Soil and Surface: A Place of Inhabitation through Reclamation

"If it resembled something, it would no longer be the whole."

— Paul Valery

Sean Burkholder
University at Buffalo

Bradford Watson
Montana State University

The topic of site has deep roots within the field of architecture, yet in many cases site is still considered as simply the carte blanche pedestal for architectural intervention. However, slowly the clear understanding of context within the practice of architecture is blossoming into a significant consideration for designers. How projects manage resources (natural or otherwise), engage residents, and are cost effective have become primary motivators of many contemporary projects; reaching beyond the idea of the iconic building or space.

These outside considerations (ecology, economy and society) all overlay the spatial landscape at varying intensities. Any particular "site" is influenced by a range of these forces, and in many cases these forces are incongruent with one another. Learning how to navigate these larger systems as a designer is a key skill, necessary for any well-considered project. However, the prioritization of this type of thinking has typically been avoided in the academy, in favor of a more form-based understanding of design.

Looking beyond the systems of isolated buildings, the processes of landscape offer a valuable avenue of departure in the exploration of system-centric design. Landscapes are designed to absorb and accommodate change, where many architectural projects are designed to reject or protect against it. Using landscape processes as an exploratory tool affords a new understanding of the implications of design decisions and the agency of the designer within the larger world.

More specifically, terrain, or classified soil surface, offers a medium to explore the potential of systems-centric design. As the substrate on which most things are built and grow, soil and its modification have significant implications to almost every built project, be it architecture or landscape. Soil is also highly contextual. As the product of an ever-mixing system of organic matter, air and water from above and geologic matter from below, the soil or pedosphere is an incredibly dynamic component of the Earth. How soil is managed has impacts on water movement, plant growth, structural bearing capacity, toxin migration, future soil development, and many other characteristics.

The city of Butte, Montana provides a highly energized venue for the study of soil and its design implications. With a tremendous history of subsurface modification, both geologically and anthropologically, the dynamic and ongoing transformation of the Butte terrain is one of its most defining characteristics.


1a

Figure 1a: Active mining at Continental Pit

CONTEXT: BUTTE, AMERICA

GEOLOGY

> "It was Geology, not geography that made this isolated valley such a remarkable place"[1]

Butte is located in western Montana at approximately 5,538 ft above sea level[2] and surround by the Continental Divide to the East, West and South. It is a cold and harsh climate with very little precipitation, less than 13 inches per year, because of its distance from the Rocky Mountain summits to the west. Butte is located along the Northern Rocky fault lines which displaced the primary veins located within homogeneous granite which mineralized and were then again displaced. This process created the complex and unique condition of minerals that extend deep into the earth.[3] Within this incredible movement created by the faults are over 130 minerals that exist in the Butte ore deposits.[4] The Butte quartz monzonite is the host rock for copper and gold veining which cross the district in an east-west manner. These veins, which stretch over 12,000 feet and have vertical continuity of over 4,500 feet include the Emma, Anaconda-Original, Syndicate, Badger-State and Alice-Rainbow and have mining widths from 5 to 50 feet. The scale of resources available within the 25 square mile area of the Butte Mining District have yet to be exceeded and allows Butte to still be called the "Richest Hill on Earth."[5] It is this richness and depth of resources that contributed to the complex network of shaft mines extending over a mile deep to reach the ore. Approximately 49 miles of vertical shafts and 10,000 miles of horizontal shafts exist under the Butte Hill as miners followed the veins of valuable materials prior to the conversion to open pit mining.[6]

MINING ACTIVITY

An early prospecting party lead by Caleb E. Irvine in 1856 found evidence of prehistoric mining, attributed to Native Americans on the Butte Hill.[7] Mining activity grew in the region in the 1860's, but peaked for that era in 1866, with a steady decline to 1874. In 1874 William Farlin returned to the district, having left years before with quartz specimens he took for examination, and laid mining claims to recently forfeited claims by the US Government. Farlin had discovered the rich concentration of precious metals in the quartz and began the exponential growth of mining, profit, population and indulgence.[7] Mining was such a defining characteristic of the region that when Montana gained statehood in 1889, it called itself the "Treasure State" and used the motto "Oro y Plata" (Gold and Silver) on the State Seal. Original mining claims in the area were for Gold and Silver but soon changed to Copper as the demand for electricity increased

1b 

across the country. The extraction of copper in Butte peaked in 1917. Today the Continental, Butte's last operational pit still produces Copper and Molybdenum and is operated Montana Resources. The Anaconda Mining Company formed in 1895 and eventually controlled all mining activities in the city. They merged with Atlantic Richfield Company (ARCO) in 1977 and ceased all mining operations in 1983 and were acquired by BP in 2000 along with all responsibilities for the reclamation of previous mining operations. From its very founding, the extraction of materials has defined Butte and at many times taken precedence over the residents and environment.

SUPERFUND

In 1912, Walter Harvey Weed wrote "Heaps of waste are everywhere prominent, attesting by their great size the extent of the underground workings"[3] foreshadowing the environmental impact of mining on the Butte Hill. In 1983 the Environmental Protection Agency (EPA) designated Silver Bow Creek as a Superfund Site, making it the largest superfund site in the United States, reaching from Butte 120 miles to Milltown, just east of Missoula. This designation started the process of collecting data and determining the appropriate remediation projects in the Butte Priority Soils Operable Unit (BPSOU). Clean up operations began in 1987 and were divided into two phases. An initial Phase I that was and expedited Response Action to source areas of contamination by removing or capping waste dumps, railroad beds and other related areas of mine waste. Phase II is the final remediation work related to addressing the remaining environmental and human health issues associated with water and soil. This plan resulted in the Record of Decision (ROD) being adopted in 2006. In 2008, The Atlantic Richfield Company (ARCO) agreed to pay $187 million to finance the cleanup of the Clark Fork River contamination as a result of a century of mining activity in Butte and Anaconda.[8]

> "The environmental benefits will go directly to local landowners with improved soil, and extend to all Montanans through cleaner water and improved fisheries." said Robbie Roberts, EPA's Regional Administrator from Denver.[9]

RECLAMATION

Due to the significant quantity of waste material created from the mining activity, and no feasible way to move it off site, it was determined that a Waste Left In Place (WLIP) procedure was the appropriate remediation. In order to stabilize the ground and reduce the risk of erosion, all waste rock to be capped in place was graded to a maximum slope of 1:3. BRES Appendix B, Butte Hill Revegetation Specifications, to the 2006 ROD for BPSOU outlines the criteria for the WLIP cap to provide a barrier between people and the waste material. Once the site was properly graded for slope and drainage, a 2" layer of limestone was placed over the waste rock for stabilization. A minimum of 18 inches of cover soil is placed over the limestone and is then seeded with an approved mix which irrigated for a maximum of two years to establish the plant life. The cap continues to be monitored to ensure that it is providing the level of protection for people and the environment but is not asked to do more.

Figure 1b: Excavation through WLIP cap.

RESTORATION

> EPA's general mission is to protect human health and the environment through implementation of environmental laws enacted by Congress and assigned to EPA for implementation. To achieve that mission, EPA needs to continue to integrate, in a meaningful way, the knowledge and opinions of others into its decision-making processes.[10]

Within the 2006 ROD for the BPSOU the EPA identifies areas of redevelopment within the reclamation sites and acknowledges that it is not always feasible to remove all contaminated waste because of the vast scale of mine dumps. Of specific note are the outline to create the Butte Hill Trail on the abandoned rail bed, now the BA & P Trail, Open Space to both help with storm water management and to improve the aesthetics of the town, Education related to damage to the Cap in Place protection of the waste material, and a series of park and recreational areas for the residents. While this does exceed the basic criteria of Human Health and the Environment, it is a passive and rather generic approach to both the physical and social restoration to a place as unique as Butte.

THE STUDIO PREMISE

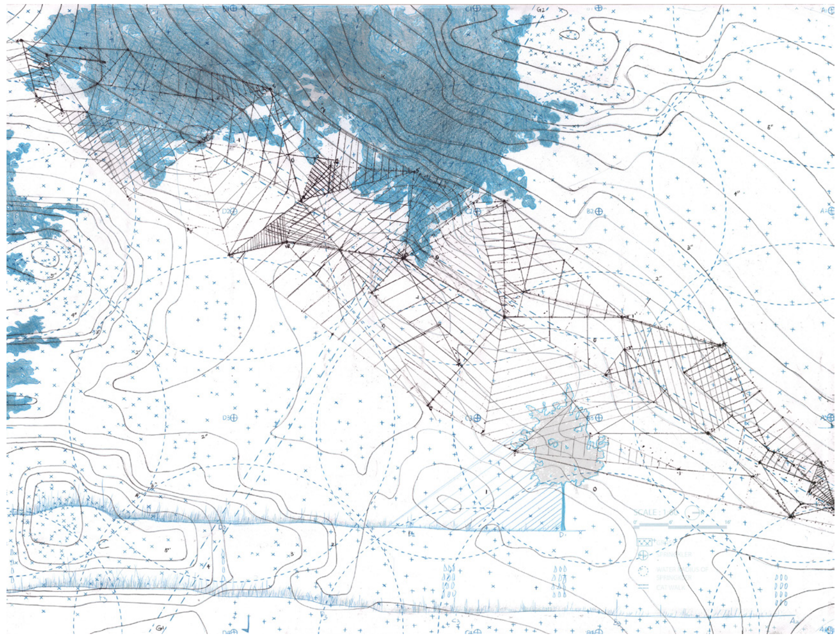
Graduate students in the School of Architecture at Montana State were asked to consider the role of system manipulation, using landform as the agency for change, within the ongoing context of the Reclamation of the landscape and the Restoration of the city of Butte. Students selected sites adjacent to the BA & P Hill Trail, the former rail connection between Butte and Anaconda, that is now an asphalt trail over 26 miles long. Because of the historic use adjacent to the rail line in Butte, the trail is flanked on both sides by sloping hillsides of primarily low grasses. This condition is a result of the Remediation phase of the EPA WLIP cap approach to protecting people from the dangers of exposed waste rock from mining. Very little thought was given to the use of these capped sites as the focus was to address immediate and significant human health and environmental risks. Since this work began in 1987 little has changed until recently when the Restoration phase of the Reclamation work began. It is within this context that students analyzed the existing conditions to propose new ways of "Restoring the Landscape".

SMALL MOVES WITHIN A LARGER SYSTEM

One of the primary motivations behind the studio was the exploration of how small interventions could instigate larger-scale change. It was important to develop the understanding of the role of the designer as an agent within nested larger systems as opposed to the generator of those systems. One of the clearest examples of this process can be taken from climate change, where small aggregate actions have triggered much larger world-wide changes. The example also illustrates one of the most significant challenges with engaging large systems - the difficulty of large-scale system perception or the comprehension of long-term time scales. For these reasons, the studio made an effort to select and frame particular systems in which to engage while being projective about their possible larger implications.

The studio also wanted to communicate that on any one site, many systems operate simultaneously and are in many cases contradictory of one another. All engagements within these systems as a designer imply or communicate value judgments or prioritization. Most dynamic systems can be placed into one of

2a

2b


Figure 2a: Students survey of existing conditions using self created tools.

Figure 2b: Students creating place using only soil and hand tools in farm field.

three categories; Ecology, Economics and Social. The point should be made that these systems are highly integrated and any attempts of distilling them into distinct entities requires the omission of some information. With that note however, these three categories serve the purpose of generally illuminating the range of inputs and outputs any given site may be involved with. In Butte, these three system categories are all quite evident and valuable to the understanding of the place. All three also appeared to have significant potential as agents for change if managed correctly.

Ecologically, the Butte region is incredibly complex. Highly disturbed landscapes have led to a wide range of ecological alteration over time. Now, adaptive organisms have found ways to thrive in the post-mining condition. An example of this is the fungus and bacteria discovered in the Berkeley Pit by Don and Andrea Stierle, researchers at Montana Tech.[11] Not only did this discovery refute the idea that the pit was a completely dead body of water, this new discovery has let to future research that points to the cancer-killing potential of these new organisms.[12] This new understanding of how a highly altered condition can produce both positive and negative results serves as an important lesson to designers. Systems evolve and adapt to modification. The more knowledgeable we are about how this adaptation occurs, the more likely we can predict outcomes and design for specific, desired results. Hydrologically, the extraction of tremendous amounts of material have altered water movement systems and now require serious investment in stormwater mitigation strategies. Numerous ditches, silt traps and detentions areas control where water goes based on what it has been in contact with. This hydrologic infrastructure is one of the most prominent features in northern Butte, thus water and its movement became a key focus for many of the studio projects.

The Economics of Butte have always been tied to resource extraction. In 1900 Montana ranked third among mining states for total output behind Michigan and Pennsylvania with their huge volumes of Iron and Coal respectively. Of Montana's product, 80% came from Butte and was composed of primarily copper and silver. Butte's total of 55 million annual dollars placed it at number five on the *state* list.[7] Butte's material was of such importance to the American war effort that after the bombing of the Miner's Union Hall in 1914 and the subsequent labor strikes as a result of the Granite Mountain Fire, martial law was instated to keep the peace. Martial law continued through 1921, the longest period of military occupation in the U.S. since the Reconstruction era. During war times, striking miners were accused of treason, and were escorted by gunpoint to work in order to support the war effort.[13]

Today, Butte's economy is still tied to the process of resource extraction, but at a smaller scale. In addition to the finances associated with the actual mining of material from the Continental Pit, southeast of the Berkeley Pit, is the economy of remediation. Much of this money is filtered through the federal government as part of the superfund reclamation project underway there. In addition to this federal money, Butte has worked diligently to market itself as a destination city for a series of well-known regional events such as an enormous St. Patricks day celebration, Evel Knievel days, the Montana Folk Festival and the Chinese New Year celebration which collectively draw over 250,000 people to the city each year. These events attempt to leverage the large number of tourists visiting the region for other sites such as Yellowstone, Glacier National Park or the Grand Tetons. According to the Montana Governor's Office of Economic Development, tourism is the fastest growing sector of the economy for the state creating 7% of the workforce, annually bringing in 10 million visitors (10 times the population of the state) and 1.8 billion dollars. The choice to focus the studio on both Terrain and Recreational program was strategic in that these are the two most funded elements in a region that suffers from low funding in other areas.

The social conditions of Butte have always been colored by the mining industry. With a historical reputation for tough, scrappy miners who would give up everything to strike it rich on the "Hill", Butte quickly became one of the most populated and prosperous cities of the West. Presently some of that toughness still exists as the mining industry has dwindled and the city has suffered from disinvestment. While miners were historically paid very well, in many cases they were treated as disposable labor in an effort to maximize profits. This is evident in events such as the destruction of Columbia Gardens, Butte's premier public space (speculated as an act of the Anaconda Mining Co. to make way for the expansion of the Berkely Pit), or massacres associated with labor strikes such as "Bloody Wednesday" in 1920.[14] Its strong position at the forefront of labor organization earned Butte the nickname "Gibraltar of Unionism".

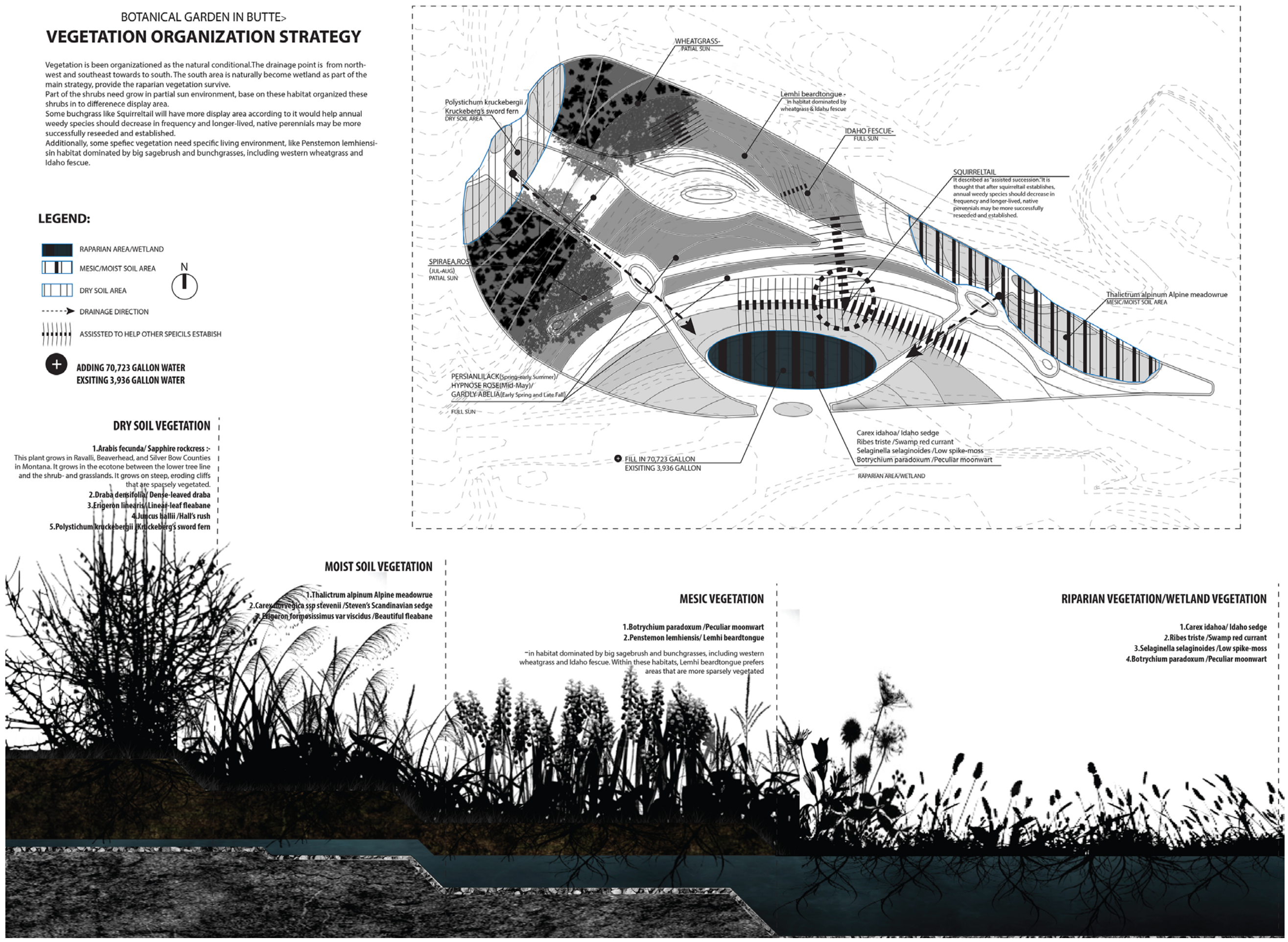
Butte residents of today could also feel this type of disenfranchisement as the city focus its attention on the attraction of tourists to Uptown Butte to pay the bills. Many of these tourism-based undertakings do very little for the current residents beyond filling the streets with visitors a couple of days per year and exploit the vacancy of relics from a post mining condition. Finding ways to empower residents by providing them with useful public spaces that speak directly to their needs was also a driving force behind the studio.

THE RELATIONSHIP BETWEEN TERRAIN AND PROGRAM

The relationship between Terrain and Program is manifold and manifests itself in many ways. Our environment is filled with our responses to dealing with terrain in order to create various desired programs. Road-cuts, debris basins and a myriad of soil-retention technologies all stand as evidence to this fact.

ENDNOTES

1. Malone, Michael P. *The Battle for Butte : Mining and Politics on the Northern Frontier, 1864-1906*. Helena, MT: Montana Historical Society Press, 1995.
2. United States Geological Survey
3. Weed, Walter Harvey. *Geology and ore deposits of the Butte district, Montana*. Washington: Government Printing Office, 1912.



3

Figure 3: Planting plan and section of proposal for endangered species botanical garden (Mengting Fu)

Socially we can see examples of this engagement of Terrain with the class-sorting associated with elevation and the strange inversion of this in Butte, with the upper class resident's migration to lower elevations, away from the mining operations on the hilltop. The studio looked to explore this relationship between use and terrain by providing a series of existing terrain conditions that could be modified within set limits to accommodate programs of the student's choosing. The choices of program were intended to be focused on the existing residents of the surrounding community, knowing full well that their association with the recreation trail would also connect them to the larger events of Butte and the visitors that accompany them.

Pedagogically, there was also a desire to push the envelope of what students enrolled within an architecture program are expected to consider with respect to landscape. As subject matter that is in many cases overlooked within the curricula, the studio intended to couple these ideas of system-centric design with a sound knowledge of landscape vocabulary. This material required a physical relationship to both existing terrain and its manipulation as a way of understanding a new skill set. For example, the surveying of a site with self-constructed, non-standard surveying equipment (Figure 2a) and the physical labor of soil movement to create place (Figure 2b). All exercises required an understanding of stormwater management, balanced cut and fill and human occupation. These exercises were intended to provide a toolkit of new skills to

4. Guilbert, John M.. *Mineralogy of the Butte district, Montana,*. Bozeman, Mont: [Anaconda Co.], 1964.
5. Czehura, Steve J. Butte, *A World Class Ore Deposit. Butte, Mt:* Montana Resources, LLP, 2006
6. Ted Duaime, Patrick Kennelly and Paul Thale. *100 Years of Underground Mining Map*: Montana, 2004.
7. Freeman, Harry Campbell. *A Brief History of Butte, Montana, the World's Greatest Mining Camp; Including a Story of the Extraction and Treatment of Ores from Its Gigantic Copper Properties.* Chicago,: H. O. Shepard Co., printers, 1900.
8. "Silver Bow Creek/Butte | Region 8 | US EPA." US Environmental Protection Agency. http://www.epa.gov/region8/superfund/mt/sbcbutte/ (accessed August 1, 2013).
9. Sector, Business. "02/07/2008: Atlantic Richfield Company agrees to pay $187M for Montana Superfund Cleanup." Environmental Protection Agency. http://yosemite.epa.gov/opa/admpress.nsf/0/CE166ABD9B8E9A76852573E8005C762B (accessed August 1, 2013).

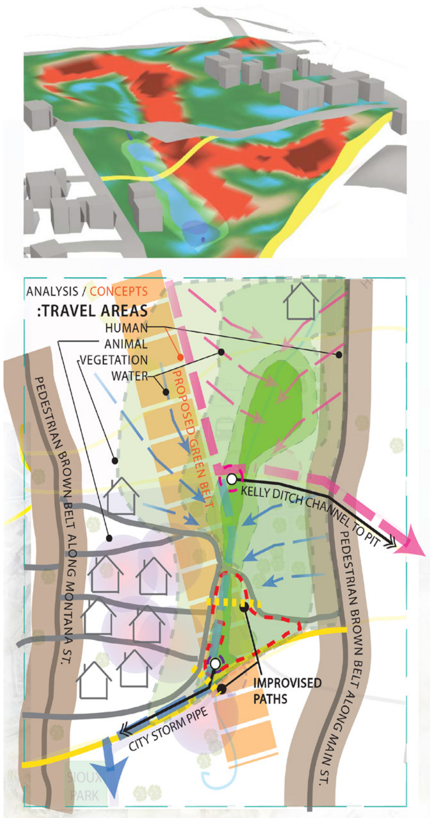
be deployed on the larger Butte problem.

In addition to this new kit of skills, students were also pushed to develop programs for their sites. This process of programming as design as opposed to designing for a particular program was also seen as a novel experiment and something that was under-represented in normative architectural instruction. This process is however quite standard within landscape architectural instruction as in many cases the projection of what is to happen on the site is the product of the designer as opposed to the client. The studio assumed that there was transferrable knowledge in this way of thinking that could apply to architectural design, particularly in a time of significant transition within the field.

The programs chosen by the students included a Botanical Garden that referenced the loss of the Columbia Gardens and other botanic species along the Clark Fork River though specific species selection coupled with their relationship of available soil depth though site re-grading (Figure 3). Another project became a didactic slice into the waste rock of the region to uncover the native soil as a way to educate the public of the recent history and transformation of the region (Figure 4a). This project also considered itself as part of a larger agenda of the historic district by demonstrating the history of the reclamation work within a particular location. A similar project called the Tailings Observation Area is located east of Anaconda along the former rail line where an area of contaminated landscape has been preserved because of its historical significance (Figure 4b). One project looked at the larger connectivity of the region and leveraged stormwater management and sediment control as a way of

4a

4b



5b

5a

Figure 4a: Tailings Observation Area

Figure 4b: Proposed historic observation area exposing original Butte hill surface (Jordan Clark)

Figure 5a: Site plan for community garden and gathering (Nattapron Janjaratmatha)

Figure 5b: Slope, drainage and access analysis (Scott Miller)

initiating both new habitat creation and the restoration of historic pedestrian connections (Figure 5a). A final project identified community reconnection as the driving force of restoration through gardening and gathering (Figure 5b).

CONCLUSION

Though a series of terrain manipulation exercises and the placement of these within the complex context of the post-mining landscape of Butte, Montana, students developed an understanding of large system connections and the micro-conditions of a specific site as agents for place-making. Students defined programs for the sites as a result of analysis and restorative action rather than being given a required program or list of spaces. This understanding of system integration and program as an active condition informs the larger agenda of architectural education and the future of these particular students. A studio of this nature could have implications on a larger system-centric focus within the studio curriculum.

Within the context of a school of architecture where new skill sets are introduced, short projects are necessary to build a language of resources. Similar to any early design studio, students must continually be challenged to be critical of the new medium and establish strong agendas within the new agency of landscape. It is too easy to resort to knee-jerk preconceptions of landscape as "fluffy" or "green" rather than part of a complex and integrated system.

This way of systemic thinking is an absolute necessity in our dynamic world. Projects that can understand the implications of their existence in a larger, rapidly changing context are more responsible and realistic. Similar to our influence and response to climate change - sometimes proactive but more often reactive - design can overlook the small aggregate pieces that make the larger picture. The Butte project prioritized the understanding of the small move, relative to context, and the significant effects it can have on the *Restoration* of a place.

10. EPA. *Community Involvement Plan for the BPSOU*, February 2013

11. Stierle, D. B., A. A. Stierle, J. D. Hobbs, J. Stokken, and J. Clardy. "Berkeleydione and Berkeleytrione, New Bioactive Metabolites from an Acid Mine Organism." [In eng]. Org Lett 6, no. 6 (Mar 18 2004): 1049-52.

12. Stierle, D. B., A. A. Stierle, B. Patacini, K. McIntyre, T. Girtsman, and E. Bolstad. "Berkeleyones and Related Meroterpenes from a Deep Water Acid Mine Waste Fungus That Inhibit the Production of Interleukin 1-Beta from Induced Inflammasomes." [In eng]. J Nat Prod 74, no. 10 (Oct 28 2011): 2273-7.

13 Butte, America. Film. Directed by Pamela Roberts. Bozeman, MT: Rattlesnake Productions, 2009. (Minute 22)

14. Writers' Program of the Work Projects Administration in the State of Montana. *Copper Camp; Stories of the World's Greatest Mining Town.* New York,: Hastings house, 1943.