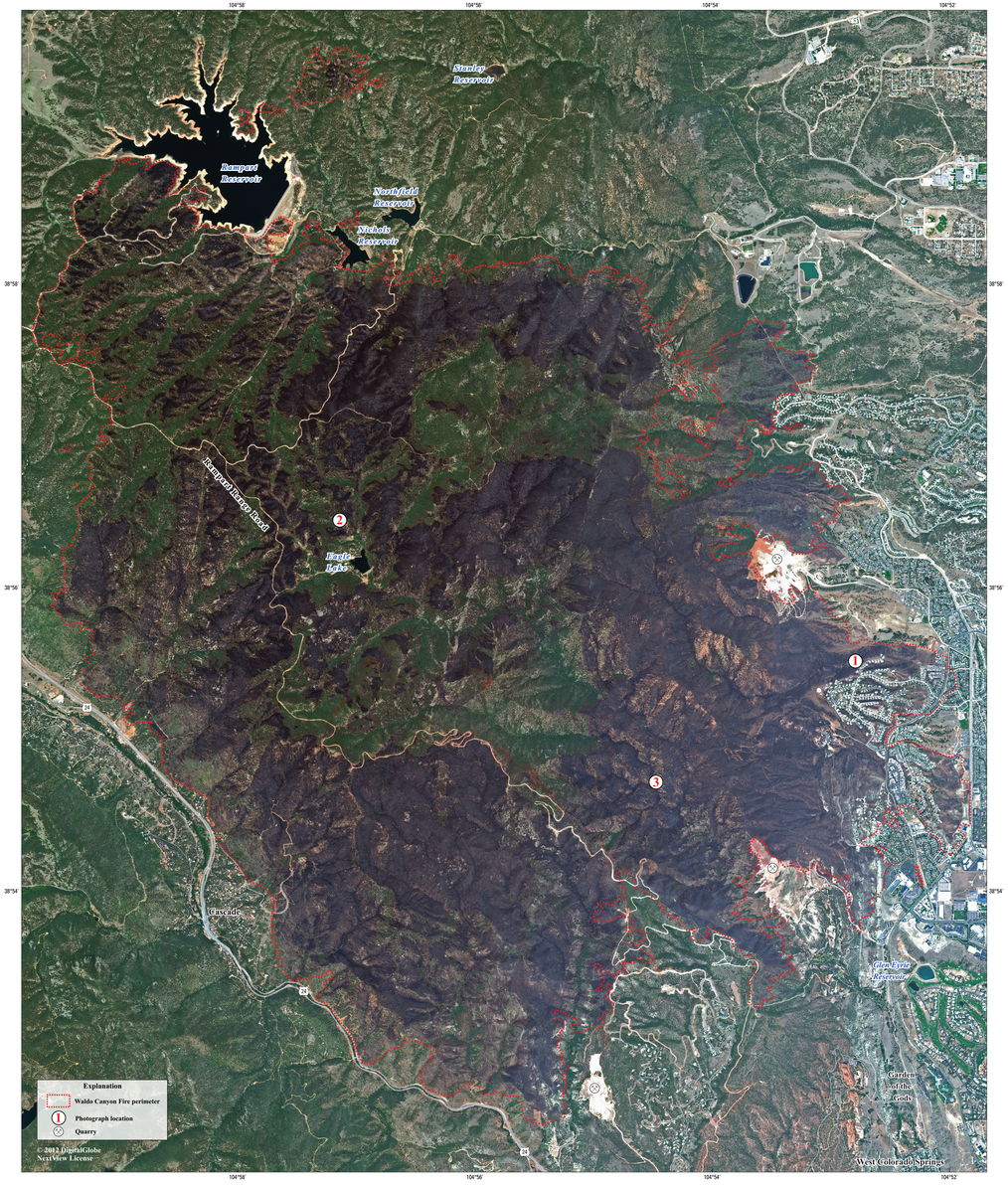
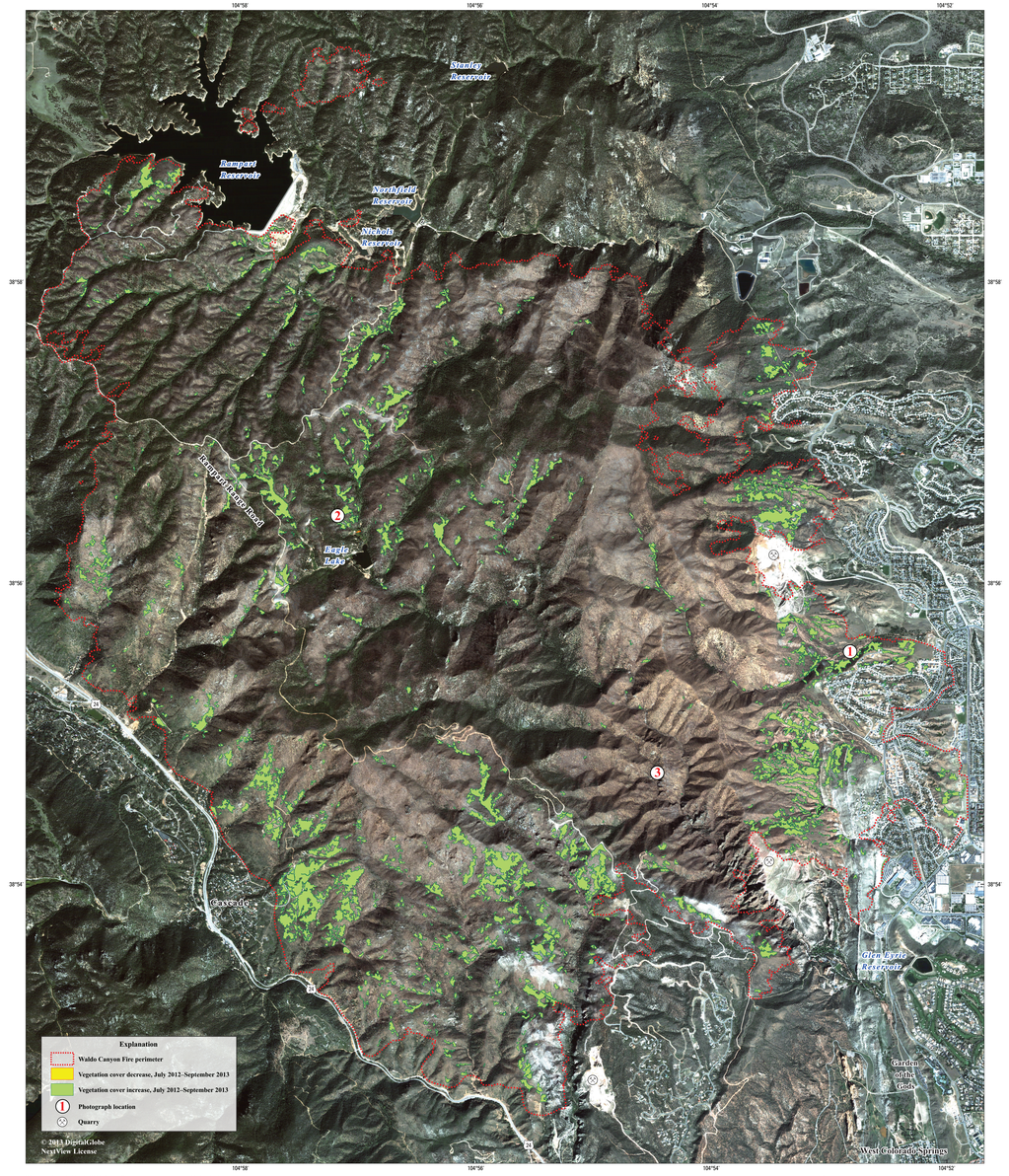
U.S. Department of the Interior
U.S. Geological Survey

Open-File Report 2014–1078



Images produced from © DigitalGlobe July 4, 2012 WorldView-2 and September 25, 2013 QuickBird data.
These datasets have been orthorectified using USGS 10-m NED DEM information to improve spatial accuracy.
Multispectral Red (Band 3), Green (Band 2) and Blue (Band 1) shown
UTM projection, Zone 13N, World Geodetic System of 1984 (WGS84)

Satellite image of Waldo Canyon burn scar near the conclusion of the fire event, collected July 2012



White areas located within the Waldo Canyon Fire perimeter represent exposed, highly reflective (bright tone) soil and rock. Vegetation cover in these areas was consumed during the fire event. To highlight this change (compared to the left) because some of the colored vegetation material has been removed. These areas do not have a colored polygon because either (1) the threshold criteria for "vegetation cover decrease" (70 percent) was not met on the image or (2) vegetation cover did not positively or negatively change between the two images.

Satellite image of Waldo Canyon burn scar (post-fire), collected September 2013

Use of Satellite Imagery to Identify Vegetation Cover Changes Following the Waldo Canyon Fire Event, Colorado, 2012–2013

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2014

SUMMARY

The Waldo Canyon Fire of 2012 was one of the most destructive wildfire events in Colorado history. The fire burned a total of 18,247 acres, claimed 2 lives, and destroyed 347 homes (Deam, 2013; Meyer, 2013). The Waldo Canyon Fire continues to pose challenges to nearby communities. In a preliminary emergency assessment conducted in 2012, the U.S. Geological Survey (USGS) concluded that drainage basins within and near the area affected by the Waldo Canyon Fire pose a risk for future debris flow events (Verdin and others, 2012). Rainfall over burned, formerly vegetated surfaces resulted in multiple flood and debris flow events that affected the cities of Colorado Springs and Manitou Springs in 2013. One fatality resulted from a mudslide near Manitou Springs in August 2013 (Lackey, 2013). Federal, State, and local governments continue to monitor these hazards and other post-fire effects, along with the region's ecological recovery.

At the request of the Colorado Springs Office of Emergency Management, the USGS Special Applications Science Center developed a geospatial product to identify vegetation cover changes following the 2012 Waldo Canyon Fire event. Vegetation cover was derived from July 2012 WorldView-2 and September 2013 QuickBird multispectral imagery at a spatial resolution of two meters. The 2012 image was collected after the fire had reached its maximum extent. Per-pixel increases and decreases in vegetation cover were identified by measuring spectral changes that occurred between the 2012 and 2013 image dates. A Normalized Difference Vegetation Index (NDVI), and Green-Near Infrared Index (GRNIR) were computed from each image. These spectral indices are commonly used to characterize vegetation cover and health condition, due to their sensitivity to detect foliar chlorophyll content. Vector polygons identifying surface-cover feature boundaries were derived from the 2013 imagery using image segmentation software. This geographic software groups similar image pixels into vector objects based upon their spatial and spectral characteristics. The vector dataset was then populated with the per-pixel spectral change information to provide an estimated percentage of vegetation increase or decrease of pixels within each polygon. Information collected during a field visit to the Waldo Canyon burn scar in September 2013 was used to help validate this assessment (see photographs 1–3). The numbers on the satellite images correspond to the location of the photographs.

For display purposes, the polygons shown on the map represent areas where significant decrease or increase in vegetation cover occurred. Only polygons that held a 70 percent or greater cover change are shown on this map (a GIS dataset with complete information is available upon request). A significant increase in vegetation cover was found in the burned area. This increase is likely due to the growth of grasses and other herbaceous vegetation. Minimal vegetation cover decrease was detected at this threshold. This product is meant to provide a broad survey of post-fire vegetation trends within the Waldo Canyon burned area to Federal, State, and local officials. It is not designed to quantify species-level vegetation change at this time.

REFERENCES CITED

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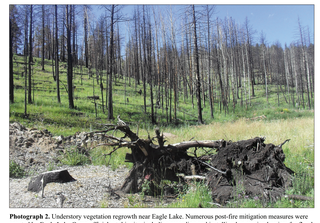
Lackey, Katherine, 2013, 1 dead, 3 missing in Colo. mudslide, flash floods: USA Today, accessed on January 3, 2014, at *http://www.usatoday.com/story/news/nation/2013/08/10/manitou-springs-colorado-floods/2658419/*.

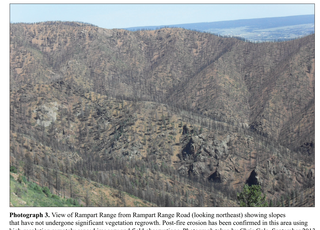
Meyer, J. P., 2013, Waldo Canyon fire: A year later, life returning to normal: The Denver Post, accessed on January 21, 2014, at *http://www.denverpost.com/wildfires/ci_23539749/waldo-canyon-fire-year-later-life-returning-normal*.

Verdin, K.L., Dupree, J.A, and Elliott, J.G., 2012, Probability and volume of potential postwildfire debris flows in the 2012 Waldo Canyon Burn Area near Colorado Springs, Colorado: U.S. Geological Survey Open-File Report 2012–1158, 8 p.

Photograph 1. Understory vegetation regrowth near the Flying W Ranch. A sediment detention basin constructed by the Flying W Ranch and the city of Colorado Springs to minimize flood effects is visible in the foreground. Photograph taken by Chris Cole, September 2013.



Photograph 2. Understory vegetation regrowth near Eagle Lake. Numerous post-fire mitigation measures were enacted by Eagle Lake Camp officials at this site, including reseeding and installing log erosion barriers for flood control. Photograph taken by Chris Cole, September 2013.



Photograph 3. View of Rampart Range from Rampart Range Road (looking northeast) showing slopes that have not undergone significant vegetation regrowth. Post-fire erosion has been confirmed in this area using high-resolution remotely sensed imagery and field observations. Photograph taken by Chris Cole, September 2013.

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