Site Selections and Topographic Design for Enduring Through Mountain Floods in Light of *Feng-shui*

Ping Xu
University of Colorado Boulder

This research explores safety for residing and enduring mountain floods. The research method includes following components: 1) studying geomorphic concepts of mountain floods and debris flows; 2) field investigations of the 2013 flood high impact zones and the optimal areas in foothills of Colorado Front Range to identify landform patterns in light of feng-shui, Chinese geomancy; and 3) studying successful precedents withstanding mountainous floods. From large-scale site selections to details of topographic design, this cross-culture study provides criteria and strategy on improving the site selection process for enduring mountain floods and sustaining mountain communities in Colorado and beyond.

Keywords: mountain floods, debris flow, landform patterns, site selection, topographic design, feng-shui

INTRODUCTION

Some people think that it is better to reside in mountain areas to avoid floods. In actuality, mountain residents can experience floods, and mountain floods can be more dangerous. Mountain floods, also called flash floods, are multi-faceted events including debris flows, postfire sequence, landslides, mudslides, post-fire factors, and overflows. This paper will mainly discuss debris flows, which can be a deadly disaster developing in areas with certain landforms, and overflows, which commonly occur in the mountains during intense and heavy rainfall.

As a professor of environmental design and consultant in *feng-shui*, as well as a Boulder mountain resident of 20 years, the author has conducted research on landscape settings and site selections. *Feng-shui*, or Chinese geomancy, is an ancient Chinese practice used to harmonize people with their environment between Heaven and Earth. This research method includes three components: first, studying geomorphic concepts of mountain floods and debris flows; second, investigating the 2013 flood high impact zones and the optimal areas in the foothills of the Colorado Front Range to identify the landform patterns in light of *feng-shui*; and third, exemplifying successful precedents of topographic design that withstood flood risks. Studying the impact areas of 2013 historic floods through *feng-shui* provides the base for this research, leading a path to improve strategies to endure mountain floods. Suitable site selections, as well as efficient topographic design and drainage systems, would benefit the resilience of mountain communities by preventing and protecting residents from possible future flood risks.

Extreme climate patterns in recent decades have often led to natural disasters. From September 9th – 15th of 2013, a historic flood struck Boulder and its surrounding communities. The violent power of the flood destroyed houses, roads, and bridges, wiped out small towns, re-routed creeks and streams, and took several lives. This flood was primarily caused by a week's worth of heavy rain over complex mountain

terrains and steep landforms in the foothills of the Rocky Mountains. This historic flood exposed the existing problems residences have developed, as the houses destroyed by the flood presented evidence of failures in site selections. Mountain floods have been researched less over time. The floods occur in remote areas with rugged terrains, and roads can be destroyed during hazardous weather, which increases the difficulty of field investigations (Takahashi, 1991). Moreover, education of site analysis does not provide enough knowledge for mountain floods, and scientific knowledge is only superficially considered. It is well known that high-intensity rainstorms trigger debris flows, but their spatial distribution appears to follow a pattern that has not been well researched (Lorente et al., 2002).

The mountain population has been increasing due to air pollution in metropolitan areas. Building techniques stretch roads to remote regions and elevations, and reliable four-wheel vehicles make all-season driving available. Moreover, many people have a fantasy of living in a mountain community with beautiful views and seclusion. The increasing residential population, dense development, and frequency of fires have changed these vulnerable mountain systems, generating additional debris and accelerating erosion. With recent extreme weather patterns, these mountain hazards are likely to occur more often. In addition, more people are moving into the zones susceptible to natural hazards, which aggravates negative impacts further. Both increasing populations and frequent hazards make the research of mountain floods essential and urgent.

Repairing damages of the 2013 floods have cost the government approximately five hundred million dollars in disaster recovery and reimbursements (Lounsberry, 2018). These recovery efforts often involve reconstructing damaged homes on their original property. Meanwhile, other residents who experienced overflows have repaired their homes with the reimbursements, but have not addressed the drainage issues of their sites. Without dealing with the site issues that have initiated damages, mountain communities located in these high impact areas remain at risk for future mountain flooding and disasters.

Debris Flow and Postfire Issues

A debris flow is one of the most dangerous natural hazards (Costa, 1987). Debris flows begin with a dense combination of mud and stone, increasing in solid concentration and size when proceeding downstream, and finally developing into a fast-moving debris flow (Takahashi,1991). During intense and heavy rain, a debris flow comes with great power from higher elevations. Debris flows can reach speeds of up to 100 mph, and the initial debris walls can be up to 30 feet tall, quickly destroying homes and taking lives (King, 2018). Debris flow impact areas are often not recognized in the known floodplain zones. There can be both major and minor debris flow events. Major debris flows have often been recognized and mitigated by scientists and local governments (Li, 2004), while minor debris flows typically occur from local hills and can go unnoticed. All types of debris flows have the potential to be deadly.

Debris flows following mountain fires are common but rarely researched (Wells, 1987). In the canyons of the Colorado Front Range, every high-impact zone has experienced a fire prior to flooding, most often occurring within two years of one another. The fire burns vegetation from the mountainsides, killing the groundcover and loosening debris. After two years, the roots of burned plants have died. During heavy rain, the dead trees fall more easily, levering out the soil and producing debris. Geomorphic research indicates that in a debris flow, a large amount of heavy timber is involved in causing landslides and destroying property (Reneau and Dietrich, 1987).

The author's field investigations indicate that the high-impact zones have always involved debris flows. The characteristics of the bedrocks and soil in the Rocky Mountains provide abundant debris—the bedrocks are often exposed, the soil is thin, and roots grow shallow, causing trees to fall easily. Mountain fires occur frequently. During intense and heavy rain, debris flows are common occurrences in the canyons of the Colorado Front Range (Xu, 2017).

The impact areas of overflows commonly occur on mountain slopes. Debris flow impact areas can include the debris fan, an area located at lower elevations, gentle plains, and the areas surrounding rivers or lakes. When a debris flow runs into a body of water, water levels rise, causing flooding. Debris flow can also occur at higher elevations, where the slope drastically changes (Xu, 2018). By using *feng-shui* as

a clue, this paper will discuss the methods and strategies to endure through mountain floods, from large-scale to small-scale, from site planning to topographic design.

FENG-SHUI PRACTICE OF SITE SELECTION FOR AVOIDING RISKS OF MOUNTAIN FLOODS

Chinese populations have inhabited mountain regions for thousands of years. Today, about 1.3 billion people, as well as two-fifths of the cultivated land, are distributed in the mountainous areas of the country. China has a long tradition of recording debris flows that have destroyed villages and killed tens of thousands of people, dating from 186 BC until the current time (Li, 2004). These mountain disasters have been crucial to teach people how to avoid site selection in mountain flood zones, and adequately select favorable sites that are optimal for survival.

China's survival experiences for thousands of years are primarily summarized in *feng-shui* practice. *Feng-shui* is practiced in selecting good timing, a suitable place, and supportive partners to sustain people's lives and societies. *Feng-shui* has many schools; particularly prominent is the "form school," which deals with landforms of special categories, including "mountains," "hills," "water," "site," and "orientation," to select favorable sites and avoid disaster. *Feng-shui* methods practice on many scales, large to small, looking from mountain ranges to cities, as well as homes and even graveyards.

Figure 1 shows a late Qing Dynasty illustration of the practice of selecting a townsite, which is an excellent example of the *feng-shui* approach (Eitel, 1873). In this picture, the official is leading a group: a *feng-shui* master consulting his compass, another checking the *feng-shui* manual, and the workers analyzing the soil and water.

FIGURE 1
A LATE QING DYNASTY ILLUSTRATION OF THE PRACTICE OF SELECTING A TOWNSITE

Source: Eitel, 1873

When dealing with the increasing hazards in mountainous areas, some vernacular siting methods may provide wisdom. Adaptations to natural laws are directed towards enhancing life by promoting harmony between humans and nature (McHarg, 1971). Though destructive, the historic 2013 flood in Colorado provides a unique opportunity for research on mountain flooding, demonstrating the evidence of impact

zones and survival areas. Based on geomorphic studies and the author's field investigations of the 2013 Colorado flood and debris flow zones, the discussion of landform patterns for site selection emphasizes three areas: the debris catchment, the debris flow track, and the debris flow fan/impact area (Onda, 2004; Clark, 1987; and Reneau & Dietrich, 1987). By combining geomorphic concepts with *feng-shui* criteria, this paper will discuss the methods and strategy used in site selections for avoiding zones susceptible to debris flows and overflows and choosing optimal areas to endure mountain floods.

Debris Catchment -- Accumulating Debris and Run-off

The debris catchment includes the hillsides of basins and canyons, where debris and run-off accumulate, and debris flows initiate. After a fire takes place in a debris catchment area, the available sources of debris increase. More importantly, wildfires change the structure of the soil, creating a waterproof layer. This change accelerates the erosion process, altering the debris track to be straight and defined. This combination of environmental factors effectively accelerates and fuels debris flows, making them more powerful, and worsening their overall impact.

Feng-shui refers to the debris catchment area as the "dragon." In particular, *feng-shui* recommends avoiding any mountain basins containing abundant debris, which are called the "sick dragon," or canyons with steep slopes and narrow channels, which are called the "violent dragon" (Qiu, 1995). An example of a *feng-shui* identified "violent dragon" is the Big Thompson Canyon in Colorado. Several houses along this canyon were destroyed during the 2013 flood. Hills with constant steep slopes, called "hills without veins," are subject to frequent flooding (Liu, 1986). Such a site can accumulate run-off and cause overflowing to houses during heavy rainfall. During the 2013 Colorado floods, water commonly overflowed into people's homes on the sides of mountain slopes.

Debris Flow Track--Developing Zone of Debris Flow

The second zone is a debris flow track, which often presents as a water channel such as a gully, dry wash, or creek, where debris events can develop. Flows generate their power by having a high volume of debris from a broad catchment pass through a narrow debris track. The debris can wash together and form small dams. During heavy rain, these dams eventually break and flush downhill, generating great power, and developing into a full debris flow (Cui, 2012).

Feng-shui practice pays special attention to bodies of water. According to *feng-shui*, a straight stream or river is evil, while a meandering stream or river is favorable. *Feng-shui* is against building on an outside downstream corner, called the "water shooting heart," where the water flow changes direction sharply. One of the highest impact sites during the 2013 floods is located in the area of the confluence in Jamestown, Boulder, CO. A dry wash can generate powerful debris flow during intense periods of heavy rainfall. In *feng-shui*, debris flow is called the "water pouring head," one of the evilest disasters (Ye, 1688). A dry wash or gully with a narrow and straight channel is called a "hidden arrow," which functions as the debris flow track (Zou, 1676). Sites positioned within a dry wash, or a straight and narrow channel, should be avoided (Liu, 1986 and Xu, 2016). For example, a house on a hillside in Big Elk Meadows, Lyons, CO, was destroyed by a post-fire debris flow in 2013.

Output Zone --Impact Area

The final area is the debris flow fan, a receiving or impact area, where the slope has dropped, and debris is released. According to geomorphic studies, along with the author's field investigations, once the debris flow meets a point where the slope suddenly drops more than 20%, the flow becomes faster with a straight channel and shoots the debris onto the plain of an impact area with a slope of less than 10%. For example, the 2013 debris flow by Chapel on the Rock ran five miles from Mountain Meeker, arrived in a plain with a slope less than 10%, released debris, and caused intense and massive destruction.

By using *feng-shui* criteria as a clue, and evaluating a site as a spatial union that includes mountains, hills, water, and orientation, the author's field investigations found that landforms which experienced substantial impacts during the 2013 floods present a combination of similar patterns. These landform patterns can be described in the following aspects. Sites impacted were often located in a valley with the

confluence of two rivers. There is a small creek, similar to a dry wash, that flows down to the site through the "violent dragon" canyon, which contains an abundance of debris sources. The narrow channel of the dry wash generated the sand and rocks to move into a powerful debris flow. The river on the site takes motion in a straight line, directly pointing toward the site, generating enough power to destroy houses. In addition, the steep-sloped hills north of the site had fires in recent years, which provided much unstable soil and dead trees. During the rainfall, these deposits developed into a local debris flow that fed into the river and hit the site. The most substantial impact areas in the 2013 Colorado floods were Jamestown and Drake, which both presented the above landform pattern characteristics.

FENG-SHUI PRACTICE OF TOPOGRAPHIC DESIGN FOR ENDURING THROUGH MOUNTAIN FLOODS

A favorable *feng-shui* site should form a U-shaped containment enfolded by hills, facing the south where there are mountain peaks in the distance. In the north, there are high hills to prevent the site from cold winds, and a meandering river passing through east or south of the site. In such a site, the qi (vital energy) accumulates (Ye, 1688). Figure 2 illustrates the ideal model of a favorable *feng-shui* site. The black zigzag patterns depict the mountain profiles, the fine lines show the foothills, the dashed lines show a river, and the small circle indicates a housing site. A detailed site selection and topographic design would further benefit the residents to endure through mountain floods.

FIGURE 2
THE IDEAL MODEL OF A FAVORABLE *FENG-SHUI* SITE

Source: Ye, Jiusheng, 1688, *Di Li Da Cheng. Chapter 3*.

"Dragon Vein"

One primary criterion of *feng-shui* is to choose an elevated landform. If the land is flat, there is no living qi, the vital energy. According to a fifth-century *feng-shui* textbook – Zhang Jing by Guo Pu, people choosing favorable sites for homes should look to build on the dragon vein (Xu, 1580). The dragon vein refers to a hill range. Such a site has the best drainage and will not accumulate run-off in the area. If the building is built in a basin, *feng-shui* calls this the "site without veins," and the flood risk is much higher. According to geomorphology research, the basin of the mountain often triggers debris flows (Bovis & Jakob, 1999).

"Dragon Whiskers"

According to the sixteenth century *feng-shui* textbook by Xu Shike, a favorable site for a house should have a "happy hill" in the north to protect the site from the wind. Such a hill could potentially drain water to the building. Therefore, a gully needs to be implemented to re-route the drainage. A natural gully is seen as good luck. If there is no gully, it is necessary to create one. This drainage system is called "the dragon whiskers" in *feng-shui* to ensure drainage is directed away from the house (Xu, 1580).

There are several precedents for site selection and topographic design that have successfully withstood flooding risk in mountainous areas. For example, the 18th century Royal Temple of Putuozongcheng, located in Chengde, China, northeast of Beijing, was built in the foothills of the mountains. The topographic design of this temple landscape follows a favorable *feng-shui* model applied in the mountains, containing a superior drainage system to protect the temple complex against mountain flooding (Figure 3).

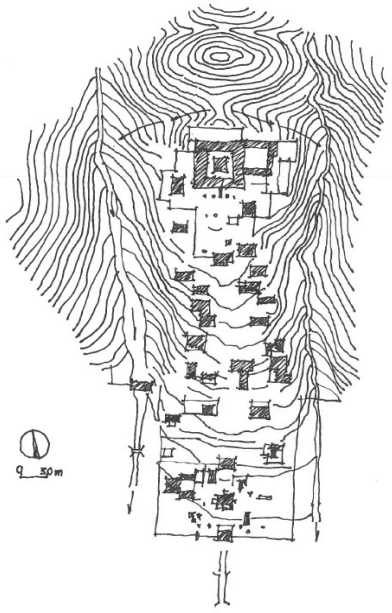
The architectural complex was built for celebrating the birthdays of both the emperor and his mother. During the birthday celebrations, local rulers from Tibet, Xinjiang, and Mongolia gathered in the temple, which was a significant political event to make close connections from the central regime to the leaders of remote regions. This building style was highly influenced by Tibetan architecture, in particular the Budala Palace (Chen, 1995).

FIGURE 3
BIRDS-EYE PERSPECTIVE OF THE ROYAL TEMPLE OF PUTUOZONGCHENG

Source: Ping Xu

The building complex is located in the foothills of the south slope on a ridge known as the "dragon vein" in *feng-shui*. In the north of the temple, there is a hill called the "happy hill" because it acts as a protective boundary to the temple. Behind the "happy hill" are several mountain ranges in the north, enfolding the site further. Additionally, one river flows through the south side of the temple, running east. The terrain behind the temple complex forms a gully and provides drainage to streams on both the eastern and western sides of the temple, moving water south. In *feng-shui*, this system is called dragon whiskers and creates drainage systems to mitigate future flooding issues (Figure 4).

FIGURE 4
SITE PLAN OF THE PUTUOZONGCHENG TEMPLE SHOWING "DRAGON VEIN" AND "DRAGON WHISKERS"



Source: Ping Xu, Sketching from a map by Chen Baosin,1995, *Chengde Summer Palaces and Eight Outer Temples,* P. 225.

The case of the "dragon vein" can also be found in the foothills of the Rocky Mountains in Boulder, Colorado, as shown in Figure 5. This house is built on the ridge of a gentle hill – the dragon vein – facing south. The surrounding hills form a u-shape, called the "tiger and dragon hills," enfolding the site. In the east, there is a valley with a creek meandering south. In the south, there is a mountain range called the "table hill" in *feng-shui*, covered by thousands of pine trees. The owner modified the topography, designing a gully behind the house. In *feng-shui*, the gully can be seen as the "dragon whiskers," to ensure no overflow of drainage from the slope of the mountain to the house. The site has an open view southeast, looking out to Boulder's city lights at night and receiving qi, the vital energy from the southeast. It is not surprising that the owner states that this house makes people happy and nourishes positive energy.

FIGURE 5
HOUSE BUILT ON A "DRAGON VEIN" IN BOULDER, COLORADO

Source: Ping Xu, 2019

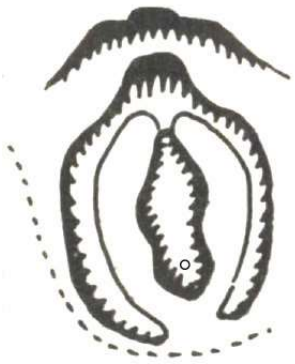
"Turtleback"

According to *feng-shui*, a site built on top of a small hill or mound is favorable. Such a site is referred to as the "turtleback" in *feng-shui* terms. The term comes from the image of a turtle in muddy water, with only the back exposed. The "turtleback" landform consists of an individual mound with gentle slopes at a higher elevation than the surrounding land, providing the building site with an excellent drainage system. Therefore, the landform of the "turtleback" would be an excellent choice for house sites in mountainous areas, as well as in plains. Structures built on the turtle's back are expected to withstand floods at this higher elevation. Pu Le Si, another eighteenth-century temple in Chengde, follows the mandala model, a Tibetan Buddhist ideology. This temple faces the west, while the east faces a unique landmark of vertical standing rock. The entire site was built on a mound, and the central building of the temple sits at the peak position.

Figure 6 illustrates a *feng-shui* conceptual map of the favorable site of the "turtleback," a site built on top of a small hill or mound. The black zigzag patterns depict the mountain profiles, the fine lines show the foothills, the dashed line represents the river, and the small circle indicates a housing site.

The case of the "turtleback" can be found in the hills of the Rocky Mountains in Colorado near the intersection of Route 36 and Kiowa Road. The steep mountains experienced debris flows, causing drastic impacts to the bottom of the valley during the 2013 floods. However, the houses located at an individual hill nearby were not impacted by the debris flow. These houses take advantage of excellent views while still staying away from potential damage.

FIGURE 6
***FENG-SHUI* MAP DEPICTING THE "TURTLEBACK" SITE**



Source: Jiang, Weiguo, 1997. *P.328. The original source is from Tiang Ji Hui Yuan, 1580. by Xu, Shike.*

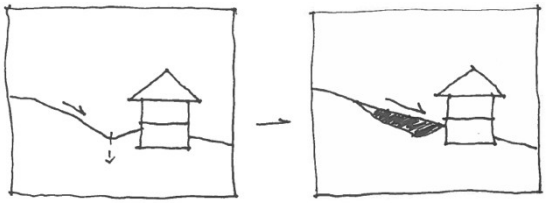
Debris flow can go up to 30 feet (King, 2018). With a strong bedrock foundation, the "turtleback" hill should rise over 40 feet higher from its surroundings, providing the hill with an excellent drainage system. Due to this strong bedrock foundation and such height, a debris flow will not be able to strike down this " turtleback" hill and instead alter the direction away from the hill. For these reasons, the "turtleback" has a great potential to act as a spot for refuge or evacuation. It is also important to notice that a hill built up from soil is considered a "fake dragon vein" or "fake turtleback," which easily causes landslides.

Topographic Design Improvement

Suitable site selection is crucial to avoid risk and increase the chances of survival during mountain floods. If people settle in debris or postfire debris zones, they should relocate their homes as soon as possible. It is not possible to avoid debris flow by modifying the topographic conditions of the area. Nature is too powerful. However, topographic design can improve a natural drainage system to reduce damage from mountain floods, particularly from overflow.

In Colorado, some residents paid a little attention to the drainage system of their property, as weather is dry, and floods do not occur often in mountains. They did not realize that soil erosion on a sloping site can change the drainage system, potentially causing run-off flowing towards the house (Figure 7). The poor drainage conditions of properties in the mountains aggravated the impacts of the overflowing during the 2013 Colorado mountain floods.

FIGURE 7
SOIL EROSION ALTERING RUN-OFF TOWARD THE HOUSE

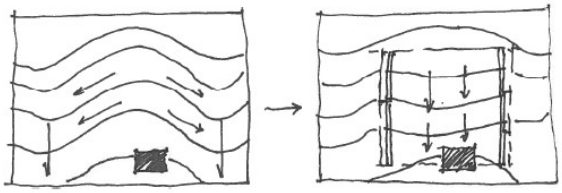


Source: Ping Xu, 2020

Also, some changes on the landscape, such as a fence or retaining wall, ignore natural drainage conditions, altering drainage direction to the house. One example was a house located in the foothills near Boulder, Colorado (Figure 8). This house was initially built on a "dragon vein," which once had a good drainage system. Unfortunately, the owner built a wire fence behind the house and placed wooden logs alongside the fence to contain his dog. After many years, the soil deposited along the fence and changed the drainage system. As a result, the run-off direction altered towards the house. Consequently, during the 2013 flood in Colorado, overflow directly flooded the basement of the house.

During the flood of 2013, high impact zones often involved postfire debris flow, while overflows occurred most commonly in the mountainous residential areas. The government has reimbursed residents for overflow damages, from a couple thousand to tens of thousands of dollars per house. When receiving funding to repair the flood damages, residents should also think about how to prevent future risk by improving the poor drainage conditions to reduce overflowing impact and damages in the future, which would also save a tremendous amount of government funds.

FIGURE 8
FENCING ALTERING DRAINAGE DIRECTION TOWARD THE HOUSE



Source: Ping Xu, 2020

CONCLUSIONS

The beauty of mountains attracts people to reside in; in another hand, it also leads them to live in the potential natural hazard-prone zones. The evidence from the impact areas of the 2013 flood was varying. Some areas experienced far worse impacts than others. Though destructive, the historic 2013 floods provide the base for this research, leading a path to improve strategies to endure natural disasters in the mountains.

Wise site selection for mountain homes is a priority for residents throughout the community. Mountains have complex terrain. Some landforms can trigger debris flows and overflows, while other

landforms provide the conditions necessary for survival during disasters. Homes built in susceptible zones to mountain floods will receive high impacts, facing the destruction of property, and even loss of life. A basin, narrow canyon with a steep slope or dry wash pointing straight towards a house, all of these areas can trigger a debris flow, causing vast destruction. In addition, the areas in the confluence of a river, particularly on the outside curve, or a site with even grading in the valley, can trigger overflow and flooding. At the debris flow prone zones, homes destroyed by the historic 2013 Colorado floods should be removed or relocated, as these areas will face similar risks in the future.

One primary criterion of *feng-shui* is to choose a raised landform, that can provide good qi – the vital energy, fresh air, and proper drainage conditions. According to *feng-shui*, a favorable site for homes should be located on a "dragon vein, " referring to a hill range. Another critical strategy of *feng-shui* is to look for the "dragon whiskers," referring to the gully behind a house. When a house is located on a hillside, there is potential for run-off to drain to the building. If there is a natural gully, the "dragon whiskers," water can drain away before reaching the house, and it is good luck. If there is not such a natural gully, it is necessary to create one. According to *feng-shui*, an individual hill with a strong bedrock foundation is referred to as the "turtleback." This place should be over 40 feet higher from the surrounding terrains, providing the land with an excellent drainage system and also enduring through a debris flow attack. Thus, the "turtleback" hill could provide a place for refuge or evacuation.

In the Colorado mountainous areas, many people don't pay much attention to the topographic drainage system in their property, as run-off is not often an issue. However, during intense rainfall, overflow is a common problem for many houses on the hillsides of mountains. Residents should improve their topographic drainage system to reduce the damages of overflow, which would also save a tremendous amount of government funds during future flooding.

The practice of *feng-shui* emphasizes horizontal-spatial analysis of landforms of mountains, hills, water, and orientation. The field investigations indicated that the high impact areas largely correspond to the negative criteria of *feng-shui*; while surviving areas correspond to the favorable criteria of *feng-shui*, which includes large-scale site selections to details of the topographic design.

Suitable site selection to avoid mountain flooding and debris flow is a primary concern. Following *feng-shui* criteria, altering topographic conditions are often applied to improve the local drainage system. The significant correspondence of *feng-shui* criteria to geomorphic concepts indicates that *feng-shui* is not only a valid method, but it can also be used to expand our knowledge of site selection and topographic design and to establish mitigation strategies for natural disasters.

This research provides recommendations for enduring through mountain floods and conducts the criteria for improving the site selection process. Its ongoing work is anticipated to predict impact zones of flooding to avoid high-risk areas and evacuate during such natural disasters. Wise site selection and topographic design would contribute to a sustainable strategy for environmental design in order to ensure survival during future flooding in the Colorado mountains and beyond.

ACKNOWLEDGMENTS

Encouraging student involvement in research, the author appreciates student participation in this work. Particularly, the author would like to thank Rosa Borunda-Martinez and Tatum Wise for helping to edit this paper.

REFERENCES

Bovis, M., & Jakob, M. (1999). The role of debris supply conditions in predicting debris flow activity. *Earth Surface Processes and Landforms*, 24, 1039-1054.

Chen, B. (1995). *Chengde Summer Palaces and Eight Outer Temples*. China Architectural Industry Publisher, Beijing.

Clark, G. M. (1987). Debris slide and debris flow historical events in the Appalachians south of the glacial border. In J. E. Costa & G. F. Wieczorek (Eds.), *Debris Flow/Avalanches: Process, Recognition, and Mitigation* (pp. 125-138). The Geological Society of America: Boulder, CO.

Costa, J. E., & Wieczorek, G. F. (1987). *Debris Flow/Avalanches: Process, Recognition, and Mitigation*. The Geological Society of America: Boulder, Colorado.

Cui, P., Zhou, G.D., Zhu, X.H., & Zhang, J.Q. (2012). Scale amplification of debris flows caused by cascading landslide dam failures. *Geomorphology*, 182, 173-189.

Eitel, E.J. (1988). *The Science of Sacred Landscape in Old China*. Synergetic Press, London. (First published in 1873 by Trubner & Co.).

Jiang, W. (1997). *Model Landform Subjects*. Yi Qun Book Store, Taibei.

King, H. M. (2018). What is a debris flow? *Geoscience News and Information*. Retrieved from https://geology.com/articles/debris-flow/

Li, T., Onda, Y., Owens, P., & Slaymaker, O. (2004). *Mountain Geomorphology*. Arnold, London.

Liu, J. (1986). *The Collection of the Ancient Texts* (reprinting 50 historical famous masterworks from 200 BC to 1600 AD.). Fu Li Publisher, Taibei.

Lorente, A., García-Ruiz, J.M., Beguería, S., & Arnáez, J. (2002). Factors explaining the spatial distribution of hillslope debris flows: A case study in the Flysch sector of the central Spanish Pyrenees. *Mountain Research and Development*, 22(1), 32-29.

Lounsberry, S. (2018, September). Five years after flood, recovery nears $500M. *Daily Camera*, 1. Retrieved from https://www.dailycamera.com/2018/09/01/five-years-after-flood-recovery-nears-500m/

McHarg, I. (1971*). Design with Nature*. Doubleday, New York.

Onda, Y. (2004). Hillslope hydrology and mass movements in the Japanese Alps. In P. N. Owens & O. Slaymaker (Eds.), *Mountain Morphology* (pp. 153-164). Arnold: London.

Qiu, Y. (1995). *Geographic Landform Guides*. New Culture Publisher, Taibei.

Reneau, S. L., & Dietrich W. E. (1987). The importance of hollows in debris flow studies; examples from Marin County, California. In J. E. Costa & G. F. Wieczorek (Eds.), *Debris Flow/Avalanches: Process, Recognition & Mitigation* (pp. 165-179). Boulder, Colorado: The Geological Society of America.

Takahashi, T. (1991). *Debris Flow*. Brookfield, Vt. Published for the International Association for Hydraulic Research by A.A. Balkema.

Wells, W. G. (1987). The effect of fire on the generation of debris flows in southern California. In J. E. Costa & G. F. Wieczorek (Eds.), *Debris Flow/Avalanches: Process, Recognition & Mitigation* (pp. 105-114). Boulder, Colorado: The Geological Society of America.

Xu, P. (2016). *Feng-shui's* "hidden arrow": A straight dry wash can trigger a debris flow disaster. *Academic Journal of Art & Science*, 1-12.

Xu, P. (2017). Fires and postfire debris flows triggered by landforms in Colorado Front Range and the subsequent impact on and by humans. *Journal of Digital Landscape Architecture*, 2.

Xu, P. (2017). Self-warning method and evacuation plan to escape from post-fire debris flows. *Academic Journal of Science*, 8(2), 121-132.

Xu, S. (1580). *Di Li Tian Ji Hui Yuan*. The Shanghai Mountain House, Shanghai.

Ye, J. (1688). *Di Li Da Cheng*. The Shanghai Mountain House, Shanghai.

Zou, T. (1676). *Di Li Da Quan*. The Shanghai Mountain House, Shanghai.