine depositional environment.

Qrt Alluvial Terrace Deposits: Probably late Pleistocene (more than 10,000 years old). Poorly consolidated flat-lying deposits of gravel, sand, silt and clay elevated above present streams.

TWu Wildcat Group- Upper Unit (Knudsen, 1993): Late Pleistocene to Late Pliocene (approximately 0.4 to 1.6 m.y.). Reddish-yellow fine- to medium-grained sandstone containing scattered pebble layers (<10%). Previously mapped as Hookton Formation in the southwest portion of the drainage and Falor Formation in the northeast. Depositional environment is generally shallow marine.

Twl Wildcat Group-Lower Unit (Knudsen, 1993): Middle Miocene to Late Pliocene (approximately 1.6 to 13 m.y.). Interbedded mudstone, silty, very fine sandstone and sandy siltstone. Upper portions of the unit are typically reddish-yellow, lower portions are gray to dark gray. Lower protions sandier and contain occasional pebble and conglomerate lenses.

Ty Yager Formation: Early Tertiary (approximately 50 to 60 m.y.) Interbedded well-consolidated silty shale, siltstone, sandstone, mudstone and conglomerate. Clasts of the shale and mudstone disaggregate over the course of several seasons by repeated wetting and dryig cycles. Sandstone units are generally massive (no visible bedding) and contain detrital muscovite. Medium gray where fresh. Finer grained materials are often well bedded. The unit in this locality is mapped as dipping steeply to the northeast.

Kjfs Central Belt of the Franciscan Complex, Sedimentary Rocks: Cretaceous/Jurassic (approximately 145 m.y.). Well consolidated sandstone, siltstone, and shale with minor amounts of conglomerate. Medium to dark gray where fresh. This unit is described as moderately to highly deformed and highly sheared locally.

Kjfm Melange: Highly sheared shale matrix containing individual blocks of graywacke, mudtone, conglomerate, greenstone, chert, blueschist, greenschist, actinolite, talc and serpentinite.

HRC Geology Department		270	Figure 1b: Key to Geologic and Geomorphic Features Related to Landsliding (Falls 1999)
Drawn By: swatkins			
Date: 6/22/2012			

Roads: paved; rocked; dirt; proposed

Watercourses: class 1; class 2; class 3

Deep-seated LS: LM; M; VL

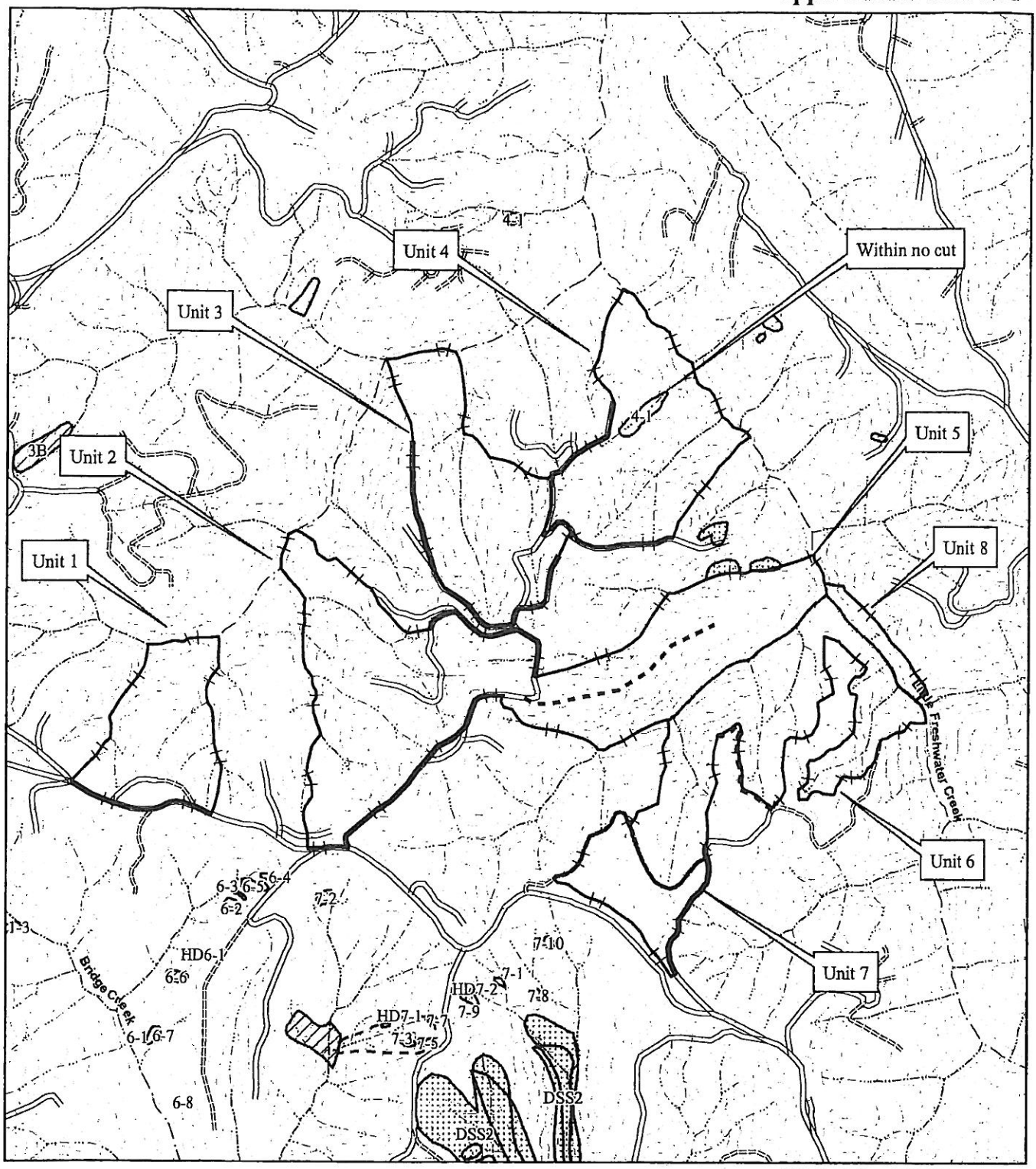
Reactivation Hazard: H; L

Rd related/Sed delivery: non-road related, no del; non-road related, yes del; road related, no del; road related, yes del

THP Boundary: Upper Little Fresh

HRC Geology Department	N	Feet 271 1,000 500 0 1,000	**Figure 2: Freshwater Watershed Analysis Landslide Mapping** compiled from maps A-4 and A-5
Drawn by: swatkins			
Date: 6/22/2012			

Upper Little Fresh THP



HRC 40 foot LiDAR contours

Roads: dirt; paved; proposed; rocked

Watercourses: class 1; class 2; class 3

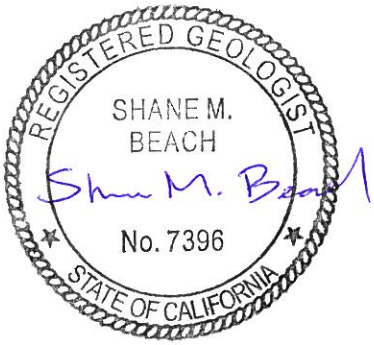
Mass Wasting: LS, DH or younger; DS, DH or younger; DS, DY or older; DSS, DH or younger; DSS, DY or older; TR, DH or younger; TR, DY or older

THP Boundary: Upper Little Fresh

HRC Geology Department	N	Feet 272 1,000 500 0 1,000	Figure 3: Unit Map
Drawn by: swatkins			
Date: 6/22/2012			

Professional Certification of Design

I, SHANE M. BEACH, PG. 7396, 1-29-13,
Name license # Date



hereby certify, in accordance with NCRWQCB R1-2006-0039 and R1-2006-0041, that the attached application and the description of THP modifications, and materials submitted along with

THP No. 1-12-064 HUM (Upper Fresh); Units # 1 through 8

a) are in accordance with accepted engineering practices, and recognized professional standards;

b) comply with the requirements of the Monitoring and Reporting No. R1-2008-0071, approved by the Executive Officer of the North Coast Regional Water Quality Control Plan; and

c) provided that the THP is properly implemented, operated, and maintained, is adequate for the THP to meet the applicable Zero Net Delivery performance standards of NCRWQCB R1-2006-0039 and R1-2006-0041 insofar as such performance can reasonably be predicted by accepted engineering geologic practices.

The opinions presented herein have been developed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable professional geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional advice included in this report.

THP: 1-12-064 HUM (Upper Little Fresh)
Units 1 through 8
January 23, 2013

Tools Used in This Assessment	Figure Number
Elevation Map with 10 ft Contours (HRC LiDAR)	1
SHALSTAB Map (Montgomery and Dietrich, 1994 and PALCO, 2006) Slope Class Map Hillshade Map	2
CGS Geology and Geomorphic Features (CGS, 1999b)	3
Mass Wasting Potential Map (PALCO, 1999)	4
Aerial Photograph Map (HRC, 2007)	5
PALCO Freshwater Creek watershed analysis deep-seated Landslide Inventory Map (WPN, 2001)	6
Road Condition Map	7

Please see back of enrollment for references

Geological Summary
(information presented from existing bodies of work):

The harvest units occupy predominantly convex to concave slope forms adjacent Class I, Class II and Class III reaches of Little Freshwater Creek. Undifferentiated Wildcat Group sediments composed of silts, sands, and infrequent gravels, underlie the bulk of the plan area. The Wildcat Formation is poorly consolidated and was likely deposited in a shallow marine environment during the mid-Miocene to late-Pleistocene. The Yager Terrane of the Franciscan Complex Coastal Belt is exposed along Little Freshwater Creek at the base of Units 3 and 4. Rocks of the Yager Terrane contain predominately well consolidated, massive sandstone with inter-beds of argillite, and conglomerate. Turbeditic mudstone inter bedded with sandstone indicate the Yager Terrane was likely deposited near the continental margin perhaps near a delta.

A geologic review was conducted by a State Licensed Professional Geologist for the THP using guidelines established under CGS Note 50 (CGS, 1997) and Tier 2 enrollment. The reviewing Geologist compared the maps provided for Tier 2 enrollment and Freshwater Creek Watershed Analysis (WPN, 2001) with observations made during field evaluations. A discussion of the findings is provided in Section 5 of the THP titled 'Reviewed Geologic Information and Disclosure of Known Unstable Areas'. This is a public document and can be found at ftp://thp.fire.ca.gov/THPLibrary/North_Coast_Region/THPs2012/1-12-064HUM/. The reviewing Geologist identified one landslide within the plan area and found the Foresters' proposed operations appropriate for the site conditions. The THP was reviewed by various agencies during the Pre-Harvest Inspection (PHI) and found to be compliant with the Forest Practice Rules and the HCP regulations with respect to disclosure of all known unstable areas. CGS (2012) produced an Engineering Geologic Review of Timber Harvesting Plan, 1-12-064 HUM (Upper Little Fresh). Their report details observations made from review of the THP document and during the PHI. The CGS (2012) report is also available for review at the above listed website.

The harvest units were evaluated at the THP level with respect to partial harvest (selection) silviculture.

Summary of Changes to THP Based on Tier II Analysis in this Unit

Forestry Silviculture/Site Prep Plan	Operational Design Plan
For reasons other than slope stability hazard, silviculture is group selection with 75 sq. feet basal area retention per acre post harvest.	No change to approved yarding methods. No site preparation will occur due to partial harvesting.

A) General Observations	B) Harvest Related Impacts and Hillslope Sensitivity
The THP units are bound by rocked and natural surfaced storm proofed roads, Class I, II, and III watercourses, and prominent ridge tops. The plan area occupies convergent and divergent slope forms with inclinations that vary from gently inclined to over 60%. The slopes exceeding 60% are infrequent and limited in acreage. Class II watercourses range from moderate to well developed and are well armored with boulders and cobbles. The Class III watercourses are moderate to poorly developed with low gradient (less than 40%) side slopes. A relatively small percentage of the slopes within the plan area were assigned values (1 and 2) by the SHALSTAB model indicating those areas have a high landslide potential. During the development of this plan standard management practices in accordance with HCP and CAL	The slopes within the unit have experienced clear cut, burning and donkey yarding (a legacy method that dragged the large diameter, felled timber to railroads). Regionally, the catchment area for the Class II and Class III watercourses appears low. Those areas modeled as having a low stability rating correspond to steep slopes along the watercourses that drain the unit. No evidence of past instability was observed within the project area. The potential for the development of shallow debris slides increases significantly where roads are constructed across

A) General Observations	B) Harvest Related Impacts and Hillslope Sensitivity
FIRE prescriptions were applied to these slopes and in general no additional restrictions were placed on them. In Units 5 and 6 some of the RMZs were expanded to include steeper streamside areas. These particular RMZ were designated in the THP as no-cut areas. Our review of these potentially landslide prone slopes revealed moderate to steep gradient planar hillsides and poorly express swales that supported insitu old growth stumps and health upright mature second growth conifers. These areas lacked geomorphic traits commonly associated with recent or historic landslide events. We observed no evidence of recent or suspended ground movements within the areas calculated by SHALSTAB to have a high landslide potential. The Mass Wasting Potential (MWP) model use to evaluate the plan area calculated a majority of the slopes to have a low to moderate potential. A large portion of Unit 5 and small region of Unit 6 were, however, classified as a High MWP (refer to Figure 4 for distribution of high potential areas). These High MWP areas appear to overlap those hillsides modeled as very steep (>65%) (Figure 2) and previously mapped as debris slide slopes (Figure 3). The combination of these two attributes in the MWP model general generates values that correspond to a High or greater MWP. No landslides or landforms with strong geomorphic traits were observed during our evaluation of slopes modeled as having a High MWP. One historic landslide was observed in Unit 4, but occurred in an area mapped as having a moderate MWP. This landslide has been excluded from harvest by the establishment of a no-cut zone. The stand is predominantly redwood and fir. The original harvest was a ground based clear cut yarded either to the down slope watercourse or the ridge top. A second entry, cable yarded thinning harvest, occurred in the 1990's.	steeply inclined slopes and incorporate fills. These activities are not proposed in this plan. Two new road segments are proposed for this plan. Both proposed road segments are located on gently inclined, upland slopes. Partially harvesting the slopes, as proposed in the THP, is not likely to significantly increase the potential for mass wasting.

C) Forestry / Silviculture Plan	D) Operational Design Plan
THP approved silviculture is group selection with a targeted retention of 75 ft^2 BA/A. The Class III watercourses will retain all channel trees, plus on side slopes greater than 50% employ a 50' RMZ that maintains 75 sq. ft evenly distributed in the buffer. Where side slopes are less than 50% employ a 25' RMZ that maintains 75 sq. ft evenly distributed in the buffer. Headwall Swales need to maintain at least 50% canopy, and No group opening greater than ¼ acre immediately above the terminus of class III with slopes greater than 40% or immediately above a headwall swale. Additionally Sub-merchantable trees and those with specific wildlife value characteristics (e.g., cavities, large limbs, broken tops, snags, etc.) will be retained within the harvest area to the extent feasible.	THP approved yarding method for this harvest plan is predominantly cable yarding with small areas of ground-based yarding on gently inclined slopes. We do not anticipate any significant increase in potential for mass wasting-related discharge as a result of yarding operations. No site preparation is proposed due to a selection silviculture.

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Montgomery, D.R. and W.E. Dietrich, 1994. A physically based model for the topographic control on shallow landsliding. Wat. Resour. Res. 30: 1153-1171. For specific details regarding the model used in this evaluation, please see Palco, 2006. Additional information from the model authors is available at the following website: http://socrates.berkeley.edu/~geomorph/shalstab

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Brief descriptions of the models used in this evaluation:

SHALSTAB was first described in Dietrich and Montgomery (1994). SHALSTAB is a simple, physically-based model based on the Mohr-Coulomb failure law that can be used to map shallow landslide potential. The model calculates the potential for failure using gridded digital elevation data. The simplicity of the model lies in the formulation of slope stability parameters that allow the model to be run parameter-free using default values suggested by the authors or determined by local measurement. Because the model uses no

field measurements of critical characteristics that determine slope stability, the evaluation of potential instability is only an approximation. In applying SHALSTAB for Tier 2 enrollment, HRC has run the model on a 10-m spatial grid using LiDAR elevation data and applied the parameters as suggested by the model authors. HRC's application of the method and parameters is described in HRC (2008).

Mass Wasting Potential (MWP) modeling is a cursory regional assessment that numerically values soil, slope inclination, geology type, and geomorphology with respect to past mass wasting. The sums of the values specific to an area are measured against a set ranking system that extends from very low to extreme. The models intent is to highlight areas of high potential for instability at the planning level. The model's use at the site specific level is limited in that pedogenic soil types are used, not textures, the geologic formations utilized provide one value for all of the incorporated facies, and the model is heavily biased if past mass wasting has occurred or has been mapped as occurring in the area.

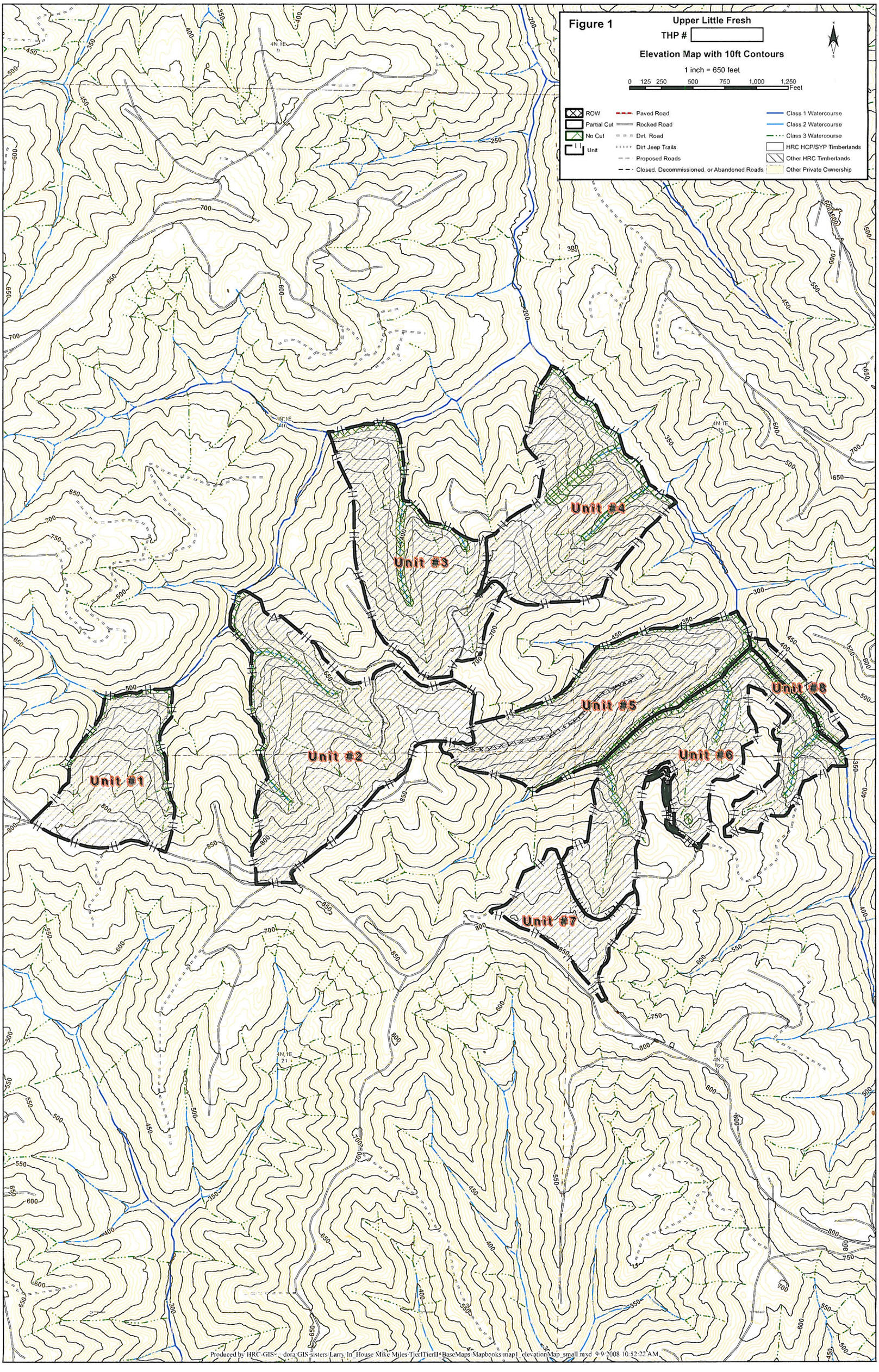
Figure 1
Upper Little Fresh
THP #
Elevation Map with 10ft Contours
1 inch = 650 feet
0 125 250 500 750 1,000 1,250
Feet
ROW
Partial Cut
No Cut
Unit
Paved Road
Rocked Road
Dirt Road
Dirt Jeep Trails
Proposed Roads
Closed, Decommissioned, or Abandoned Roads
Class 1 Watercourse
Class 2 Watercourse
Class 3 Watercourse
HRC HCP/SYP Timberlands
Other HRC Timberlands
Other Private Ownership
Unit #1
Unit #2
Unit #3
Unit #4
Unit #5
Unit #6
Unit #7
Unit #8
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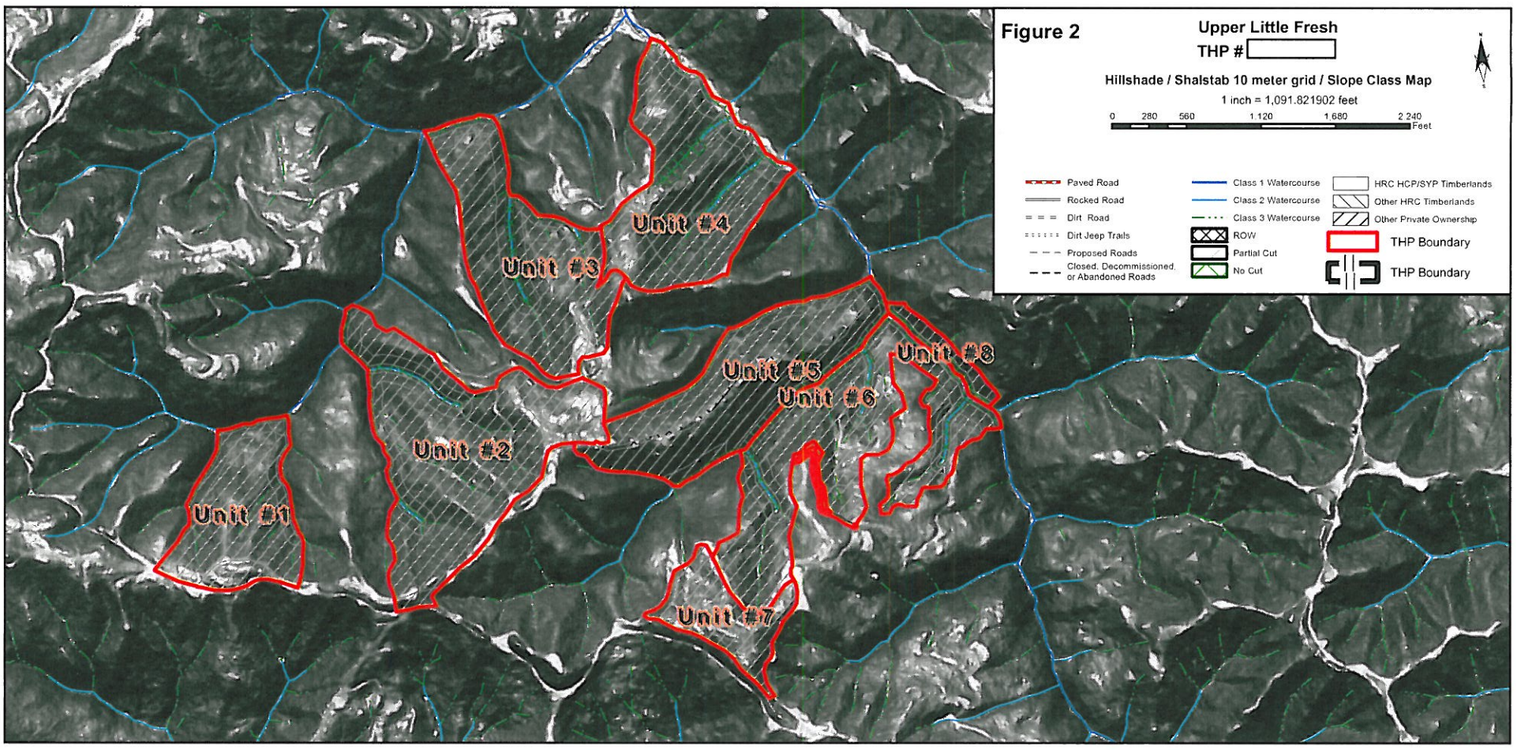
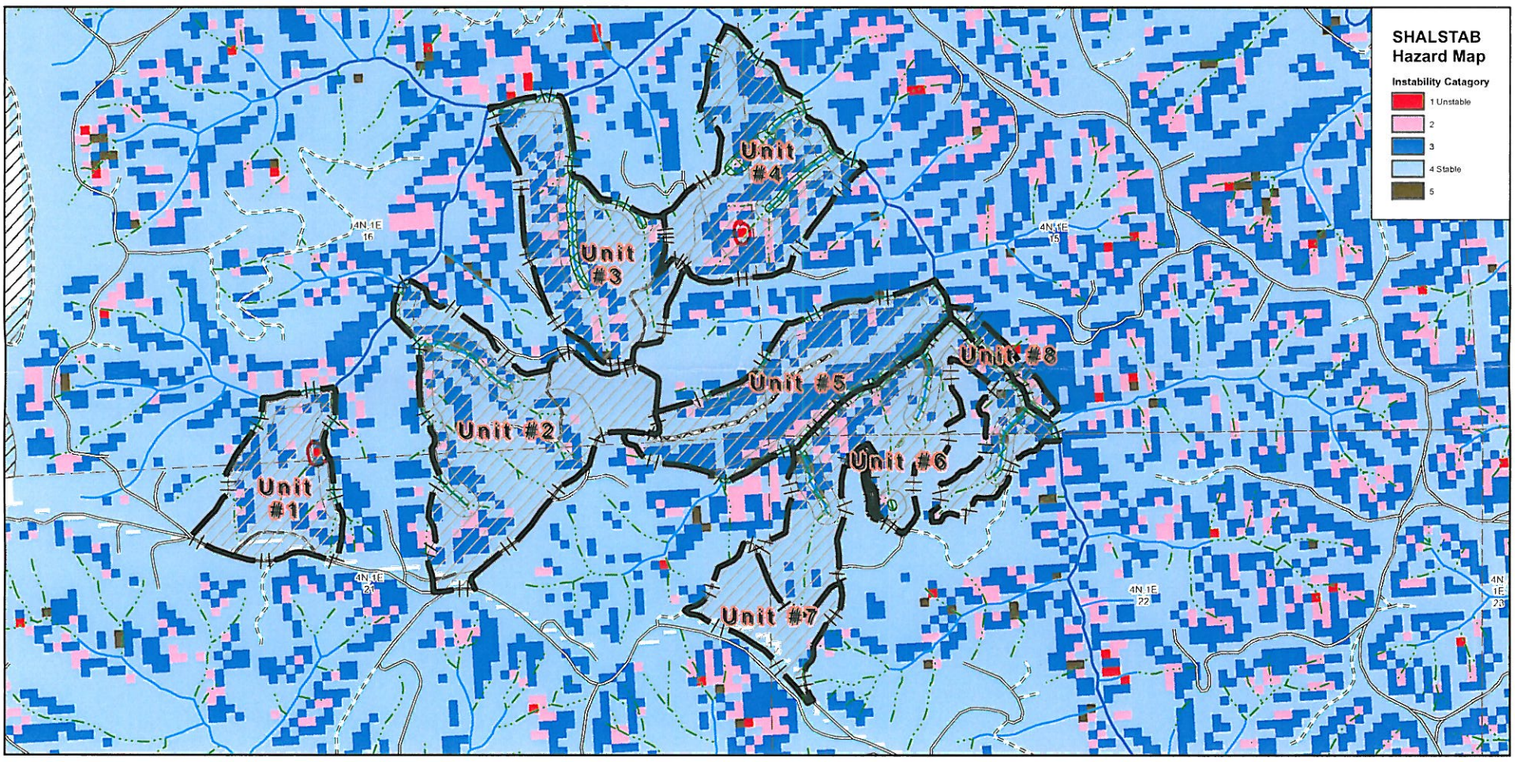
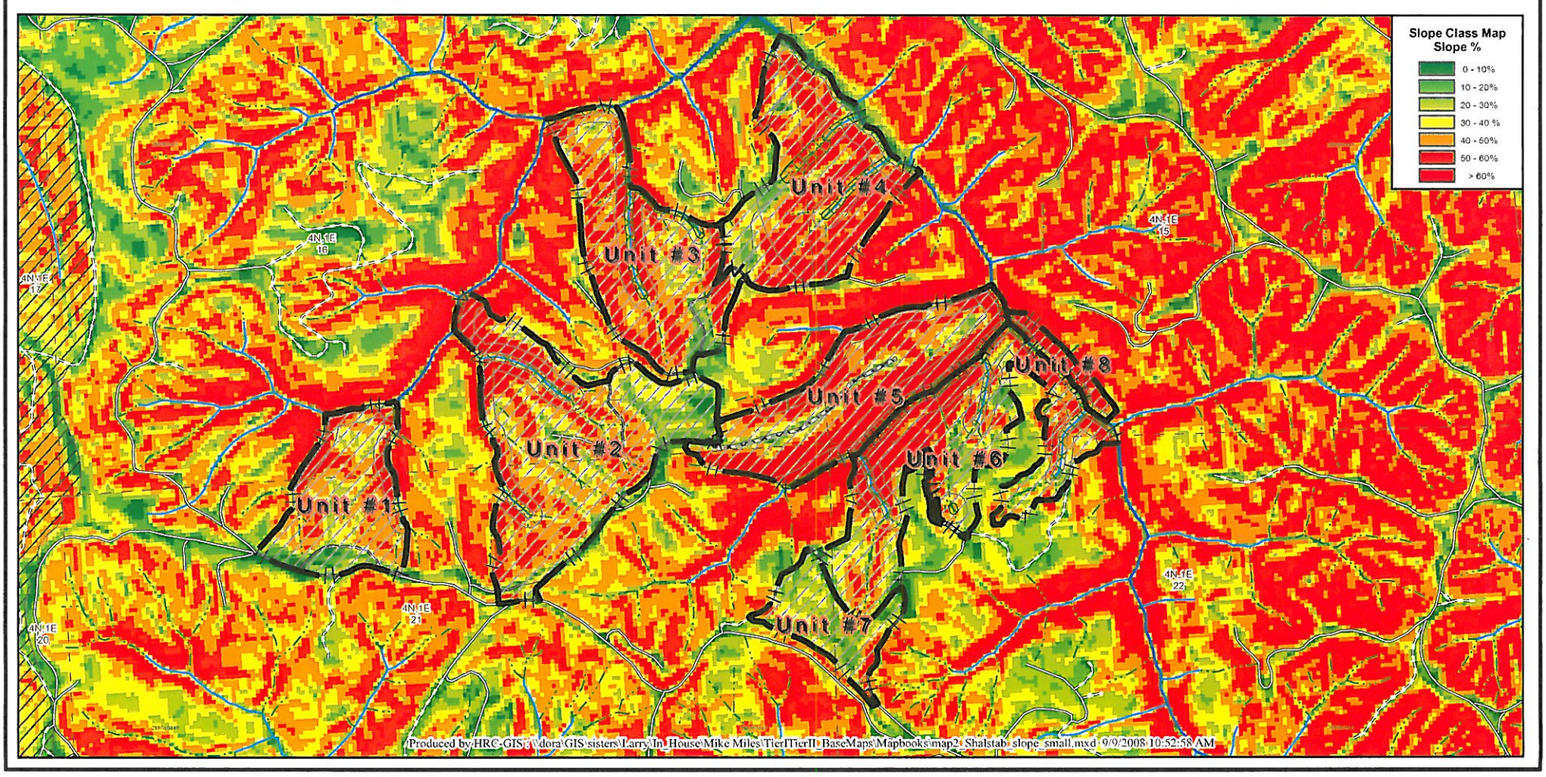


Figure 2
Upper Little Fresh
THP #
Hillshade / Shalstab 10 meter grid / Slope Class Map
1 inch = 1,091.821902 feet
0 280 560 1,120 1,680 2,240
Feet
Paved Road
Rocked Road
Dirt Road
Dirt Jeep Trails
Proposed Roads
Closed, Decommissioned or Abandoned Roads
Class 1 Watercourse
Class 2 Watercourse
Class 3 Watercourse
ROW
Partial Cut
No Cut
HRC HCP/SYP Timberlands
Other HRC Timberlands
Other Private Ownership
THP Boundary
THP Boundary
Unit #1
Unit #2
Unit #3
Unit #4
Unit #5
Unit #6
Unit #7
Unit #8


SHALSTAB
Hazard Map
Instability Catagory
1 Unstable
2
3
4 Stable
5
Unit #1
Unit #2
Unit #3
Unit #4
Unit #5
Unit #6
Unit #7
Unit #8
4N 1E 16
4N 1E 15
4N 1E 21
4N 1E 22
4N 1E 20


Slope Class Map
Slope %
0 - 10%
10 - 20%
20 - 30%
30 - 40 %
40 - 50%
50 - 60%
> 60%
Unit #1
Unit #2
Unit #3
Unit #4
Unit #5
Unit #6
Unit #7
Unit #8
4N 1E 16
4N 1E 15
4N 1E 21
4N 1E 22
4N 1E 20
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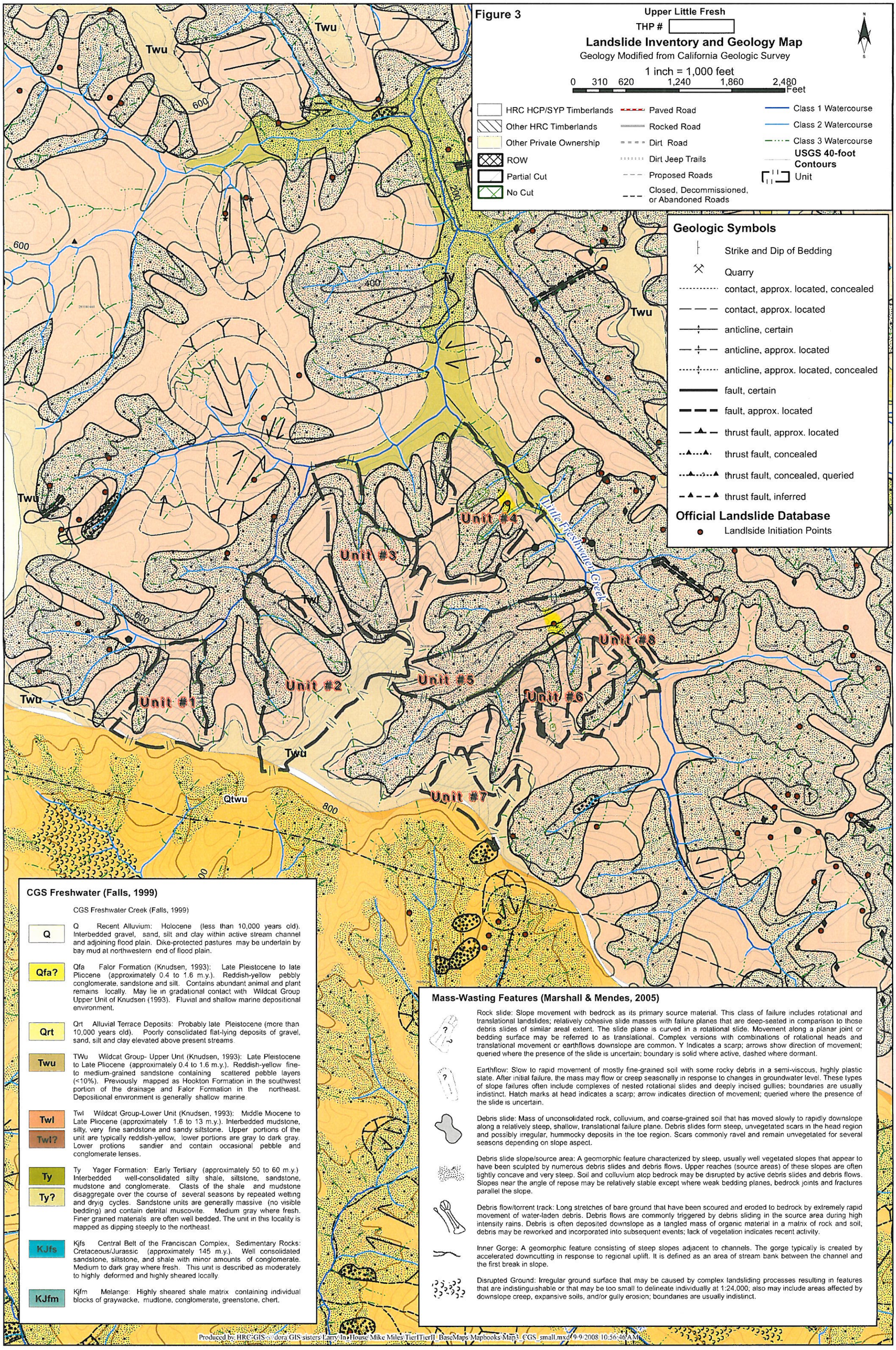
Figure 3
Upper Little Fresh
THP #
Landslide Inventory and Geology Map
Geology Modified from California Geologic Survey
1 inch = 1,000 feet
0 310 620 1,240 1,860 2,480 Feet
HRC HCP/SYP Timberlands
Other HRC Timberlands
Other Private Ownership
ROW
Partial Cut
No Cut
Paved Road
Rocked Road
Dirt Road
Dirt Jeep Trails
Proposed Roads
Closed, Decommissioned, or Abandoned Roads
Class 1 Watercourse
Class 2 Watercourse
Class 3 Watercourse
USGS 40-foot Contours
Unit
Geologic Symbols
Strike and Dip of Bedding
Quarry
contact, approx. located, concealed
contact, approx. located
anticline, certain
anticline, approx. located
anticline, approx. located, concealed
fault, certain
fault, approx. located
thrust fault, approx. located
thrust fault, concealed
thrust fault, concealed, queried
thrust fault, inferred
Official Landslide Database
Landlside Initiation Points
Twu
Twl
Qtwu
Unit #1
Unit #2
Unit #3
Unit #4
Unit #5
Unit #6
Unit #7
Unit #8
Little Freshwater Creek
600
400
800
CGS Freshwater (Falls, 1999)
CGS Freshwater Creek (Falls, 1999)
Q
Q Recent Alluvium: Holocene (less than 10,000 years old). Interbedded gravel, sand, silt and clay within active stream channel and adjoining flood plain. Dike-protected pastures may be underlain by bay mud at northwestern end of flood plain.
Qfa?
Qfa Falor Formation (Knudsen, 1993): Late Pleistocene to late Pliocene (approximately 0.4 to 1.6 m.y.). Reddish-yellow pebbly conglomerate, sandstone and silt. Contains abundant animal and plant remains locally. May lie in gradational contact with Wildcat Group Upper Unit of Knudsen (1993). Fluvial and shallow marine depositional environment.
Qrt
Qrt Alluvial Terrace Deposits: Probably late Pleistocene (more than 10,000 years old). Poorly consolidated flat-lying deposits of gravel, sand, silt and clay elevated above present streams.
Twu
TWu Wildcat Group- Upper Unit (Knudsen, 1993): Late Pleistocene to Late Pliocene (approximately 0.4 to 1.6 m.y.). Reddish-yellow fine- to medium-grained sandstone containing scattered pebble layers (<10%). Previously mapped as Hookton Formation in the southwest portion of the drainage and Falor Formation in the northeast. Depositional environment is generally shallow marine.
Twl
Twl?
Twl Wildcat Group-Lower Unit (Knudsen, 1993): Middle Miocene to Late Pliocene (approximately 1.6 to 13 m.y.). Interbedded mudstone, silty, very fine sandstone and sandy siltstone. Upper portions of the unit are typically reddish-yellow, lower portions are gray to dark gray. Lower protions sandier and contain occasional pebble and conglomerate lenses.
Ty
Ty?
Ty Yager Formation: Early Tertiary (approximately 50 to 60 m.y.) Interbedded well-consolidated silty shale, siltstone, sandstone, mudstone and conglomerate. Clasts of the shale and mudstone disaggregate over the course of several seasons by repeated wetting and dryig cycles. Sandstone units are generally massive (no visible bedding) and contain detrital muscovite. Medium gray where fresh. Finer grained materials are often well bedded. The unit in this locality is mapped as dipping steeply to the northeast.
KJfs
Kjfs Central Belt of the Franciscan Complex, Sedimentary Rocks: Cretaceous/Jurassic (approximately 145 m.y.). Well consolidated sandstone, siltstone, and shale with minor amounts of conglomerate. Medium to dark gray where fresh. This unit is described as moderately to highly deformed and highly sheared locally.
KJfm
Kjfm Melange: Highly sheared shale matrix containing individual blocks of graywacke, mudtone, conglomerate, greenstone, chert.
Mass-Wasting Features (Marshall & Mendes, 2005)
Rock slide: Slope movement with bedrock as its primary source material. This class of failure includes rotational and translational landslides; relatively cohesive slide masses with failure planes that are deep-seated in comparison to those debris slides of similar areal extent. The slide plane is curved in a rotational slide. Movement along a planar joint or bedding surface may be referred to as translational. Complex versions with combinations of rotational heads and translational movement or earthflows downslope are common. Y Indicates a scarp; arrows show direction of movement; queried where the presence of the slide is uncertain; boundary is solid where active, dashed where dormant.
Earthflow: Slow to rapid movement of mostly fine-grained soil with some rocky debris in a semi-viscous, highly plastic state. After initial failure, the mass may flow or creep seasonally in response to changes in groundwater level. These types of slope failures often include complexes of nested rotational slides and deeply incised gullies; boundaries are usually indistinct. Hatch marks at head indicates a scarp; arrow indicates direction of movement; queried where the presence of the slide is uncertain.
Debris slide: Mass of unconsolidated rock, colluvium, and coarse-grained soil that has moved slowly to rapidly downslope along a relatively steep, shallow, translational failure plane. Debris slides form steep, unvegetated scars in the head region and possibly irregular, hummocky deposits in the toe region. Scars commonly ravel and remain unvegetated for several seasons depending on slope aspect.
Debris slide slope/source area: A geomorphic feature characterized by steep, usually well vegetated slopes that appear to have been sculpted by numerous debris slides and debris flows. Upper reaches (source areas) of these slopes are often tightly concave and very steep. Soil and colluvium atop bedrock may be disrupted by active debris slides and debris flows. Slopes near the angle of repose may be relatively stable except where weak bedding planes, bedrock joints and fractures parallel the slope.
Debris flow/torrent track: Long stretches of bare ground that have been scoured and eroded to bedrock by extremely rapid movement of water-laden debris. Debris flows are commonly triggered by debris sliding in the source area during high intensity rains. Debris is often deposited downslope as a tangled mass of organic material in a matrix of rock and soil, debris may be reworked and incorporated into subsequent events; lack of vegetation indicates recent activity.
Inner Gorge: A geomorphic feature consisting of steep slopes adjacent to channels. The gorge typically is created by accelerated downcutting in response to regional uplift. It is defined as an area of stream bank between the channel and the first break in slope.
Disrupted Ground: Irregular ground surface that may be caused by complex landsliding processes resulting in features that are indistinguishable or that may be too small to delineate individually at 1:24,000; also may include areas affected by downslope creep, expansive soils, and/or gully erosion; boundaries are usually indistinct.
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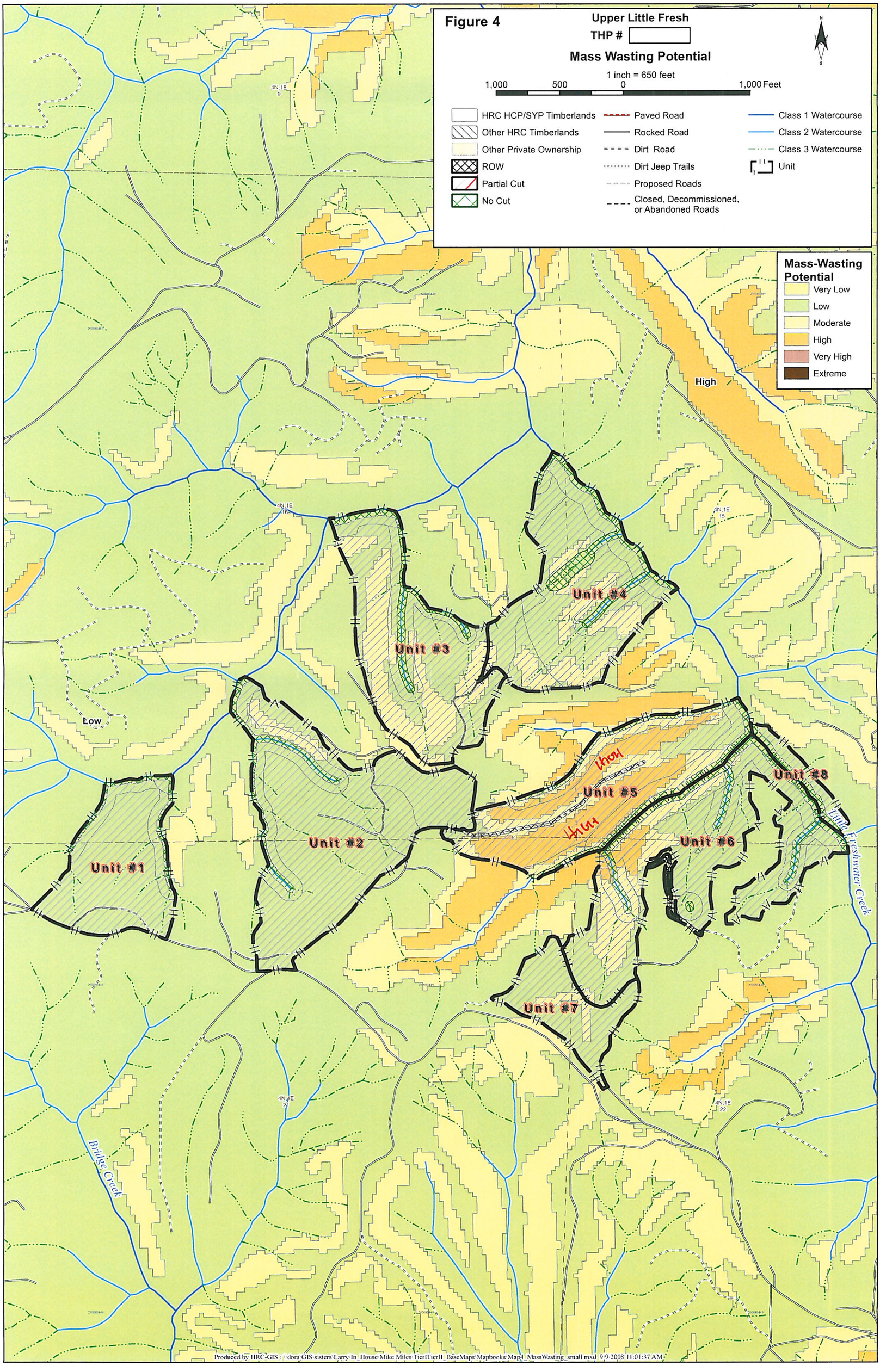
Figure 4
Upper Little Fresh
THP #
Mass Wasting Potential
1 inch = 650 feet
1,000 500 0 1,000 Feet
HRC HCP/SYP Timberlands
Other HRC Timberlands
Other Private Ownership
ROW
Partial Cut
No Cut
Paved Road
Rocked Road
Dirt Road
Dirt Jeep Trails
Proposed Roads
Closed, Decommissioned, or Abandoned Roads
Class 1 Watercourse
Class 2 Watercourse
Class 3 Watercourse
Unit
Mass-Wasting Potential
Very Low
Low
Moderate
High
Very High
Extreme
High
Low
Unit #1
Unit #2
Unit #3
Unit #4
Unit #5
Unit #6
Unit #7
Unit #8
Little Freshwater Creek
Bridge Creek
4N 1E 9
4N 1E 16
4N 1E 15
4N 1E 21
4N 1E 22
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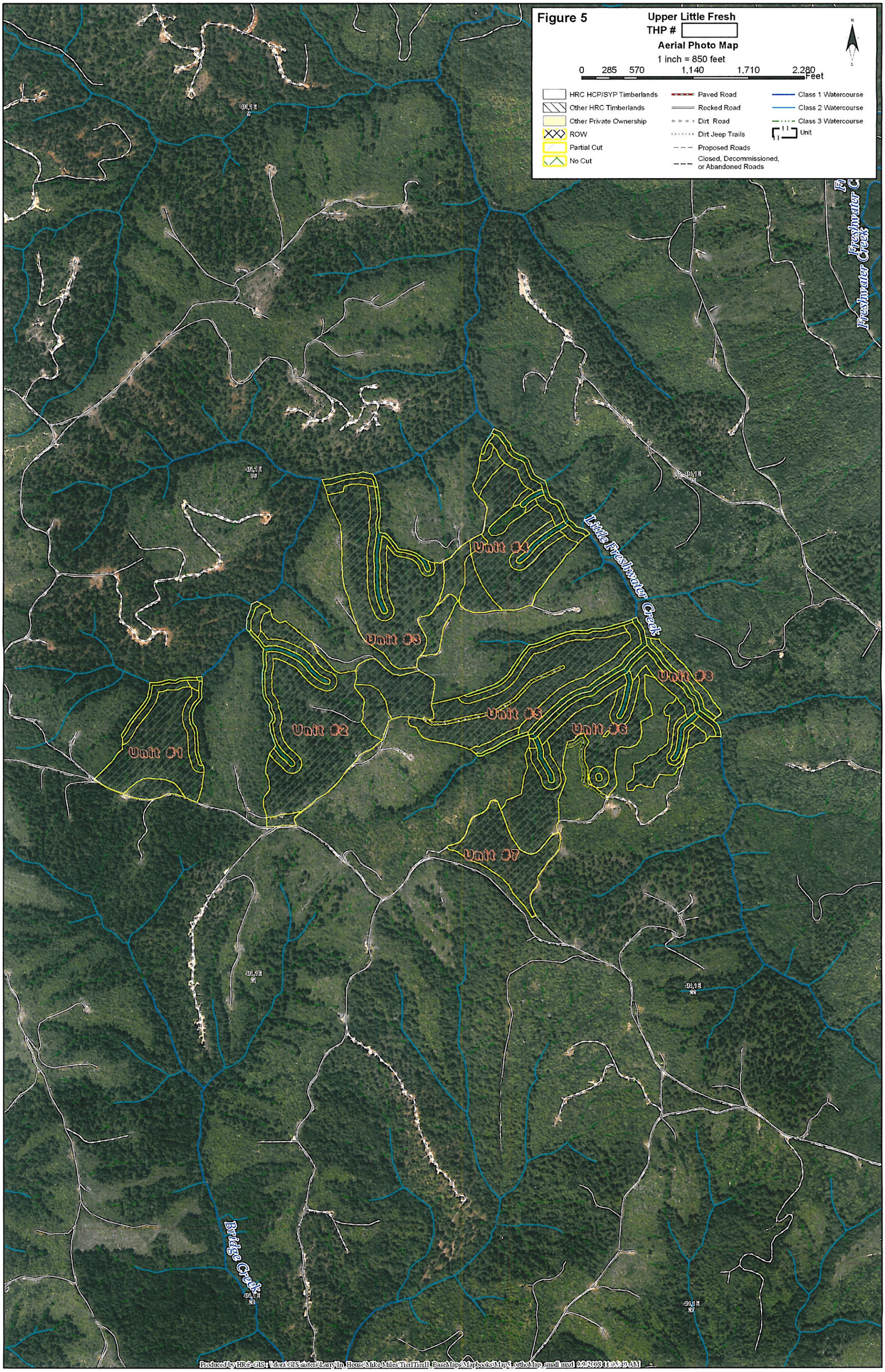
Figure 5
Upper Little Fresh
THP #
Aerial Photo Map
1 inch = 850 feet
0 285 570 1,140 1,710 2,280 Feet
HRC HCP/SYP Timberlands
Other HRC Timberlands
Other Private Ownership
ROW
Partial Cut
No Cut
Paved Road
Rocked Road
Dirt Road
Dirt Jeep Trails
Proposed Roads
Closed, Decommissioned, or Abandoned Roads
Class 1 Watercourse
Class 2 Watercourse
Class 3 Watercourse
Unit
Little Freshwater Creek
Freshwater Creek
Bridge Creek
Unit #1
Unit #2
Unit #3
Unit #4
Unit #5
Unit #6
Unit #7
Unit #8
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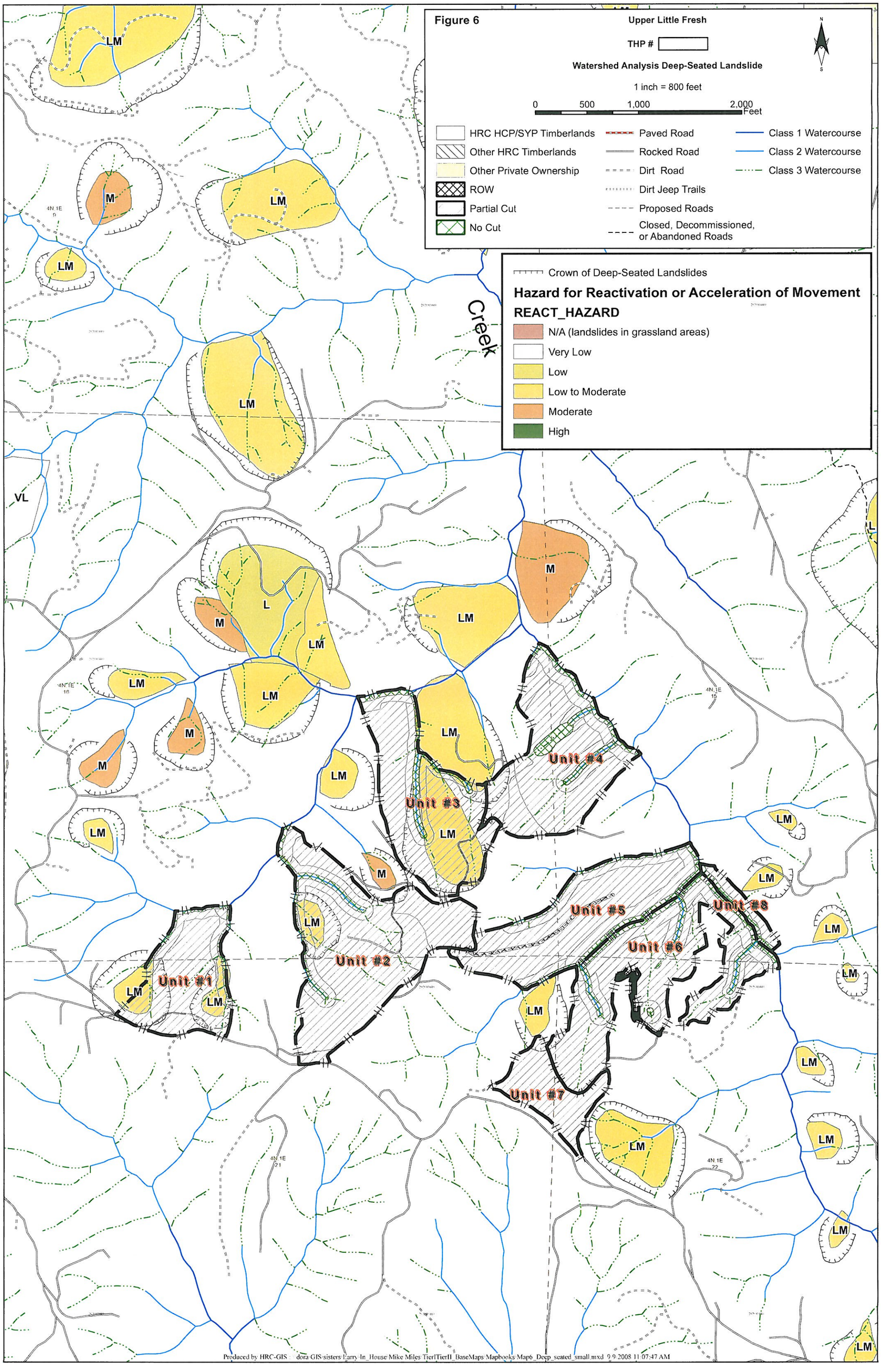
Figure 6
Upper Little Fresh
THP #
Watershed Analysis Deep-Seated Landslide
1 inch = 800 feet
0 500 1,000 2,000 Feet
HRC HCP/SYP Timberlands
Other HRC Timberlands
Other Private Ownership
ROW
Partial Cut
No Cut
Paved Road
Rocked Road
Dirt Road
Dirt Jeep Trails
Proposed Roads
Closed, Decommissioned, or Abandoned Roads
Class 1 Watercourse
Class 2 Watercourse
Class 3 Watercourse
Crown of Deep-Seated Landslides
Hazard for Reactivation or Acceleration of Movement
REACT_HAZARD
N/A (landslides in grassland areas)
Very Low
Low
Low to Moderate
Moderate
High
Creek
Unit #1
Unit #2
Unit #3
Unit #4
Unit #5
Unit #6
Unit #7
Unit #8
LM
M
L
VL
4N 1E 5
4N 1E 16
4N 1E 15
4N 1E 21
4N 1E 22
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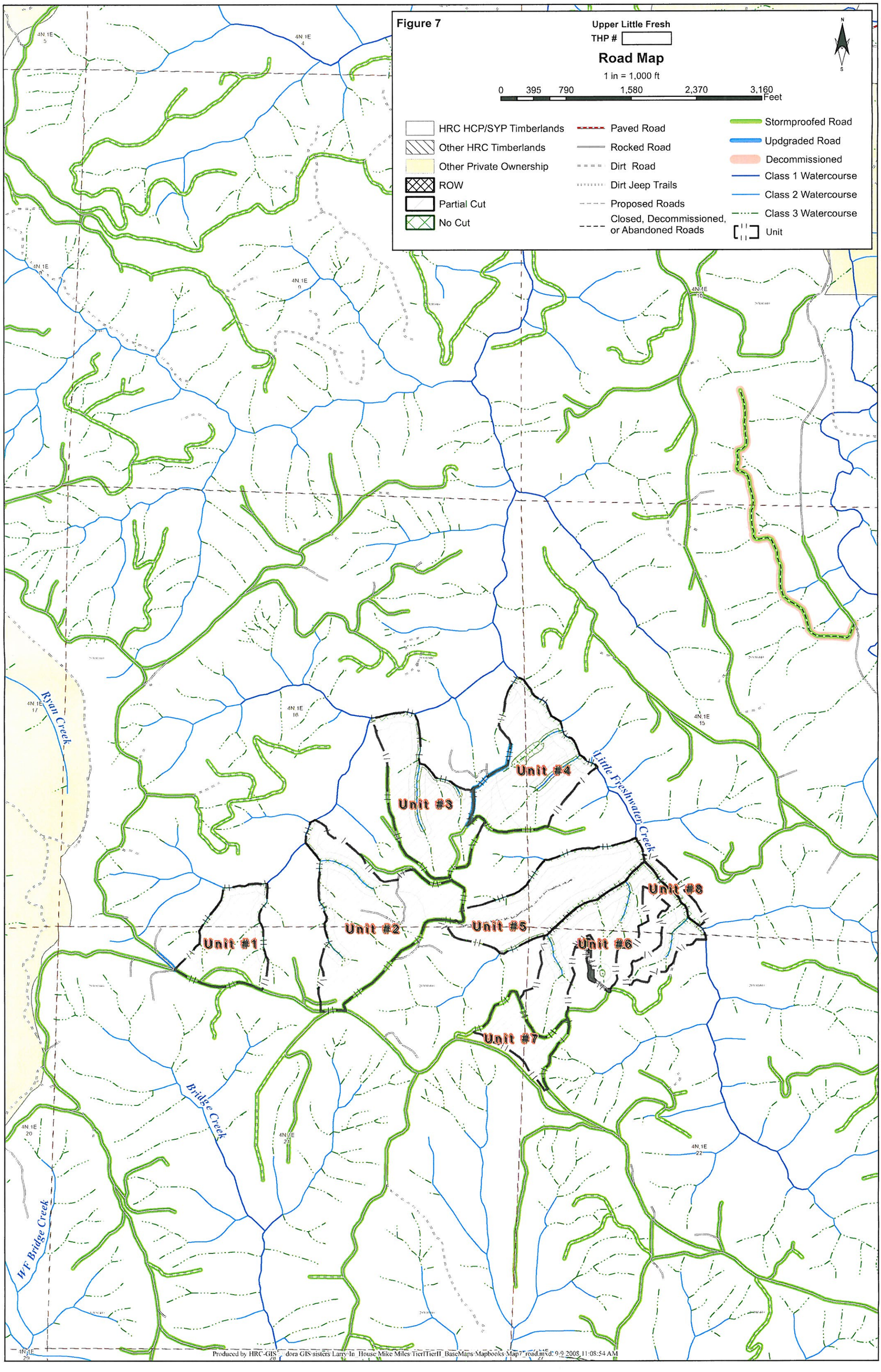
Figure 7
Upper Little Fresh
THP #
Road Map
1 in = 1,000 ft
0 395 790 1,580 2,370 3,160
Feet
N
S
HRC HCP/SYP Timberlands
Other HRC Timberlands
Other Private Ownership
ROW
Partial Cut
No Cut
Paved Road
Rocked Road
Dirt Road
Dirt Jeep Trails
Proposed Roads
Closed, Decommissioned, or Abandoned Roads
Stormproofed Road
Updgraded Road
Decommissioned
Class 1 Watercourse
Class 2 Watercourse
Class 3 Watercourse
Unit
Ryan Creek
Little Freshwater Creek
Bridge Creek
WF Bridge Creek
Unit #1
Unit #2
Unit #3
Unit #4
Unit #5
Unit #6
Unit #7
Unit #8
4N 1E 5
4N 1E 4
4N 1E 9
4N 1E 10
4N 1E 17
4N 1E 16
4N 1E 15
4N 1E 20
4N 1E 21
4N 1E 22
4N 1E 29
4N 1E 28
4N 1E 27
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