

ADIRONDACK LANDSLIDES: HISTORY, EXPOSURES, AND CLIMBING

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ABSTRACT

Rock, soil, and vegetation avalanche down the slopes of the Adirondack Mountains, especially the High Peaks, on a regular basis. These landslides occur most often in response to heavy rainfall events and saturated conditions. The first guides and explorers used slides as the path of least resistance en route to various summits. Some slides have received considerable interest because of their recreational potential, location and accessibility, recent activity, or the well exposed geological features they contain.

Tropical Storm Irene struck the region on August 28, 2011. It wreaked havoc on local communities, as well as, many areas of the backcountry. The deluge triggered over forty significant slides and countless minor ones, some of which are easily accessible. It thus opened up slide climbing to a wider audience and provided exceptional bedrock exposures for geoscientists interested in the Adirondack Region. The text below incorporates a short history of the slides and a sample of the more interesting Irene-related slides.

INTRODUCTION

Hurricane Irene made landfall in the United States as a Category 1 hurricane. The storm was down-graded to a tropical storm by the time the heaviest rain bands reached the Adirondacks on August 28, 2011. It was not the wind but the large volume of precipitation

over an afternoon that caused the most damage. Amounts totaled 7.55 inches on Whiteface Mountain (Stanne 2012) and up to 10 inches (in) in Keene (based on reports from local residents). I will focus my discussion on the eastern High Peaks (Figure 1) where the impact was greatest (Brown 2011).

This event had real implications for me and my wife, and we observed the East Branch of the Ausable River rise nearly a meter (m) in a few minutes. As a consequence, mature pine trees and propane tanks were removed from residents' yards and collided with the Route 73 bridge in Upper Jay. The Ausable crested over 3.35 meters (11 feet [ft]) above flood stage. It is estimated that the storm resulted in 62 billion gallons of water entering the Ausable River watershed due to rainfall totals exceeding 25.4 centimeters (cm; 10 in) (Brown 2011).

The water removed culverts, undermined roads, damaged bridges, and destroyed buildings. Damage from flooding in the nearby villages of Keene, Keene Valley, and Upper Jay was staggering. Trees with their root systems intact were torn from riverbeds and deposited on Route 73. Houses were shifted from foundations or flooded. Normally a small mountain stream, Styles Brook, carried a cabin downstream and lodged it under a bridge between Upper Jay and Keene. Governor Andrew Cuomo requested a major disaster declaration on August 28, 2011.

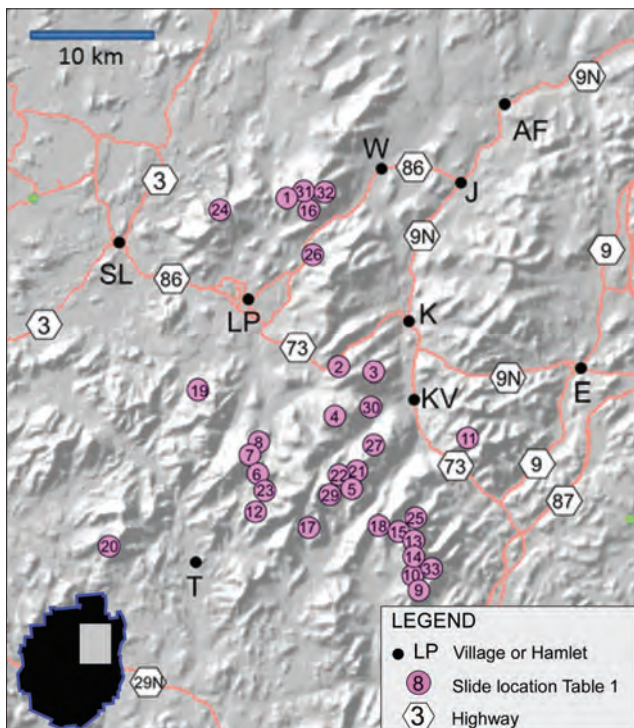


Figure 1: Location of historic and recent landslides mentioned in Table 1 and text. Numbers refer to Table 1. Background is a shaded relief map of the High Peaks Region. Village abbreviations include: AF – Ausable Forks; E – Elizabethtown; J – Jay; K – Keene; KV – Keene Valley; LP – Lake Placid; SL – Saranac Lake; T – Tahawus; W – Wilmington. Inset shows location of high peaks (grey rectangle) with respect to the Adirondack Park (dark) and boundary (blue).

Irene's greatest affects were felt on the afternoon of August 28, 2011; it was short in duration but extreme in intensity. Its effects were historically unprecedented and likened to a 100-year flood by many residents. The following days were chaotic and heartbreaking as the destruction of the event was fully realized and the scale of the human tragedy became apparent. Tropical Storm Irene's impact on the towns and villages has been well documented by the media, but the changes to the backcountry were also extensive.

In response, the Department of Environmental Conservation closed portions of the backcountry to assess the damage soon after the storm. These included the Giant Mountain Wilderness Area, Dix Mountain Wilderness Area, and the Eastern High Peak zone. Most were opened again by mid-September. Over the following months the infrastructure of the backcountry was slowly repaired: trails rerouted, ladders fixed, and bridges rebuilt. It was decided that breached dams at Duck Hole and Marcy Dam would not be repaired and that some trails, such as, the Southside Trail along Johns Brook would no longer be maintained.

In the weeks and months that followed, aerial photographs posted on the internet showed some of the changes to the Eastern High Peaks. There were a striking number of slides reported, yet photographers only captured a subset of them. My interest began as a simple question, "Which slides were new and which remained unmodified?" Figure 2 shows several slides triggered during Irene. Basin Mountain's *Northeast Shoulder* slide dominates the photo. Slides on Algonquin Peak, Wright Peak, and a ridge of Saddleback Mountain also show new activity.

Figure 2: A new landscape formed during Tropical Storm Irene. The 2011 slides are the lighter strips. Photo by author.



Gratefully no one died from the slides associated with Tropical Storm Irene. However, an article describing the “great flood” of 1830 in an 1872 issue of the *Plattsburgh Republican* was written by the mountain guide Orson Schofield Phelps. The opening paragraphs describe scenes that were similar to those that occurred during Tropical Storm Irene. The latter half of the article describes a slide and its effect on a local family.

Phelps wrote of incessant rains continuing for nine days washing away houses, business, and bridges. On the ninth day, a slide triggered in the Walton Brook Basin (44°13'49.4"N, 73°49'56.4"W) – the *Walton* slide. It killed a member of the Walton family, one of two brothers who lived near the brook. His wife, Lucy, was caught in the debris and survived for a time. She reportedly succumbed to injuries sustained during the event two years later (Phelps 1872). The article is a testament to the ever-changing nature of the landscape and to the powerful forces that sculpt it both slowly and during extreme weather events. Only remnants of the slide remain today, proof that nature reclaims even the most disrupted terrain and heals over time.

CHARACTERISTICS OF SLIDES IN THE ADIRONDACK HIGH PEAKS

Slides or debris avalanches like the *Walton* slide occur with some regularity; one might say frequently in terms of geologic time (see Table 1). History shows that they are generally triggered by intense precipitation falling over a short period of time (localized downbursts/hurricanes) or heavy rainfall over several days, thoroughly saturating the soil. The range of precipitation intensity varies from 10 cm in one hour to 56 cm over two days (Bogucki 1977). When the thin layer of soil covering the underlying bedrock becomes saturated on an area of sufficient slope, gravity can exceed frictional forces and slippage can occur, sometimes catastrophically. Soil, trees, and rocks can slide downhill at an amazing speed. Debris avalanches are most likely to occur on slopes between 17° and 44° though most form on slopes > 30° (Bogucki 1977). Small stream valleys or gullies draining higher elevations of sufficient slope seem especially susceptible to sliding.

Existing slides are often augmented in length, width, or in the number of converging slide tracks near their head walls, generally following the course of small tributaries or intermittent gullies. As discussed below, these additions to pre-existing slides commonly occur and, even if the change is significant, are not technical “new” slides but repeat offenders. Slides distinctly separated from a neighboring track are generally described as “new,” but an intriguing question is – are they truly new or simply a modern incarnation of an ancient landslide?

Tim Tefft suggests that the *Lake Placid* slide (44°21'55.1"N, 73°54'26.1"W) has probably re-occurred over thousands of years (Tefft 2011). If true, this puts “new” in a subjective context and accurate only when related to a human lifespan or initiation of settlement. For simplicity’s sake, I will continue using the term if a slide is distinct and not an enlargement of an existing slide, though “reactivated” may be a more accurate descriptor in most cases.

Historic photographs and aerial photographs also confirm that slides often reoccur in the same areas. Resources such as Google Earth aid with navigation as well as provide a limited set of historic aerial photographs. The timeline feature provides incremental imagery back to the 1990s. The pattern of trees on mountainsides and regrowth in disrupted streambeds indicate that landslides scars can gradually revegetate. Comparing photographs of recent slides to older images of the same area sometimes show the new slide located in roughly the same area as an older slide. The *Lobster Claw* slide (44°4'29.6"N, 73°46'55.2"W) located on the western aspect of the ridge between Dix Mountain and Hough Peak is a good example of a recurrent slide. It was created after Tropical Storm Irene during the early summer of 2013 as a result of heavy rains.

POST-SETTLEMENT HISTORY OF ADIRONDACK SLIDES

It is no secret that the easiest way to climb a mountain is via the path of least resistance. The slides provide such a path. While they may be precarious, ascending one is generally easier than bushwhacking through stiff, tightly woven evergreens that top the summit of many of the High Peaks. Following a stream to higher elevation often provides access to slides. The earliest guides and explorers—Phelps, Colvin, and Nye—used this to their advantage.

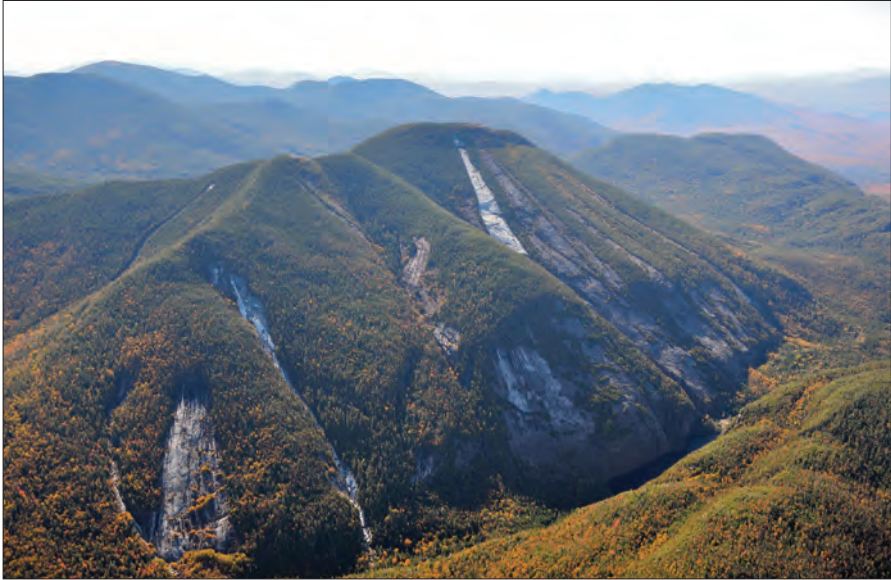
The first trail to Mt. Marcy's summit was cut from the southeast by the guide Orson Schofield Phelps in 1861. It ascended from Panther Gorge between Marcy and Haystack to Marcy's "great slide" (now called the *Old Slide* [44°6'24.7"N, 73°55'13.3"W]) on its southern aspect. The slab, though steep with some sections approaching 45° or more, effectively bridged the gap between the Skylight/Marcy drainage stream and Marcy's ridge. Russell M.L. Carson writes in *Peaks and People of the Adirondacks* that the trail "was eventually abandoned for a new route selected by Colvin, August 28, 1873." Trails are generally a safer option than climbing a slide; particularly when transporting heavy equipment such as that used for the initial surveys or during inclement weather.

On the southern face of Whiteface Mountain, we find another early trail that incorporated a slide, the *Lake Placid* slide, whose long gray path can still be seen from the village of Lake Placid. By most accounts, this formed (or more likely was enlarged) in the early 1800s. The generally low-angle southwest-facing scar comprised the final section of the first trail cut from Lake Placid around 1865 by Bill Nye (Hayes 1928). This too was abandoned when an alternative trail was cut.

Mt. Colden is one of the most slide-torn mountains of the High Peaks with tracks on nearly all of its aspects. Figure 4 shows a large concentration of slides on Mount Colden's northwestern flank. Adirondack surveyor Verplanck Colvin was descending Whiteface Mountain on August 20, 1869 during a thunderstorm that he described as one that "had not occurred for very many years" (Colvin 1869). Soon after, he learned of changes to Avalanche Lake at the foot of Mt. Colden. The Trap Dike, a large eroded gabbroic dike about 30 m

(100 ft) deep and over 18 m (60 ft) wide, was cleaned out. This was likely the birth or an enlargement of the *Colden* slide (44°7'50.1 N, 73°57'51.3"W), the largest slide that intersects the Trap Dike. It was the classic exit for those climbing the Trap Dike until 2011. Colvin's description of the denuded cleft bears a striking similarity to the changes wrought by Tropical Storm Irene.

Figure 3: Mount Colden's slide-torn northwestern aspect above Avalanche Lake. Photo by author.



A new slide formed on the western side of the Sentinel Range during July of 1932. “The slide began in a narrow wash not more than 15 ft wide and created the present denuded strip which is over 400 yards long” (*Lake Placid News* 1932). Two parties explored the slide within a week and described it as primarily a landslide as opposed to rockslide.

Six years later in the summer of 1938, several days of rain created a slide on the south-southeastern flank of Wright Peak (West 1940). Ranger Alton C. West climbed it soon after. He vividly described both how it was formed and the destruction he encountered. It has grown in at the base but still remains a popular slide climb known as the *Left Wing Airplane* slide (44°8'59.6"N, 73°58'42.0"W), in reference to a B-47 bomber that crashed into the peak during January of 1962. Pieces of the wreckage are strewn on the slide, both sides of the summit ridge, and on the summit proper. The *Right Wing* slide formed years later about 200 m (650 ft) to the east. Wright Peak is also known for three additional slides on its northeastern aspect – the *Angel* slides (44°9'18.3"N, 73°57'59.1"W). There are three in the set; two formed in 1999 and one in 2011.

One of the most notable slide arrays to both the casual observer and for the slide climbing community was enlarged after a localized cloudburst over Giant Mountain on June 29, 1963. Local climber Jim Goodwin reported eleven new or enlarged slides in the Fall/Winter 1963/64 issue of *Peaks* magazine. Activity was reported on the western cirque, northeastern and southeastern slopes, and on the ridge above Putnam Brook. The western cirque slides quickly gained popularity. The *Eagle* (44°9'33.8"N, 73°43'21.1"W) and *Bottle* (44°9'45.3"N, 73°43'31.5"W) slides are still classic climbs. In the valley below, Roaring Brook trapped several cars in floodwaters, gravel, and mud as it overflowed its banks (Joplin 2013). Slides along Roaring Brook, Giant Mountain, and above Roaring Brook Falls created additional exposures of an intrusion breccia first noted by Kemp (1921) and of considerable geologic interest (deWaard 1970; McLelland et al. 2016).

Hurricane Gloria moved over the region in 1985 and left Santanoni Peak with the 1.6 km (1 mi) long *Ermine Brook* slide (44°4'12.4"N, 74°8'42.7"W) on its southwestern flank. It was one of the longest slides at 1.6 km (1 mi) until 2011. While it has grown in over the years, it is a worthwhile, if not remote, scramble with a 17.7 km (11 mi) approach. Tropical Storm Floyd then struck the region on September 16, 1999. It brought heavy rains and destructive winds that created widespread blowdowns. The precipitation triggered over a dozen slides, some destined to become slide climbing and ski mountaineering classics. Several were enlarged by Tropical Storm Irene. These accounts are only a few examples of the myriad slides created over the years. Table 1 provides available information on slides that date back to the early eighteen hundreds.

Table 1: Information on historic and modern landslides in the Adirondack Region. Exact dates are noted when known. All slides listed are significant in length (>152.4 m [500 ft]). Neither the dates nor slide list are meant to be all-inclusive. Rather they are meant to demonstrate that the mountains are in a continual state of flux. Other weather events such as floods during 1864, 1893, and 1924 each involved sufficient precipitation to wash away bridges and cause extensive damage to the region. It is safe to conclude that slide activity accompanied many unlisted events.

DATE OF CHANGE	MOUNTAIN NAME SLIDE ASPECT	SLIDE EXAMPLE(S) NUMBER ON FIGURE 1	TRIGGER	REFERENCE
1808	Whiteface, SW	1) <i>Lake Placid</i> slide	n/a	(Chilson, George, Tucker, and Wheeler 2003)
1830	Cascade, NW; Porter Mtn. Ridge, NE; Big Slide, S	2) <i>Cascade</i> slide 3) <i>Walton</i> slide 4) Main face of Big Slide Mtn.	Nine days of heavy rain	(Watson, 1869; Phelps, 1872; Konowitz 2011)
1856, 9/30	Gothics, SE	5) Slide on "East" Face	Heavy rain	(Arnold 2011; Chilson, George, Tucker, and Wheeler 2003)
1869, 8/20	Colden, NW	6) <i>Colden</i> slide	Thunderstorm (or enlargement)	(Colvin 1869)
1932, 7/30 or 7/31	Kilburn, W	n/a	Heavy rain	(<i>Lake Placid News</i> 1932)
1938, Sum.	Wright, SSE	7) <i>Left Wing</i> slide	"Great Hurricane" of 1938	(West 1940)
1942, Sept.	Colden, NW	8) One or more western	Rainfall face slides	(<i>Ticonderoga Sentinel</i> 1942)
1947	Macomb, W	9) Multiple	Hurricane	(Eagan 2011)

DATE OF CHANGE	MOUNTAIN NAME SLIDE ASPECT	SLIDE EXAMPLE(S) NUMBER ON FIGURE 1	TRIGGER	REFERENCE
1950	Macomb, W	10) <i>Macomb</i> slide (into Slide Brook)	Hurricane	(Eagan 2011)
1963, 6/29	Giant, Rocky Peak Ridge, Multiple/ Each Peak	11) >12 Slides including: <i>Eagle, Bottle, Tulip, Question Mark, Finger, Dipper, East Face</i> (enlarged), NE slides, <i>Putnam Brook</i> slides	Isolated downburst	(Goodwin 1963)
1969, 8/17 (est.)	Cliff, SE	12) <i>Cliff</i> slide	n/a	(Healey 1969)
1970	Dix, W & WSW	13) <i>North Fork</i> 14) <i>South Fork</i> 15) <i>Hunters Pass</i> slides each enlarged	n/a	(Mellor 1997)
1971, 9/6	Whiteface, E & N cirques	16) Six <i>Ski</i> slides 17) Enlarged/1 near Wilmington Turn	Thunderstorm.	(<i>Adirondack Record- Elizabethtown Post</i> 1971)
1973, 6/23 (est.)	Nippletop, W	18) <i>Nippletop slide</i> (aka <i>Right to Life</i>)	Three days of heavy rain	(Healy 1973)
1979	South Meadow, n/a	n/a	n/a	(McMartin and Ingersoll 2001)
1983, 10/7	Nye, NNW	19) <i>Nye</i> slide	Earthquake	(Warren 2013)
1985	Santanoni, SW	20) <i>Ermine Brook</i> slide	Hurricane Gloria	(McMartin and Ingersoll 2001)
1990, 6/16	Multiple High Peaks	10 slides including 21) <i>Gothics True North</i> 22) <i>Finger</i> slides 23) <i>Colden (SE)</i> 1990	10 inches of rain in one night	(Silliman 1991)
1991	Moose, NW	24) <i>Moose Mtn.</i> slide	n/a	(Chilson, George, Tucker, and Wheeler 2003)
1993, Aug. (2nd week)	Dix; N, NW	25) Six Slides	Two days of heavy rain	(McConaughy 1997)
1995, Oct.	Kilburn, WNW; Lower Wolfjaw, NW	26) <i>Kilburn (aka Monument)</i> slide 27) <i>Bennies Root Canal</i> slide	Cloudburst	(Manchester 2005)
1996, June	Peak 3149 near Snowy Mtn., E	28) <i>Griffin Brook</i> slide * Not shown on Figure 1	n/a	(Chilson, George, Tucker, and Wheeler 2003)
1998, June	Saddleback	29) <i>South</i> Slide	Cloudburst	(Goodwin 2016)
1999, 9/16	Multiple High Peaks	12+ slides	Tropical Storm Floyd	(Peeks 1999)
2010	The Brothers, NE	30) <i>Brothers'</i> slide	n/a	
2011, 6/3	Whiteface, NE/SE	<i>Ski</i> slides 31) #.5 32) #2B	Storm	(Lynch 2011)
2011, 8/27	Multiple High Peaks, All	At least 40 > 152.4 m (500 ft long, undetermined number of smaller slides)	Tropical Storm Irene	
2013, late June or early July	Dix, W	33) <i>Lobster Claw</i> slide	Rainstorms	

SLIDES ORIGINATING DURING TROPICAL STORM IRENE

Tropical Storm Irene produced more slides than any storm in recorded history with at least 40 tracks measuring greater than 152.4 m (500 ft) in length including their runout. The longest (1.7 miles including the runout) lies on the northeastern aspect of Saddleback Mountain. The mountain's *Back in the Saddle* slide was enlarged with a new tributary dubbed *Catastrophic Chaos*, a name that has gained popularity despite it being an enlargement of *Back in the Saddle*. The *Northeast Shoulder* slide on the east-southeastern aspect of Basin Mountain's northeastern summit is one of the widest (nearly 500 ft near its base) in the 2011 set (see Figure 1). The northernmost significant outlier, *Cooper Kill* slide, avalanched on Wilmington Peak. The closest significant slide to a road is *Cascade* slide, the runout of which reaches Upper Cascade Lake between Keene and North Elba. Like the pre-existing slides, some of the 2011 creations are single track while others involve multiple tributaries converging downslope. Given the quantity of slides created it is unrealistic to describe each, but the following represent some of the most interesting created by the storm. Table 2 lists most of the significant Irene-related slides.

Figure 4: Mark Lowell examining the debris at the base of Basin Mountain's Northeast Shoulder slide. About two weeks after Tropical Storm Irene the smell of tannin and fresh wood was strong. Photo by author.



Basin Mountain: The 2011 damage to Basin Mountain in the heart of the Great Range, a combination of eight High Peaks and two lesser mountains, was vast. Prior storms have not been kind to this steep-flanked peak either. Tropical Storm Floyd added several scars to the mountain in 1999. Ten major and minor slides on multiple aspects were added to the collection in 2011. The most obvious of these lies on the east-southeastern aspect of the Basin's northeastern shoulder – the *Northeast Shoulder* slide (44°7'18.4"N, 73°52'33.6"W). It is divided into four

distinct sections from bottom to top: the runout, a 152.4 m (500 ft) wide technical slab (enlarged on the eastern side by about 45.5 m [150 ft]), a low angle mid-section, and a steep, yet textured, track that narrows to a gully at the top. In contrast to some of the slides, this is one of the most remote with an approach of 13.7 km (8.5 mi) from the Garden trailhead in Keene Valley. The walk is through some of the most rugged terrain of the High Peaks. For the effort, one finds 1006 m (3300 ft) of slide and runout with over 442 m (1450 ft) of elevation gain.

Cascade Mountain: *Cascade* slide (44°13'16"N, 73°51'59.1"W) on Cascade Mountain's northwestern aspect was widely reported on since it is easily visible from Route 73 in Keene. This area is of particular interest to geologists due to its unique high-temperature contact metamorphic minerals formed when a large block of marble was incorporated into anorthositic magma (Valley and Essene 1980). The most obvious are large boulders of blue calcite and green diopside located in its runout. A minor "T" shaped slide, likely the remnants of the 1830 slide, adorned the mountain until 2011. This now constitutes the top of the most recent incarnation of the *Cascade* slide.

Notable features of *Cascade* slide include a waterfall located a few minutes' walk above the lakes, excellent exposure of minerals in the stream bed, and walls above the falls and a large inset dike (approximately 45.5 m [150 ft] long, 1.2 m [4 ft] wide, and 3 m [10 ft] deep). While nearly all slides contain dikes, the dimensions and characteristics of this one make it unique. Easy access with a challenging start makes this a popular venue for scramblers, ice climbers, and photographers. A walk of 152.4 m (500 ft) from the isthmus between the Cascade Lakes leads to the runout. The total distance to the top of the slide is 1207 m (3960 ft) with 427 m (1400 ft) of elevation gain.

Mount Colden: The Trap Dike of Mt. Colden is an historic area used as the first known ascent route up Mt. Colden by Robert Clarke and Alexander Ralph in 1850 (Singer 2011). The dike was completely denuded of trees in 2011 by what was quickly named the *Trap Dike* slide (44°7'48.5"N, 73°57'44.2"W). It released on the northwestern aspect near the summit and stripped an ever-widening swathe of forest to the dike. A chock-stone the size of a small house sits in the Trap Dike and marks the bottom of the slide. On aerial photos, an apron of coarse debris can be seen extended outward from the lakeshore where the runout entered Cascade Lake. The approach to the slide base is just over 8 km (5 mi) from Adirondack Loj and involves climbing the Trap Dike to an elevation of 1173.5 m (3850 ft). The slide length is 548.5 m (1800 ft) with 259 m (850 ft) of elevation gain.

Dix Mountain: Like Mt. Colden, Dix hosts dozens of slide tracks on multiple aspects. The *Buttress* slide (44°4'58.5"N, 73°48'0.8"W) on Dix Mountain's western slope is particularly impressive because of its location and steep slope. The track avalanched

down a cliff-riddled area of Hunters Pass, a narrow pass described by Alfred Billings Street in *The Indian Pass* as one of four gorges that are “peerless in majesty and awful beauty” (1869). Many slides can be easily climbed with appropriate caution and equipment, however, here the slope and features – cracks, corners, and twin roofs at its base—make it a technical slide rated 5.4 on the Yosemite Decimal System of rating. The approach to the base is just over 8.85 km (5.5 mi) from the Elk Lake trailhead. The slide length is 442 m (1450 ft) with 274 m (900 ft) of elevation gain.

Lower Wolfjaw Mountain/Upper Wolfjaw Mountain: Various aspects of these neighboring High Peaks were affected by the storm. The watershed draining these slopes contributed to severe damage to the Johns Brook River Valley and along the Ausable River. Figure 5 shows the long slides on the Johns Brook side of Lower and Upper Wolfjaw Mountains. The bottom right track nearly destroyed a lean-to which was later moved to a location farther from the brook.

Bennies Root Canal slide (44°9'30.5"N, 73°50'7.7"W) on Lower Wolfjaw Mountain's northwestern aspect quickly became a classic venue for scramblers, skiers, and the occasional geologist (Chiarenzelli et al. 2015). Relatively easy access and a long length combined with a moderate slope contribute to its popularity. Low-angle slab dominates until the confluence of three tributaries (two from 1995). The terrain then steepens. The mid-section hosts an abundance of dikes, xenoliths, and other geologic features. A moderate walk of 3.86 km (2.4 mi) from Keene Valley's Garden Trailhead leads to the bottom of the runout. The slide and runout length is 2.09 km (1.3 mi) with 564 m (1850 ft) of elevation gain.

Khyber's slide (44°9'8.3"N, 73°50'25.2"W) is an adjacent track that lies over a ridge to the southwest. It is similar in character on its lower portion but hosts two large “steps” or steep drops in the slide. Those looking for early season ice to climb are likely to find it here. The runout of *Khyber's* slide crosses the Southside Trail a short distance to the southwest of *Bennies Root Canal*. The runout is not as clean as *Bennies Root Canal*, but a length of 2.25 km (1.4 mi) with approximately 457 m (1500 ft) of elevation gain makes it worth exploring.

The neighboring Upper Wolfjaw Mountain hosts several enlarged slides on its northwestern ridge that share a common runout with *Khyber's* slide. The uppermost track, the *Skinny* slide (44°8'35.1"N, 73°50'36.3"W), is an enlarged track of Tropical Storm Floyd in 1999. It has a longer approach and contains two features of note: a large dike dissecting the runout and a crevice about halfway up the slide proper. The crevice was created when a large piece of the face displaced and slid about a meter. Climbers can wriggle through the fissure and exit onto the slab above. Starting at the Garden Trailhead, an approach of 6.8 km (4.25 mi) leads to an 853 m (2800 ft) runout and slide track with 289.5 m (950 ft) of elevation gain.

Figure 5: Photograph of Fall foliage and the long ribbons of Bennies Root Canal slide and Khyber's slide in the foreground with Giant Mountain's 1963 western cirque slides in the background. Photo by author.



Saddleback Mountain: Several slides, large and small, were created in close proximity along Orebed Brook on Saddleback Mountain and Gothics, its neighbor. The northeastern aspect *Back in the Saddle* slide ($44^{\circ}7'38.2''\text{N}$, $73^{\circ}52'23.2''\text{W}$) had a large tributary dubbed *Catastrophic Chaos* ($44^{\circ}7'41.1''\text{N}$, $73^{\circ}52'22.1''\text{W}$) intersect it high on the climber's right. The tributary is almost 61 m (200 ft) wide at its widest point. It is the longest track in the Adirondacks including the slide proper and disrupted streambed. Nearby slides destroyed portions of the Orebed Trail, but this track runs adjacent with the trail and ends near the Orebed Lean-to. Moderately easy access

and a long challenging slide with an interesting runout make it a popular destination for more experienced scramblers. The distance from the Garden Trailhead to the runout at the lean-to is 7 km (4.4 mi). The entire track is 2.7 km (1.7 mi) long with 527 m (1730 ft) of elevation gain.

Wilmington Peak: Two steep headwalls of anorthosite were exposed on the northeastern flank of the peak in 2011. The slide then trends to the east. The *Cooper Kill* slide (44°26'1.6"N, 73°50'26.8"W) is notable as the northern outlier of the significant slides. Most of the runout is choked with rubble and other debris, but the headwall is a challenging climb with bailout options to the right. On a geologic note, it is also the only slide on which I have located a fossil—a gastropod in a small piece of displaced limestone, attesting to the power of ice to transport and deposit materials both laterally and, in this case, vertically. Those wanting to explore it only need only walk 2.8 km (1.75 mi) from the trailhead along Bonnieview Road in Wilmington. The slide and runout length is 1.6 km (1 mi) with 457 m (1500 ft) of elevation gain.

Table 2: Select Tropical Storm Irene related slides. This table represents over 50 significant (>152.4 m [500 ft] in length) and minor slides.

MOUNTAIN	SLIDE DETAILS
Algonquin	Enlarged a slide in the <i>Northeast Bowl</i> (44°8'49.2"N, 73°58'53.7"W) and stripped Wright Brook's streambed.
Basin	Created the <i>Northeast Shoulder</i> slide (44°7'18.4"N, 73°52'33.6"W) on ESE aspect of NE shoulder. Multiple new and enlarged slides in <i>Chicken Coop</i> slide array (44°7'34.6"N, 73°52'52.3"W) on the N aspect of Basin's NE shoulder. Created NW slide (44°7'21.0"N, 73°53'36.9"W) on Basin's NW summit (Haas, 2016). Created several small slides (44°6'59.2"N, 73°52'44.6"W) on Basin's ridge S of the <i>East Face</i> . These slid into <i>East Face</i> run-out (44°7'5.5"N, 73°52'36.5"W) which was stripped to the <i>Northeast Shoulder</i> slide runout.
Blake	Created three new slide tracks low on ESE aspect (44°4'45.8"N, 73°50'15.9"W).
Cascade	Created <i>Cascade</i> slide (44°13'16"N, 73°51'59.1"W) on NW aspect from pre-existing "T" shaped slide.
Colden	Created the <i>Trap Dike</i> slide (44°7'48.1"N, 73°57'44.2"W) on NW aspect near summit. <i>Trap Dike</i> stripped of vegetation from 3,850' in elevation to Avalanche Lake. Enlarged <i>Crucifyer</i> slide (44°8'11.4"N, 73°57'32.8"W) in NW gully enlarged to trail. Created small slide (44°8'9.3"N, 73°57'38.2"W) on NW aspect of NE Shoulder. Created <i>Colden Cooler</i> slide (44°7'51.8"N, 73°57'10.3"W) on NE flank of Colden's NE Shoulder.
Dix	Added a tributary (44°4'51.6"N, 73°47'2.6"W) to the north of old <i>Beckhorn</i> slide on E aspect of mountain. Created <i>Buttress</i> slide (44°4'58.3"N, 73°47'58.6"W) on W aspect of Dix' SW buttress. Enlarged <i>Hunters Pass</i> slide (44°5'3.6"N, 73°47'39.3"W) on W with two small tributaries along S edge.

Giant	Enlarged <i>Putnam Brook</i> slide (44°9'53.4"N, 73°44'8.4"W) below Giant's NW shoulder.
	Enlarged <i>Northeast</i> slides (44°10'3.0"N, 73°43'8.9"W)—new tributary on W side and enlarged E tributary.
	Enlarged <i>Tulip</i> slide (44°9'23.7"N, 73°43'43.8"W) in WNW aspect in the W cirque).
	Enlarged <i>Eagle</i> slide drainage in W cirque (44°9'31.2"N, 73°43'31.3"W).
Gothics	Created NW aspect slide in <i>Orebed</i> slide array (44°7'38.2"N, 73°51'55.0"W) E of Orebed Trail.
Lower Wolfjaw	Enlarged <i>Bennies Root Canal</i> slide—new tributary descends N from summit; stripped runout NW to Johns Brook.
	Created tributary <i>Khyber's</i> slide; runs NW to Johns Brook.
Macomb	Enlarged multiple slides W/SW of summit (44°3'2.6"N, 73°47'6.9"W).
Marcy	Created a small slide (44°6'39.9"N, 73°54'53.4"W) between the <i>East Face</i> slab and <i>Grand Central</i> slide.
Saddleback	Created the <i>Catastrophic Chaos</i> tributary of the <i>Back in the Saddle</i> slide (44°7'39.5"N, 73°52'25.1"W).
	Created a slide (44°7'40.2"N, 73°52'19.1"W) to the E of the <i>Back in the Saddle</i> slide.
	Created several smaller slides (44°7'39.1"N, 73°52'13.2"W) between <i>Back in the Saddle</i> and the <i>Orebed</i> slides.
	<i>Orebed</i> slide (44°7'45.1"N, 73°52'4.1"W) on NNE aspect enlarged from a minor pre-existing exposure; intersects the Orebed Trail.
	Created three slides (44°7'14.8"N, 73°52'8.8"W) on SE aspect of Saddleback's S ridge.
Tabletop	Created a slide on NNE aspect (44°9'17.8"N, 73°54'23.8"W) centered between Tabletop and Phelps Mountain. Old slide track had regrown.
	Created a slide S of Howard Mountain on NE aspect of ridge (44°8'56.6"N, 73°53'21.2"W).
Upper Wolfjaw	Enlarged <i>Skinny</i> slide on NW ridge along its E side (44°8'35.5"N, 73°50'37"W).
	Enlarged the <i>Wide</i> slide on NW ridge (44°8'48.1"N, 73°50'54.4"W). New slab was exposed at the bottom and along E and W sides of upper slab. Runout intersected the Range Trail and Southside Trail.
	Created a N aspect slide (44°8'54.4"N, 73°50'40.3"W) between <i>Skinny</i> and <i>Wide</i> slides.
	Created <i>Beaver Brook</i> slide (44°8'13.7"N, 73°50'38.5"W) on S aspect. Runout turns E.
Wright	Created new <i>Angel</i> slide (44°9'21.5"N, 73°58'1.9"W) on NE aspect adjacent to and NW of the 1999 <i>Angel</i> slides.
Wilmington Peak	Created <i>Cooper Kill</i> slide (44°26'1.6"N, 73°50'26.8"W) on NE aspect. Runout turns E.
	Created small slide (44°25'59.5"N, 73°50'27.0"W) adjacent to headwall of <i>Cooper Kill</i> slide.

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GIANT'S WASHBOWL WITH THE FIRST FROSTING OF SNOW ON THE GREAT RANGE

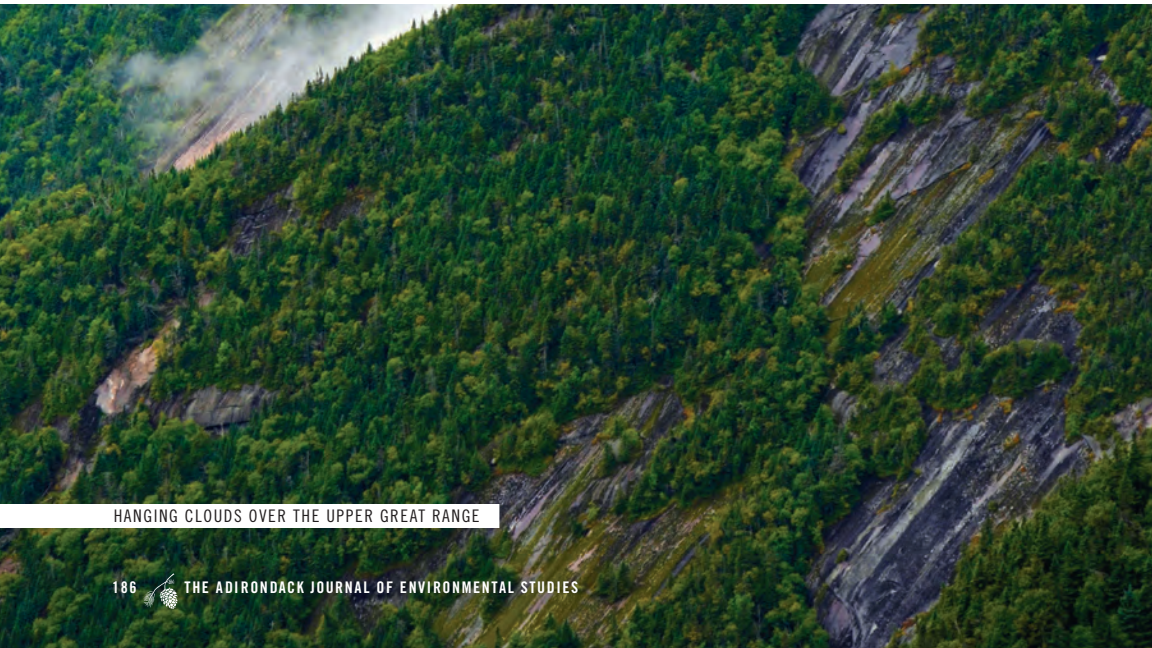




“I am greatly indebted to the writings of previous geologists in this region, and the present paper is in part a ‘re-interpretation’ of the geology based on additional quantitative data and developed in the light of geologic thought at the present time.”

Arthur Francis Buddington

**EXCERPT FROM HIS MEMOIR *ADIRONDACK IGNEOUS ROCKS AND THEIR METAMORPHISM*
1939**



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