Reclaiming Rocky Flats: Revealing Buried Cold War History

Daniel R. Horrigan

A thesis
submitted in partial fulfillment of the
requirements for the degree of

Master of Architecture

University of Washington
2018

Committee:
Rick J Mohler
Susan Jones
Juliette Dubroca

Program Authorized to Offer Degree:
Architecture

University of Washington

Abstract

Reclaiming Rocky Flats: Revealing Buried Cold War History

Daniel R. Horrigan

Chair of Supervisory Committee:
Rick J. Mohler & Susan Jones

This thesis examines the reclamation of abandoned Cold War military infrastructure, where history has literally been buried by efforts to restore these sites to their original states. The contamination present at many of these obsolete military installations prevents true restoration from being possible, leading to a simulacrum of nature at best. The Cold War history found on these landscapes contains valuable lessons for the public about the danger inherent in nuclear weapons manufacture and proliferation. Engaging in reclamation brings new life to these sites as places of dark tourism, where architectural interventions facilitate an educational mission, while protecting visitors from the contamination. This thesis focuses on Rocky Flats, a secretive Department of Energy plant located near Denver, Colorado. During its operation from 1952 to 1992 the plant produced plutonium triggers and other components for nuclear weapons. The facility is alleged to have leaked radioactive and other toxic materials into the surrounding landscape. The contamination of the site is alleged to have caused exposure related illnesses in plant employees and civilians living nearby. The proposed architectural Intervention at Rocky Flats, guided by the design strategies of viewing, monitoring, and learning reveals history and reclaims the site as a place of dark tourism. This thesis presents a model applicable to other similarly contaminated sites in order to raise public awareness of the Cold War history that is typically lost to restoration efforts.

acknowledgments

I would like to thank Louisa Iarocci for inspiring my interest in the after life of Cold War military bases and her guidance as I developed my work. Furthermore I would like to express my gratitude for the thoughtful feedback, encouragement, and instruction provided by Susan Jones, Rick Mohler, and Juliette Dubroca through the design process. Finally I must give accolades to my friends and family for their unwavering support throughout my education.

table of contents

list of figures

Images by author unless otherwise noted

Source: https://gdb.rferl.org/6426594D-30E2-4621-B633-60E387D712C1_w1023_r1_s.jpg

01 introduction

On Friday March 23rd, 1951 the Denver Post published the seemingly innocuous headline, “There’s Good News Today: U.S. to Build $45 Million A-Plant Near Denver” (Figure 1).[1] Little did the citizens of Colorado realize that this plant, named Rocky Flats, would be the site of ongoing controversy for decades to come. The plant, initially code named “Project Apple,” was to produce the plutonium triggers for nuclear bombs as part of the vast Cold War infrastructure being developed across the United States, as the arms race with the Soviet Union became a top national defense priority.[2]

Rocky Flats is unique compared to other sites of nuclear bomb production. Unlike the Hanford Reach in Washington, or Los Alamos in New Mexico, it was located only 7 miles south of the city of Boulder and 16 miles northwest of Denver.[3] The sprawling 800 building complex covered ten square miles east of the Rocky Mountains along the front range, and provided jobs for thousands of workers, many of whom lived in subdivisions nearby (Figure 2).[4]

Over the course of its operation from 1952 to 1992 the plant leaked plutonium, beryllium, uranium, and other highly toxic substances into the surrounding area, leaving the soil and ground water severely contaminated.[5] Due to Cold War national security concerns the site operated under a shroud of secrecy, and the nature of the nuclear arms race exempted the plant from federal environmental regulations.[6]


THE DENVER POST

THERE'S GOOD NEWS TODAY

U.S. TO BUILD $45 MILLION A-PLANT NEAR DENVER

Paratroopers Fill the Sky in Surprise Attack on the Reds

Work to Start in April on Site North of Arvada

Figure 1 | Article Announcing the Plant

In 1989, public outcry towards the base and allegations of the illegal use of a plutonium incinerator led the FBI and EPA to raid the Department of Energy operated plant (Figure 3).[7] Following the raid, a federal grand jury was assembled as part of an investigation into alleged breaches of environmental law by the operator, Rockwell International, forcing the company to pay an 18.5 million dollar fine.[8]

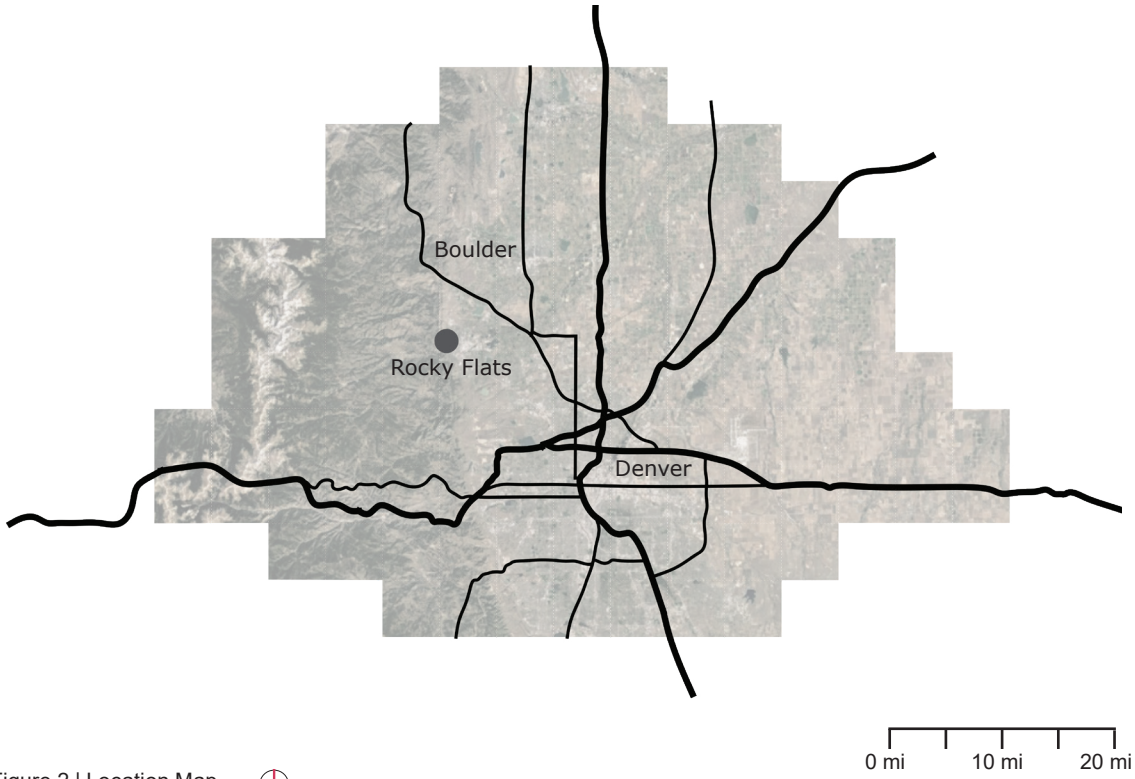


Figure 2 | Location Map

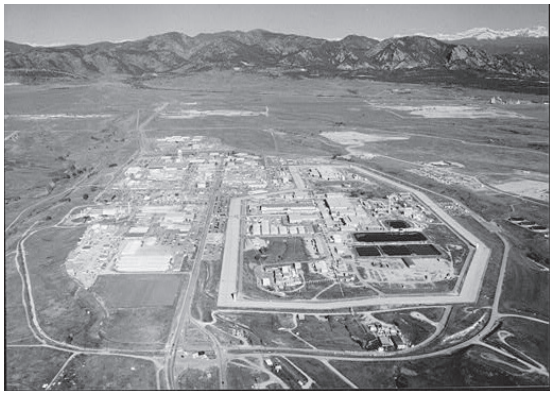


Figure 3 | Rocky Flats Circa 1952

Disgruntled members of the grand jury leaked a report detailing the investigation to the media after the employees of the DOE and Rockwell were spared indictments.[9] In addition to the environmental contamination, it was alleged that residents of the surrounding area and plant workers developed cancers and other illnesses from exposure to the soil and water around Rocky Flats. Rockwell International was also sued as part of a class action lawsuit that alleged the Dow Chemical Corporation and Rockwell knowingly allowed land downwind of the plant to be contaminated. However, the lawsuit was dismissed in 2011 by the Tenth Circuit Court of Appeals.[10] Although the facility was closed in 1992, designated an EPA Superfund Site, and renamed the Rocky Flats Environmental Technology Site in 1994 as cleanup operations started, the contamination of the site will persist long into the future.[11]

The structures at the Rocky Flats plant were demolished between 2001 and 2005 with the contaminated debris either buried or sent to waste storage sites elsewhere as part of the Rocky Flats Cleanup Agreement (Figure 4).[12] Currently the Department of Energy maintains the 1,300-acre site at the former industrial plant, called the Central Operating Unit, for ongoing monitoring and cleanup efforts.[13] This process of burial and demolition has removed most of the physical traces of Rocky Flats. In 2001 the U.S. Department of Fish and Wildlife established the 5,237-acre Rocky Flats National Wildlife Refuge on the site, slated to open in the summer of 2018, as part of efforts to restore the landscape.[14]

Figure 4 | Activists Protesting Near Rocky Flats

However significant public concern remains about the efficacy of the cleanup, with citizen groups like “Rocky Flats Glows” arguing the site is still contaminated with plutonium among other toxins and therefore unsafe for public use.[15] Furthermore, a lawsuit to block the opening of the refuge was filed in federal court in the spring of 2018 by citizen groups along with the former head of the FBI investigation into the plant, John Lipsky.[16] Nearly seventy years after its opening the Rocky Flats site remains embroiled in controversy as questions about the efficacy of remediation efforts remain.

The fate of Rocky Flats is not unique, much of the vast military infrastructure of the Cold War is disappearing across the United States. In his book, *Survival City: Adventures among the Atomic Ruins of America*, journalist Tom Vanderbilt notes that “the Cold War is literally being buried, the fires extinguished as the body laid to rest.”[17] Furthermore, Vanderbilt’s observation that “its effects and vestiges remain, sometimes in surprising guises,” seems to be embodied in the contaminated buried ruins at Rocky Flats.[18] The nuclear weapons program during the Cold War was the most expensive military program in American history, yet its history is slowly vanishing along with its built evidence including: radar installations, production facilities, and missile silos that are being demolished and covered with soil across the country (Figure 5).[19] The legacy of the men and women who sacrificed their health working on these sites is being forgotten while the environmental contamination from such installations will remain for an eternity.

Figure 5 | Demolition of Rocky Flats

Scientists and ecologists agree that the plutonium alone at Rocky Flats will be radioactive for the next 240,000 years.[20] With rising public consciousness of the harmful environmental impact and the public health threats posed by these sites, the current practice of attempting to band-aid these scarred landscapes with wildlife refuges is an inappropriate response. Public understanding of both the environmental folly and human sacrifice related to the activities that occurred on these sites is essential. This is especially urgent due to the persistent effects of the contamination, and the delayed onset of exposure related illnesses.

Demolishing the physical traces of these sites does little more than remove visual reminders, while the invisible contaminants remain, effectively erasing history. The nature of the contamination present on the sites of Cold War nuclear weapons production and the human tragedy caused by the development of these weapons demands a more thoughtful approach than burial and obfuscation (Figure 6).

Figure 6 | The demolition of a Minute Man II Missile Silo

This thesis will explore the role architecture can play in addressing places like Rocky Flats where, in attempting to erase a conflicted past, history has literally been buried, while concerns about public health persist. It poses the question as to how architecture can elucidate the invisible history and contamination found on these sites. It is imperative to learn from the past follies of Rocky Flats and other such landscapes used to make weapons of war, to avoid repeating the mistakes of the past. Furthermore, transparency and education about Rocky Flats' legacy is imperative due to the site's proximity to the metropolitan areas of Denver and Boulder.

The goal of the proposed architectural intervention at Rocky Flats is two-fold, first raising awareness of plant's story and the risk the site continues to pose to the populations of Denver and Boulder. The second is the exploration of design strategies that will create new understandings of this military site while offering protection to visitors and a greater awareness of its legacy. Considering the controversy surrounding the story of Rocky Flats, it is important to note that this thesis seeks to present history objectively by creating an intervention that allows both sides a voice regarding the plant's legacy. Both the protesters and plant workers have their own views of the site's history and it is important to allow visitors to draw their own conclusions about Rocky Flats' past.

Although this thesis seeks to remain objective, the fact remains that during the operation of Rocky Flats contamination escaped the plant, whether this was intentional or not

is a debate that falls outside the scope of this work (Figure 7). The proposed project consists of a series of architectural interventions at Rocky Flats that accept the damage done to the landscape and foster historical knowledge through direct experiences of the site. It envisions facilities that foster public interaction with the landscape's history through the incorporation of the contaminated ruins of the base into the proposed interventions.

Providing visitors access to the site will help raise awareness of the tragic story of Rocky Flats, as collectively experienced by workers at the plant and nearby residents. Protective architecture will allow visitors to explore the site and gain direct experience of

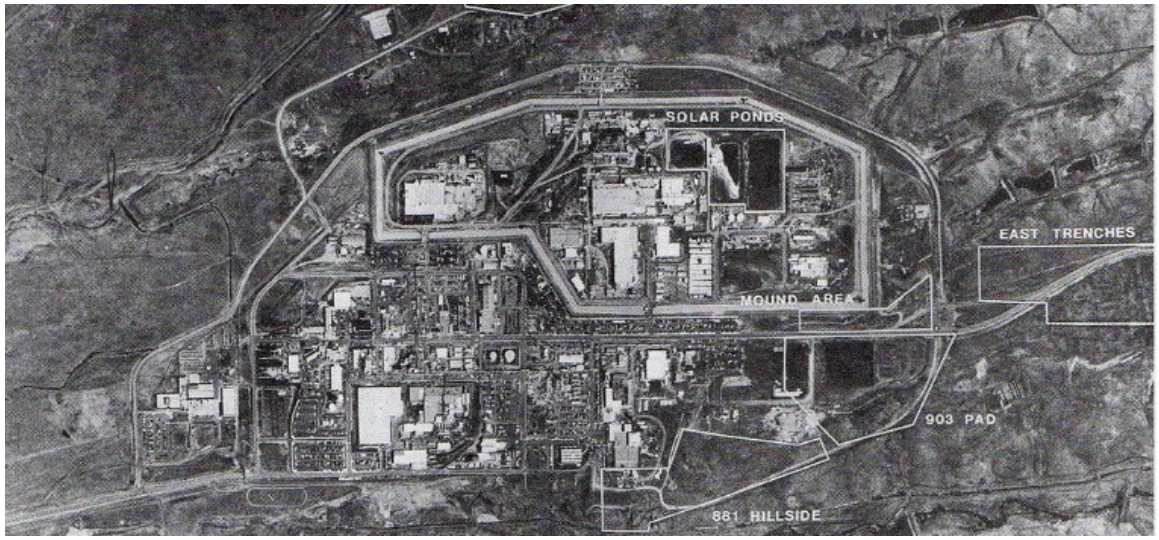


Figure 7 | Aerial Photo Showing Historic Priority Cleanup Sites

sweeping foothills around the plant as well as the subterranean remains of the facility, without risking exposure to the toxic dust lingering on the site.

Guided by the design strategies of viewing, learning and monitoring the proposed interventions reclaim Rocky Flats creating a new life for the site allowing it to serve as a warning against nuclear proliferation (Figure 8). Architecture will serve as the means to exhume the environmental and human legacy of the plant and safeguard the public as they experience the past and learn about the tragedy created by weapons production during the Cold War era.

---

1 Len Ackland, Making a *Real Killing: Rocky Flats and the Nuclear West* (Albuquerque: University of New Mexico Press, 2002), 52.
2 Ackland *Making a Real Killing*, 58.
3 Ibid., 62,79.
4 United States. US Department of Energy. Office of Legacy Management. R*ocky Flats Fact Sheet*. July 25, 2017. Accessed April 12, 2018. https://www.lm.doe.gov/Rocky_Flats/Documents.aspx.
5 United States. US Department of Energy. Office of Legacy Management. *Rocky Flats Fact Sheet*.
6 Ackland *Making a Real Killing*, 168.
7 Kristen Iversen, *Full Body Burden: Growing up in the Nuclear Shadow of Rocky Flats* (Random House, 2013), 218.
8 Iversen, *Full Body Burden*, 356-357.
9 Ibid., 357.
10 Ibid.., 358.
11 Ackland *Making a Real Killing*, 237.
12 Iverson, *Full Body Burden*, 358.
13 “About the Refuge - Rocky Flats - U.S. Fish and Wildlife Service,” U.S. Fish & Wildlife Service, accessed April 20, 2018, https://www.fws.gov/refuge/Rocky_Flats/about.html.

14 Ibid.

15 “Rocky Flats Glows,” Rocky Flats Glows, , accessed April 20, 2018, https://rockyflatsglows.com/.

16 Bruce Finley, “Rocky Flats May Soon Open for Recreation, but the Feds Skipped a Study on Plutonium Exposure and the Risk It Poses to Cyclists and Hikers, Lawsuit Says,” The Denver Post, May 02, 2018, , accessed May 14, 2018, https://www.denverpost.com/2018/05/02/rocky-flats-plutonium-exposure-lawsuit/.

17 Tom Vanderbilt, *Survival City: Adventures among the Ruins of Atomic America* (Chicago: University of Chicago Press, 2010). 197.

18 Tom Vanderbilt, *Survival City*, 197.

19 Stephen I. Schwartz, Atomic *Audit: The Costs and Consequences of U.S. Nuclear Weapons since 1940* (Washington, D.C.: Brookings Institution Press, 1998), 3.

20 Iverson, *Full Body Burden*, 76.

Figure 8 | Nuclear Weapons Testing Over the Bikini Atoll

02 theoretical framework

This thesis seeks to explore the ways architecture can provide a new model for revealing the invisible history of the Cold War in order to increase public consciousness of the human and environmental tragedy these secretive facilities witnessed. The current practice of demolition and burial in the effort to transform former military sites into wildlife refuges inadequately addresses the reality of these places.

In *Reclaiming the American West*, author Alan Berger discusses an incident that illustrates the faults of the current approach. He relays the tale of a wildlife reserve on the restored site of Rocky Mountain Arsenal, a former chemical weapons production facility. The discovery of ten sarin gas bombs near a publicly accessible area forced the closure of the site until the bombs could be removed.[1] This event illustrates the inadequacy of the current restoration practices on these sites and underscores the pressing need to understand and interpret the invisible and toxic wound Cold War military infrastructure has left on the landscape.

The following chapter will explore concepts related to the operation of reclamation in proposing a new means of understanding the site as a wound, and the role of architecture can play in exposing history and protecting visitors in the context of dark tourism. It will employ these concepts to create a theoretical framework for an architecture that responds authentically to the environmental and human tragedy of Rocky Flats. An argument will be made in favor of reclaiming the site in contrast to the current practice of restoration. The concepts of wounding and scarring will be employed as a metaphor in order to generate new programmatic

possibilities to synthesize the old and new, marking the wound while containing it. The newly formed scar will subsequently be understood as a space appropriate for dark tourism that can act as a means of defining the events at Rocky Flats as both a human and environmental tragedy.

Furthermore, an understanding of dark tourism and its architectural implications will elicit a justification for visitation to the site and an appropriate means for spreading awareness of the story of Rocky Flats. The dark tourist site will foster interaction with the contaminated ruins in the effort to convey memories while educating visitors. Finally, the concluding portion of the chapter will examine two distinct architectural precedents relevant to the proposed project in terms of the reuse of former military bases through the development of architectural interventions. Precedent analysis will discuss the reinterpretation of a former Soviet Airbase by DGT architects as the new Estonian National Museum. It will also examine Peter Zumthor's unbuilt Topography of Terror museum in Berlin as sensitive architectural intervention on a site with a challenging history.

Figure 9 | Minute Man Missle in Silo

reclamation not restoration

In the introductory chapter of *Survival City: Adventures Among the Ruins of Atomic America*, Tom Vanderbilt provides an account of the demolition of a series of Minuteman II ballistic missile silos in North Dakota (Figure 9). These Cold War relics were stripped of all valuable material, demolished, and capped with a concrete slab and returned to the farmers

Figure 10 | View of Rocky Flats in 1995 & 2005

whose land they occupied.[2] The warheads of the missiles in these silos were the final destination of the plutonium triggers produced at Rocky Flats; however these sites are also connected by their fates. Both, once crucial pieces of the United States' nuclear deterrence system, lie dormant with all evidence of their existence buried today, save for the invisible contaminants they left behind.

The story of the missile silos in North Dakota is representative of the current treatment of these sites following the conclusion of the Cold War. President George H.W. Bush's decision in 1992 to cease America's nuclear proliferation by halting the development of the Trident II missile program sealed their fates.[3] As part of the Rocky Flats Cleanup Agreement and subsequent Rocky Flats National Wildlife Refuge Act, the Department of Energy along with other government agencies demolished the buildings at Rocky Flats between 2001 and 2005, and began the process of restoring and monitoring contamination on the site (Figure 10).[4] This effort as part of the cleanup agreement, erases the history of the site and creates a simulacrum of nature, where contamination will remain active for hundreds of thousands of years.

The "Western Paradox" as defined by historian Donald Worster refers to the prevalent notion of "simple minded nature fantasy" or the belief in an ideal nature versus the reality of environmental harm inflicted by American society.[5] Alan Berger reinforces the misconception of being able to restore damaged landscapes in the discussion of the Rocky Mountain

Arsenal incident mentioned earlier. He expands on this notion by acknowledging that culture has difficulty determining how to handle landscapes scarred by resource production and or extraction.[6]

As a site of toxic resource production, plutonium, uranium, americium, tritium, and so forth Rocky Flats presents itself as a landscape in need of reclamation, not restoration (Figure 11). Berger states that “altered landscapes are reclaimable as new ecological situations, having wider programmatic possibilities.”[7] The term restoration implies returning a site to its previous ecological state whereas reclamation accepts the site has been permanently altered by human activity. The ecological reality of the altered state yields new programmatic possibilities through acceptance of the contaminated state. Exploring the new possibilities of this approach is the focus of the architectural interventions proposed in this thesis.

Lebbeus Woods echoes the case against restoration noting that it “ends as parody” and suggests that what has been lost in war can never be replaced. He observes that “new directions and new choices are articulated” when reclamation occurs.[8] The natural state of the landscape surrounding Rocky Flats was lost forever due to the relentless expansion of the United States nuclear arsenal during the Cold War. In reclaiming the site for a new use architecture creates a more authentic direction in choosing to accept the loss of the site’s former natural state. Berger argues that reclaimed landscapes are the result of the way society through

Figure 11 | View of a Room used for Storing and Retrieving Plutonium

technology, science, and culture works to reorder land in new ways that allow humans to create realities that fulfill their purposes.[9] Architecture is intrinsically a product of human technological systems, and culture that reorders reality in a manner that provides utility to its occupants; therefore, the design proposal seeks to provide an appropriate means of reclaiming a site like Rocky Flats.

Furthermore, the citizens group Rocky Flats Glows argues the site and surrounding areas still contain unacceptable levels of radioactive contamination. The group goes so far as to advise citizens not to visit the wildlife refuge slated to open in the summer of 2018 (Figure 12).[10] In light of the inadequacy of approaching this site as a restoration project, conceptualizations of the landscape necessitate that Rocky Flats be understood as a site with the potential for reclamation through architecture. The operation of reclamation begins with a closer examination of the mark former use has left on the landscape as an eternal reminder of the wound caused by its past.

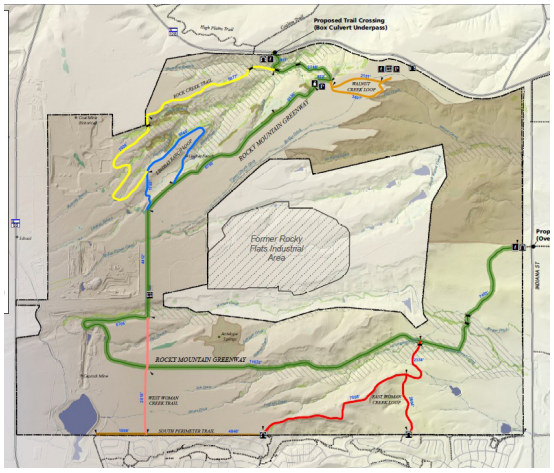


Figure 12 | Map of the Proposed Wildlife Refuge

Figure 13 | The Cold War Horse, a Sculpture by Jefferey Gipe

healing the wounded landscape

> "Acceptance of the scar is central to existence. Healing is not an illusory, cosmetic process, but something that by articulating differences both deeply divides and joins together"
> - Lebbus Woods, *War and Architecture*, 31

Understanding Rocky Flats as a wounded landscape frames its past as a tragedy and is a methodology for reclaiming and healing the site. Rocky Flats' proximity to Denver and Boulder has in its past led to politically charged controversy affecting both the employees of the plant and neighboring residents, positioning it at the crossroads of Cold War and Colorado history. Anna Storm, writing in *Post-Industrial Landscape Scars* imparts the notion that the marks left by past industries are reminders of wounds, imbued with notions of betrayal, sorrow, and abuses of power; while memorializing the stories of the communities that resisted them.[11] This idea applies directly to Rocky Flats, where a pristine foothills landscape became a factory dedicated to the production of weapons with the potential to wipe out all life on planet Earth. Rocky Flats' legacy brought illness and suffering to the workers and neighbors of the plant and environmental contamination, under the shroud of Cold War secrecy.[12] The site of the plant is permanently marked and wounded by the remaining contamination and its controversial history.

The idea of the post-industrial landscape as a scar presents itself as a potent metaphor for addressing the story of Rocky Flats. Storm argues that "memories need footholds, and the scar metaphor provides a conceptual tool to capture both memories and the footholds in a

cohesive way."[13] It lays the groundwork for an emotionally charged reading of the site, creating the possibility of revealing and healing the invisible history of the plant (Figure 13). Scars not only serve as the marks of a wound, but they also signify healing as new scar tissue is formed in the process. As opposed to restoration operations, reclaiming the wounded landscape implies a sequence of events from wounding to healing, with the scar metaphor suggesting healing as a possible outcome. Author Anna Storm supports this notion, describing how the new layers of dense scar tissue form part of the living body and create a wholeness in the understanding of the events on a site.[14]

The scar metaphor, when applied to Rocky Flats, completes the understanding of the space by creating distinct states of the site, a pre-wounded state, a wounded state,and finally the reclaimed scarred. The metaphor serves in developing a cogent narrative about Rocky Flats suggesting the of healing this site through architectural intervention presents itself as a valid approach. This metaphor not only allows for the marking, and healing of the landscape, it also forms an understanding of the intervention as the synthesis of old and new as well as past and present.

Lebbus Woods describes the scar as a "mutant tissue" that conjoins the old and new without dismissing either in the pursuit of forming a unified whole (Figure 14).[15] The formation of a scar, in the context of a body, fuses the damaged tissue with newly formed scar tissue. The fusion of these tissues brings the past and present together through the scar without sacrificing

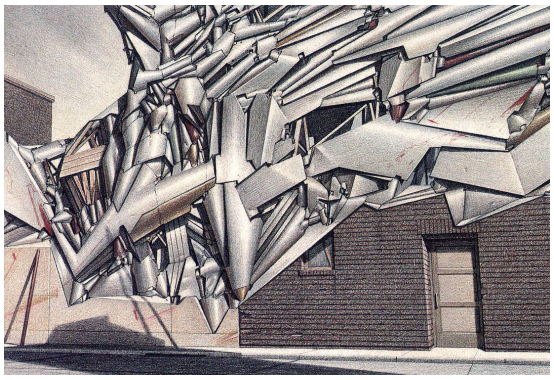


Figure 14 | Drawing of the Scar by Lebbus Woods

the integrity of either the new or the old. In synthesizing these states, the scar metaphor serves also to reveal the past, simultaneously accepting it and moving forward. Design intervention understood as a part of healing the wounded landscape, joins the past and present as a scar with architecture forming the new mutant tissue. In *Post-Industrial Landscape Scars*, Anna Storm argues the scar allows for the integration of many dichotomies present on scarred sites, observing that the scar is “organic and created on the basis of past significances entangled with present standpoints.”[16]

Scarring thus provides an integrative metaphor for addressing the past of these sites in the context of the present, serving to create a wholeness in the understanding of the site. In *War and Architecture* Lebbus Woods states that “architecture is a major coalescing activity in society, bringing together many flows into a single complex stream.”[17] His argument for the power of architecture to develop multiple forces echoes Storm’s argument for the integrative power of the scar metaphor. Both authors provide a justification for the ability of architecture to synthesize the past and present on a site into a new and meaningful experience. The power of the scar metaphor, operating in a manner analogous to biological scarring, allows architectural interventions to address these sites more appropriately than restoration. It offer the potential to integrate the dichotomies present on Cold War bases, and serves to protect their histories from erasure, while the new mutant tissue opens the site to a new life.

Figure 15 | DOE Fencing around Rocky Flats

As the reclaimed landscape of Rocky Flats is understood through the lens of the scar metaphor, the site is opened to new programmatic possibilities transcending the nature reserve strategy often dictated by restoration. These new possibilities are created when the past damaged by war, has been permanently altered and the state of the sites suggest new conceptualizations for human understanding.[18] In accepting the destruction, architecture serves to “build upon the shattered form of the old order a new category of order inherent only in present conditions.”[19] Sites like Rocky Flats were degraded in a more invisible insidious way than outright conflict. The environmental contamination left behind by their operations was a direct result of the decades long global conflict between the United States and the Soviet Union (Figure 15). Therefore, Wood’s observations about the relationship between war and architecture and the new programmatic possibilities that result remains appropriate to these sites. The mutant tissue created by the process of scarring on Rocky Flats offer the potential to yield new forms of knowledge based on Woods understanding.[20] In healing the wounded landscape through the scar, the metaphor allows architecture to build on Rocky Flats’ dark past, revealing it and fostering a new meaningful life for the site.

The scar also serves to clarify the role architectural intervention will play in exposing the past and protecting visitors within the reclaimed landscape. As mentioned previously, the scar provides a permanent marker of the wound signifying healing. Through its integrative nature, scarring brings both the past and present together allowing for a complete understanding of the site. Through these processes the history of Rocky Flats, and similar places can be exposed. In

doing so the architecture reveals the once buried history of the site, and in turn serves to raise awareness in the public consciousness about the story of Rocky Flats.

As the past is exposed, visitors to the site require protection from the permanent contamination; just as a scar protects a wound from further damage or infection. Architectural intervention must physically protect visitors due to the real concerns related to the efficacy of cleanup operations and ongoing debate regarding safe levels of exposure to radioactive substances. Conceptualizations of the intervention serving as a protective scar seeks to assuage these concerns while recognizing the past failures to prevent the spread of contamination.

dark tourism and ruin

The need for protection also complicates the intervention's aim of revealing history, as past events now necessitate the need for protective enclosures for visitors to the site. The exposure and protection dichotomy gleaned from the scar metaphor builds on the scar's role as a marker of the wound, a signifier of healing, and a device for coalescing the past into new programmatic uses imbued with new forms of knowledge. The proposed use for Rocky Flats as a site of dark tourism yields the final piece of the conceptual framework defining the reclamation approach to these former Cold War sites.

In the aim of reclaiming the scarred landscape of Rocky Flats; this thesis proposes the former plant take on the role as a site of dark tourism (Figure 16). The concept of dark tourism serves the intervention by orienting the understanding of the past, and justifying visitation. Dark

Figure 16 | Rocky Flats Circa 1952

tourism is a phenomenon defined by the growing interest in the late twentieth and early twenty-first centuries of visiting sites where disasters and atrocities have occurred.[21]

In their book, John Lennon and Malcom Foley more specifically describe the phenomenon, as visitation to sites and objects where global communication technologies like media reporting, have generated interest that is rooted in the anxiety and doubts such sites generate about the modern era.[22] Media stories about Rocky Flats exposed the secretive work conducted at the plant to the public generating significant concern about the plant and spurring activism against it (Figure 17). Furthermore, the exposure of the plant's true nature continues to generate significant concerns and anxiety about the virtually permanent contamination. These concerns are exacerbated when the plant's proximity to a major metropolitan area is considered. An accident at Rocky Flats when it was in operation had the potential to create an exclusion zone around the Denver and Boulder metropolitan areas similar to the one found at Chernobyl.[23] In light of these concerns, a space for dark tourism is developed as the new programmatic possibility for Rocky Flats.

Dark tourism also serves in defining the events at Rocky Flats as both an environmental and human tragedy. The permanent transformation of thousands of acres of natural landscape into a contaminated industrial site coupled with the ailments suffered by workers and nearby residents is understood as a tragedy in the context of dark tourism. In defining Rocky Flats history as a tragedy, the need for reclamation through healing the scarred landscape is clarified

Figure 17 | Rocky Flats Inspired Artwork

and dark tourism justified. This concept also provides a rationale for visitation to Rocky Flats and similar Cold War sites as users are drawn through interest in their tragic stories.

According to authors Sharpley and Stone, visitation to these sites has the potential to make death present and consumption of these sites bringing a new understanding through memorialization and education.[24] Furthermore, in creating this type of space architectural intervention facilitates the process of educating guests about its history and memorializing its past. As mentioned earlier, Rocky Flats is located closer to population centers than other similar sites, the proximity provides it with an automatic level of interest in the former base.

The opportunity to experience Rocky Flats first hand will not only spur interest in the site, but also can spread awareness of its legacy and dangers through visitation. Sharpley and Stone developed several categories of dark tourism in their studies, one being “perilous places,” or sites that still pose a slight risk to visitors and appeal to desires to confront mortality.[25] The danger still posed by the contamination at Rocky Flats helps categorize the site as a perilous place. This appeal encourages tourism allowing the reclaimed site to function in exposing the past while offering a degree of protection to visitors.

While dark tourism clarifies the purpose of reclamation and healing the wounded landscape, any intervention facilitating tourism must grapple with the concept of authenticity. Revealing lost history risks favoring one interpretation of events over another or presenting an

incomplete perspective of past events. Authors Sharpley and Stone argue that dark tourism sites can lose a degree of authenticity and meaning for visitors if historical events are presented in an altered or distorted manner stating these sites must “ideally authenticate the events they represent.”[26] In the pursuit of authenticity the intervention seeks to avoid distorting the history of Rocky Flats by presenting its past in an objective and neutral manner.

The importance of authenticity in creating a space for dark tourism is further underscored by these authors, who advise that dark tourism spaces must recognize all relevant histories on a site, good and bad, to create an authentic memorialization of tragic past events.[27] Incorporating the ruins of the plant and the contamination into the intervention elevates the degree of authenticity to a greater level (Figure 18). Providing access to the original historical artifacts on the site must aim to present history in a neutral manner. Through a sensitivity to authenticity, the history of these sites can be exposed and their past wounds begin to heal.

> “The ruin slows time and grasps the past as a part of the present, as it inserts the present within the past”
> - Marc Treib in *Remembering Ruins, Ruins Remembering, Spatial Recall*: pg 195

Direct access to Rocky Flats also holds the potential of revealing the complex nature of the ruins and contamination because both serve as marks of the physical memory forming the wound. Two forms of ruins exist on these kinds of abandoned sites; the physical remains of the facilities, and the unseen contamination left on site. These physical reminders echo Marc Treib’s argument that ruins bring the past to the present and bring the present into the past.[28] History

Figure 18 | Excavated Ruins at the Plant

is exposed through the direct relationship accessing the ruins provides, as the memory of the wound is brought forth into the present. Dark tourism aids this evolution by allowing visitors to contemplate both their own mortality, and the environmental damage caused by these sites "from a perceived safe distance."[29] Author Marc Treib, in the essay "Remembering Ruins, Ruins Remembering" states that "we also use the idea of the ruin to retard the fading of memory" underscoring the importance of the ruin in preserving memory.[30]

This thesis thus proposes to reclaim the site at Rocky Flats by enabling direct access to the ruins .Through memorialization of the human and environmental tragedies of Rocky Flats an authentic narrative of the landscape can be developed and fostered through built form. Physical access to the ruin brings the past to the present, educating the visitor and raising public consciousness of the tragedy. Understanding the events of the past allows the visitor to create new readings of both the present and future by juxtaposing it with the past.[31] Architecture through reclamation forms the scar that allows the creation of these new understandings, achieving the dual goal of exposing history and protecting visitors from the contamination still on site. The practice of dark tourism fostered by ruins create a sense of authenticity through first hand experience of these sites, drawing visitors and memorializing the past (Figure 19).

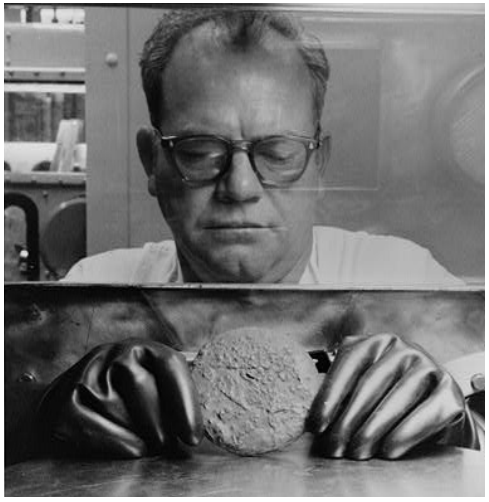


Figure 19| A Worker Handles a Plutonium Buttom

Figure 20 | Aerial View of Rocky Flats

precedent analysis

Examination of architectural precedents that grapple with similarly difficult sites yields valuable insight for developing a framework for addressing Cold War military installations. These case studies explore sites with politically charged histories, where human tragedy or environmental degradation have occurred. Each project approaches a difficult location with a sensitivity to the past while incorporating the physical remains of their history. These projects confront and accept history without attempting to obfuscate or restore the sites to idealized recreations.

The first project, located in Tartu Estonia exposes and accepts a tragic history. It is located in a nation held under foreign occupation for much of the twentieth century which brought great suffering on the people. The Estonian National Museum designed by DGT Architects, completed in 2016 was built on former Soviet Airbase (Figure 21). The architects dismissed the original site and chose to locate the building at the end of an old military runway.[32] Their intent was to create a “physically present ruin of a painful history” in order to reinvigorate it in a way that exposes and accepts history.[33]

Figure 21 | Aerial View of The Estonian National Museum

The building does not seek to restore the site, rather the site is left raw bearing the marks of the digging required to remove contamination from the soil.[34] The form of the structure lifts off of the ground at the end of the runway, gradually ramping up towards the sky creating a shallow triangular form in section. The form recalls the site’s former use as an airbase while

abstracting the flight path of a jet taking off from the runway. The lift brings the memory of the site to the forefront of the visitor's mind as they enter the museum beneath the large canopy (Figure 22).

The museum reclaims the site leaving the signs of Soviet occupation intact, while accepting the wound and scarring over it through the synthesis of old and new elements. The integration of existing base buildings fosters the new use of the site; creating a sense of pride and honor in both the past and the new possibilities of the future.[35] The site planning leaves the existing area largely untouched while incorporating old garages by transforming them, into shops, bars, and cafes.[36] The architects developed an intervention that forms a scar over a wounded history by coalescing the old and new into a unified whole that respects its constituent elements.

Incorporating the runway and other ruins on the base fosters a sense of authenticity by allowing visitors to experience them directly. Furthermore, the project exposes the history of the site through the adaptive reuse of military facilities. The Estonian National Museum is understood as the reclamation of a wounded landscape through its sensitive reading of the site and its embedded history. Dan Dorell, one of the lead architects, designed the museum with the intent that the intervention was "mature enough to get over the trauma."[37]

Figure 22 | View of Exterior & Entry Canopy

The collections of the museum contain artifacts of common people that attest to the repression and suffering they experienced under Soviet rule (Figure 23).[38] The project seeks to aid in the rebirth of cultural history and national identity without forgetting the pain wrought by the site's former use.[39] DGT's museum interprets the site through built form in a manner that reclaims the site while exposing its history and healing the past.

Figure 23 |View of Gallery

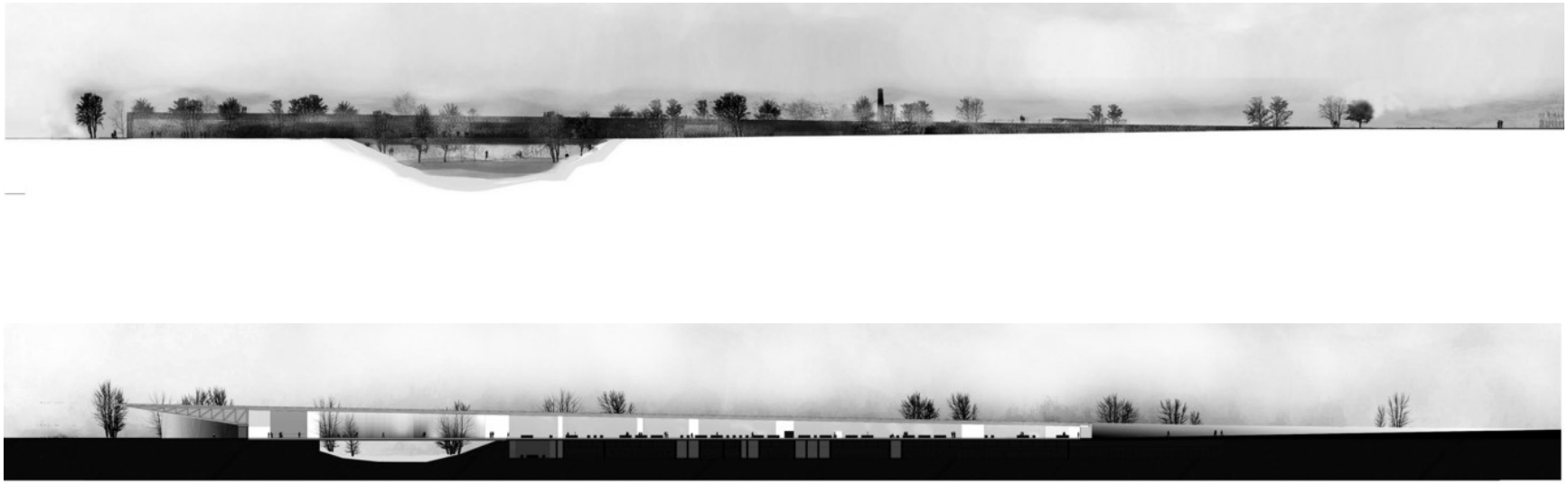


Figure 24 | Section Cuts

Peter Zumthor's unbuilt proposal for the Topography of Terror, in Berlin Germany designed from 1993 to 2005, offers insight into an authentic approach to a dark tourism space. The project slips between the ruins of the Gestapo, SS, and SD headquarters, which were leveled during WWII and excavated in 1987 (Figure 25).[40] The museum is intended to display preserved Nazi documents providing visitors a glimpse into the internal workings of the regime.[41] Zumthor's project falls within the scope of dark tourism as it allows visitors to directly interact with a site where unspeakable horrors occurred.

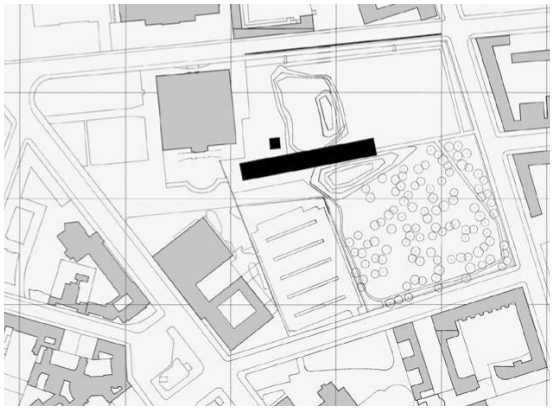


Figure 25 | Site Plan

Furthermore, the project provides a model for an authentic approach to exposing history on an extremely sensitive site. The project sought to create an environment where the meaning and experience of the place was not overwhelmed by the architecture, favoring pure tectonic language over symbolism (Figure 26).[42] Lennon and Foley observe that the "permanency of monuments, ruins, and preserved spaces, can serve to attract a public dissatisfied with constant stimulation and media culture in the modern age." By rooting the building to the ruins on the site Zumthor creates an experience where history is not overwhelmed with a sober and simple design that brings the memory of past horrors to the present.

Zumthor's building achieves reclamation of the area and forms a scar over its wounded past through thoughtful interpretation. In accepting the presence of the ruins and developing an architecture grounded in them, the Topography of Terror reclaims this area of Berlin. Zumthor's

Figure 26 | Exterior View

proposal draws on all elements in its surroundings, allowing nothing to hang from the ceilings or be attached to the walls, grounding the architecture literally in the history of the site and simultaneously distinguishing the two (Figure 27).[43] In accentuating the connection between context and building in a literal way, the Topography of Terror brings the past into the present, in acknowledging the power of the ruin.

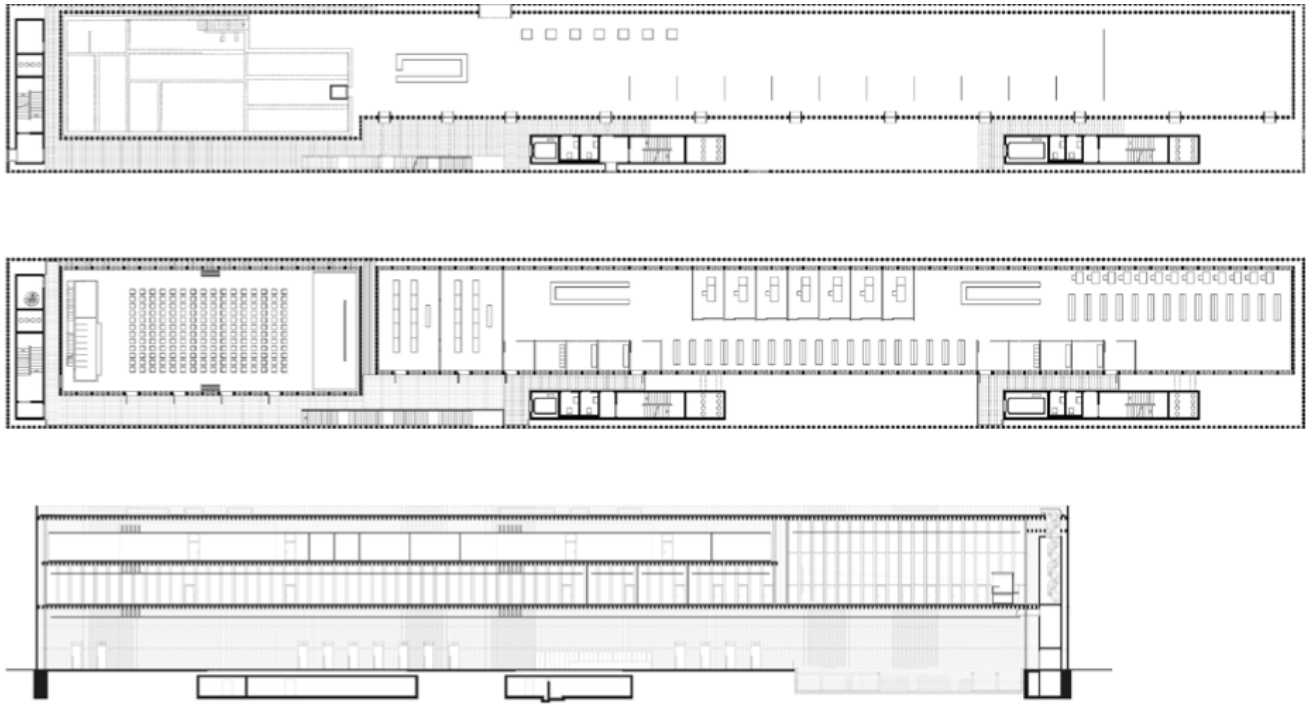


Figure 27 | Plans and Section Cuts

The literal grounding of the project also forms the scar as the building and site are synthesized into a new mutant tissue. This tissue imbues the building with its new programmatic function as a space of dark tourism. The project leaves the ruins untouched and is sited between the excavation zones, indicating Zumthor's museum accepts the wound of its tragic past. The architecture visually differentiates itself from the site through its use of white concrete and timber, becoming a bright and transparent volume (Figure 28).[44] This differentiation allows both the new and old tissue to read separately while unifying the experience on site, and serves to both reveal the past and heal it through education and memorialization of the victims.

In his approach to exposing a buried history and healing the wounded landscape, the Topography of Terror creates an authentic dark tourism experience that allows the past to be understood. Peter Zumthor further links site and building through the tectonic language of "pure construction" by employing vertical ribs separated by thin glazed surfaces which through their rhythm provide a visual connection to the surrounding site (Figure 29).[45] The design allows the "semantic complexity" of relationships between old and new to orient the visitor to the past and future.[46] This relationship allows visitors to confront tragic histories and uses the understanding garnered by these experiences to create present and future meaning. Thus the scar tissue created by the intervention fosters these new forms of knowledge, healing the past. The unbuilt design proposal develops an architectural framework that responds authentically to a difficult site. An understanding of the power of reclamation through the concept of scar metaphor creates a dark tourism experience that brings the memory of past tragedy to life.

Figure 28 | View of Interior

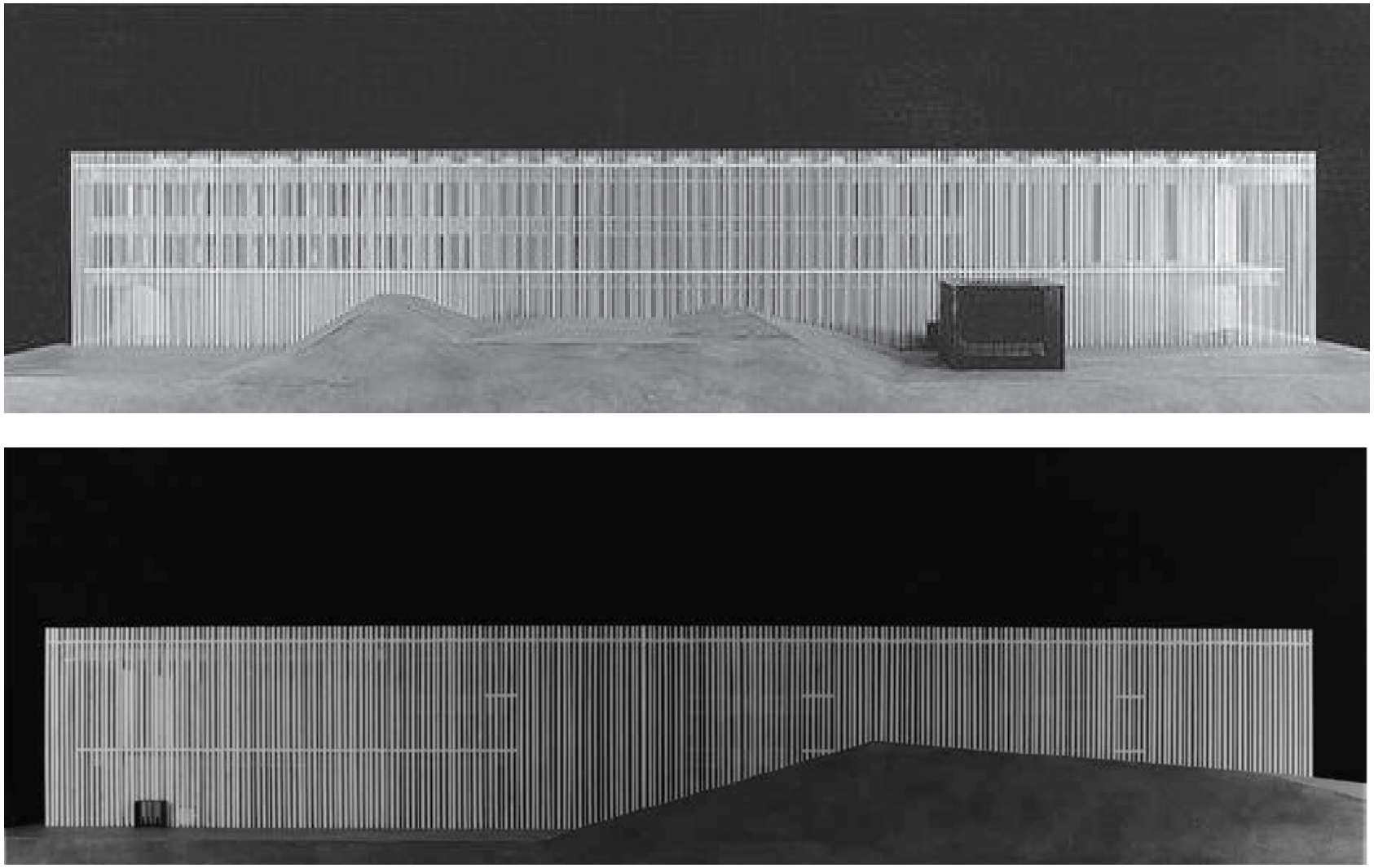


Figure 29 | Elevations

conclusion

The proposed architectural intervention at Rocky Flats seeks to provide a model for intervening at similar Cold War sites, where a troubled past has permanently altered the landscape. Developing this model requires a theoretical framework responsive to the complexities inherent within these sites. As discussed throughout the course of this chapter the design intervention requires a sensitive understanding of the place through a series of operations at various levels. Guided by the overarching goal of revealing buried history the project will accept the trauma of the past on these sites and move forward. In rejecting restoration in favor of reclamation the framework avoids the “restoration parody” Woods warns against in *War and Architecture*.[47] The author elaborates on his point, stating layered complex histories of cities are erased in the pursuit of restoration.[48] Restoring military sites to a simulacrum of their natural pre-war state erases the complexities and questions raised by their past in the same way.

Reclamation provides the opportunity to explore the past through this acceptance which leads to a new understanding of the site as a wounded landscape. In seeking to heal this wounded landscape, the site is not only marked, but its past is divided into states representing the healing process. Prior to wounding, biological tissue exists in a natural state; analogous to the way Rocky Flats existed as a natural landscape prior to the construction of the plant.

The construction of the plant and subsequent leaking of contaminants brings the site into its current wounded and contaminated state, just as a body is injured through an accident (Figure 30). The place enters its final state as a scarred landscape, which integrates the new and old into a new mutant tissue as the intervention begins healing the trauma. In its final state the site embraces its past as the scar tissue yields a new understanding for the location as a place appropriate for dark tourism.

Figure 30 | Plutonium Manufacturing at Rocky Flats

In embracing dark tourism, the histories of Rocky Flats and other similar installations are exposed, enabling the memorialization of past traumas. Dark tourism becomes a generator of new forms of knowledge regarding these places as the scarred landscape allowing the sites to accept their history. In addition to framing the past as an environmental and human tragedy, concepts related to perilous dark tourism guide the project towards an authentic portrayal of this past while generating interest in the site. Ruins in the form of physical remains and remnants of contamination become crucial components in the pursuit of authenticity.

Interest in the site generated by the ability of ruins to make history real in the present serves in exposing the memories buried by restoration. Architecture forms the enclosure protecting visitors from the ruins, reinforcing the nature of the site as it forms the new mutant scar tissue, while maintaining authenticity. Visitation raises awareness of the past, as greater public consciousness memorializes the tragedy. Through this framework the tragic history of Rocky Flats is made real. The rejection of the burial and erasure of the past allows for new understandings of the site in the hope that such human and environmental tragedies are not repeated.

---

1 Alan Berger, *Reclaiming the American* West (New York, NY: Princeton Architectural Press, 2002), 32.
2 Vanderbilt, *Survival*, 197.
3 Ackland, *Making a Real Killing*, 227.
4 Iverson, *Full Body Burden*, 357-358.
5 Donald Worster, *Under Western Skies: Nature and History in the American West* (New York: Oxford University Press, 1994), 90-91.

6 Berger, *Reclaiming the American West*, 32.
7 Ibid., 32.
8 Lebbeus Woods, *War and Architecture = Rat I Arhitektura*, vol. 15, Pamphlet Architecture (New York, NY: Princeton Architectural Press, 1993), 10.
9 Berger, *Reclaiming the American West*, 61.
10 “Rocky Flats Glows,” Rocky Flats Glows, , accessed April 20, 2018, https://rockyflatsglows.com/.
11 Anna Storm, *Post-industrial Landscape Scars* (Basingstoke, Hampshire: Palgrave Macmillan, 2016),
12 Ackland, *Making a Real Killing*, 69.
13 Storm, *Post-industrial Landscape Scars*, 8.
14 Ibid., 4.
15 Woods, *War and Architecture*, 31.
16 Storm, *Post-industrial Landscape Scars*, 3.
17 Woods, *War and Architecture*, 6.
18 Ibid., 14.
19 Ibid,. 14.
20 Ibid., 31.
21 John Lennon and Malcolm Foley, *Dark Tourism* (London: Continuum, 2000), 3.
22 Ibid., 11.
23 Ackland, *Making a Real Killing*, 165.
24 Richard Sharpley and Phillip R. Stone, *The Darker Side of Travel the Theory and Practice of Dark Tourism*, vol. No. 41, Aspects of Tourism (Tonowanda, NY: Channel View Publications,2009), 36.
25 Sharpley and Stone, *The Darker Side of Travel*, 11.
26 Ibid.,112.
27 Ibid.,163.
28 Marc Treib, *Spatial Recall: Memory in Architecture and Landscape* (New York; London: Routledge, 2009), 195.
29 Sharpley and Stone, *The Darker Side of Travel*, 37.
30 Treib, *Spatial Recall*, 197.
31 Ibid., 199.

32 Rowan Moore, “Estonian National Museum Review – Touching and Revealing,” The Observer, January 01, 2017, , accessed April 27, 2018, https://www.theguardian.com/artand design/2017/jan/01/estonia-national-museum-review-touching-and-revealing-dgt-dorell.

33 “Estonian National Museum / DGT Architects (Dorell.Ghotmeh.Tane),” ArchDaily, June 06, 2016, , accessed April 27, 2018, https://www.archdaily.com/788767/estonian-national-museum-dgt-architects.

34 Moore, “Estonian National Museum Review – Touching and Revealing,” The Observer, January 01, 2017.

35 Woods, *War and Architecture*, 31.

36 Insa Thiel, “Entrée into past Times: Estonian National Museum in Tartu,” Detail-online.com, , accessed April 27, 2018, https://www.detail-online.com/article/entree-into-past-times-estonian-national-museum-in-tartu-29380/.

37 Moore, “Estonian National Museum Review – Touching and Revealing,” The Observer, January 01, 2017

38 Ibid.

39 “Estonian National Museum / DGT Architects (Dorell.Ghotmeh.Tane),” ArchDaily, June 06, 2016, , accessed April 27, 2018, https://www.archdaily.com/788767/estonian-national-museum-dgt-architects.

40 Claudio Leoni, “Peter Zumthors ‘Topography of Terror’,” *Architectural Research Quarterly* 18, no. 02 (2014): doi:10.1017/s1359135514000426, 111.

41 Steven Spier, Martin Tschanz, and Chirstian Richters, *Swiss Made: New Architecture from Switzerland*, 1st ed. (New York, NY: Princenton Architectural Press, 2003), 219.

42 Spier, Tschanz, and Richters, *Swiss Made*, (New York, NY: Princenton Architectural Press, 2003), 224-225.

43 Spier, Tschanz, and Richters, *Swiss Made*, 225.

44 Leoni, “Peter Zumthors ‘Topography of Terror,’ 113-114.

45 Spier, Tschanz, and Richters, *Swiss Made*, , 224.

46 Treib, *Spatial Recall*, 199.

47 Woods, *War and Architecture*, 14.

48 Ibid., 14.

Figure 31 | Uranium Processing Facility at Rocky Flats

Figure 32 | Rocky Flats National Wildlife Refuge

03 site analysis

Rocky Flats is a particularly relevant site for exploring a methodology to guide interventions at other derelict Cold War installations. As previously noted the complex is located near the cities of Denver and Boulder; furthermore in recent years housing developments, like the Candelas community, have been built adjacent to the site. Rocky Flats was part of a growing number of military bases brought to the state in the 1950's by Senators Edwin Johnson and Eugene Millikin; others included the Air Force Academy, and the North American Air Defense Command.[1] The plant was located close to Denver due to its attractive climate, developed labor pool, and the desire of the Atomic Energy Commission to avoid the need to construct a company town to house the employees.[2]

Operating for nearly fifty years producing plutonium triggers, the secretive facility at Rocky Flats became mired in controversy. Public concerns and whistle blower allegations of environmental crimes led to an investigation and the 1989 raid on the plant during a joint endeavor between the FBI and EPA called "Operation Desert Glow."[3] After conducting a series of flyovers with infrared cameras the FBI and EPA became suspicious that Rockwell International was illegally operating a plutonium incinerator and allegedly spraying contaminated water into nearby fields which gave the agents probable cause.[4] The site remains a flash point between those who believe the area is safe and those who believe it still poses serious threats to human health. Numerous public schools in Colorado recently banned field trips to the proposed Rocky Flats Wildlife Refuge (Figure 32).[5] Recently Denver area journalist Vincent

Carroll argued that health concerns about the site are exaggerated and the DOE has done an adequate job remediating the contamination.[6]

Developing a deep understanding of facilities like Rocky Flats is essential to the formulation of a successful design solution. These types of sites are strongly rooted in the physical space they occupy and their historical context. The following chapter will propose a methodology for built interventions at these facilities, focusing on Rocky Flats and its unique circumstances. The thesis objectives will be articulated as the design proposal seeks to heal the history of Rocky Flats by exposing it. A detailed discussion of the site selection and analysis will follow as the site is understood in terms of its natural pre-contaminated state and its wounded post contaminated state. The proposed design seeks to shift the site into its new reclaimed scarred state bringing new life to Rocky Flats. The design strategies of viewing, monitoring, and learning in relation to the program of spaces guide this new state as Rocky Flats becomes a site of perilous place style dark tourism. Finally, the concept of glove boxes is explored as a means to protect users as they engage in viewing monitoring and learning within the intervention.

Revealing buried history through an architectural intervention at Rocky Flats remains the primary aim of this thesis. In doing so the proposed project seeks to provide closure for the plant's troubled legacy by giving a voice to the parties involved with the plant. Furthermore, it seeks to heal the suffering wrought on employees and neighbors of the facility through their exposure to the leaked contamination.

The goal of the design program is to memorialize the site by providing space for education through museum exhibits and opportunities for direct interaction with ruins of the former plant. With Denver's neighborhoods closing in on the plant's boundaries more every year answering the question, of what to do with Rocky Flats becomes increasingly critical. The architectural intervention and the themes embedded within it seek to answer this question with the objective of healing the landscape and tragic legacy to allow the stakeholders of the plant to move forward.

The thesis proposal seeks to avoid the erasure of the past experienced at Rocky Mountain Arsenal where the discovery of the sarin gas bombs illustrated the inadequacy of burying history and the futility of the restoration minded approach to these sites. Tom Vanderbilt in *Survival City* recounts the tale of his visit to the bizarre, yet stately Missile Site Radar Pyramid and Safeguard Missile Defense System (Figure 33).[7] The author need permission from the Air Force to visit the complex and found he had been the only visitor for months after viewing the guest log.[8] This site represents a burial of history as it fades from memory through restricted access and obscurity. Preventing erasure in this form is another objective of the intervention at Rocky Flats, and it provides a rational for allowing visitors to directly experience the site of the plant itself. Limiting access erases the power of the ruins to convey history and memory, which are crucial elements in the healing process.

Figure 33 | "Nixon's Pyramid" The Safeguard Missle Site Radar Installation

Len Ackland in the essay “Open Wound from a Tough Nuclear History” argues in favor of opening a museum that presents all sides of the Rocky Flats story, criticizing the DOE for attempting to bury the past by withholding financial support.[9] Ackland argues in favor of exposing and preserving the memory of Rocky Flats and provides further support for reclaiming and healing the site through allowing visitation. In fact the Rocky Flats Cold War Museum has existed as a museum without a home since 2007, as it has lacked the funding or support from the DOE Office of Legacy Management for a physical structure.[10] Providing the Rocky Flats Cold War Museum with a home is another objective of the proposed project. Its artifacts and

Figure 34 | Rocky Flats Employees and Anti Rocky Flats Protestors

story will exist as a part of the museum's collection in order to expose all histories and give some closure to the controversy (Figure 34). However, proceeding successfully with the healing mission of the proposal requires thorough analysis of the site and its relationship to the lingering contamination and its past.

The physical site of Rocky Flats is integral to the architectural response, and as such the project is driven primarily by the site. The former plant and its surrounding buffer zone are located on the front Range of the Rocky Mountains northwest of Denver and bounded on all sides by roadways. The Central Operable Unit (COU) which contains the buried ruins of the plant will be incorporated for the purposes of authenticity and dark tourism (Figure 35).

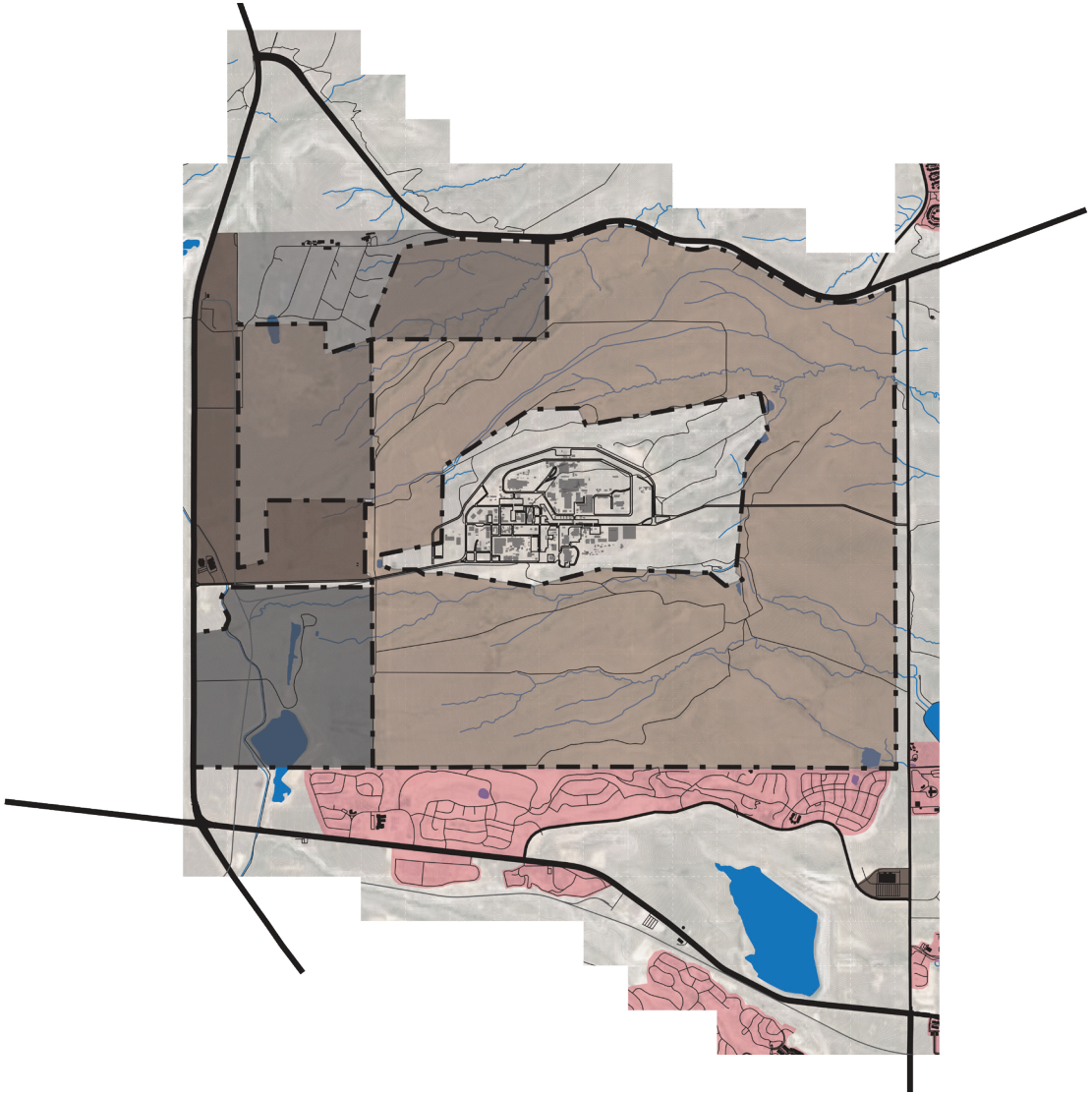


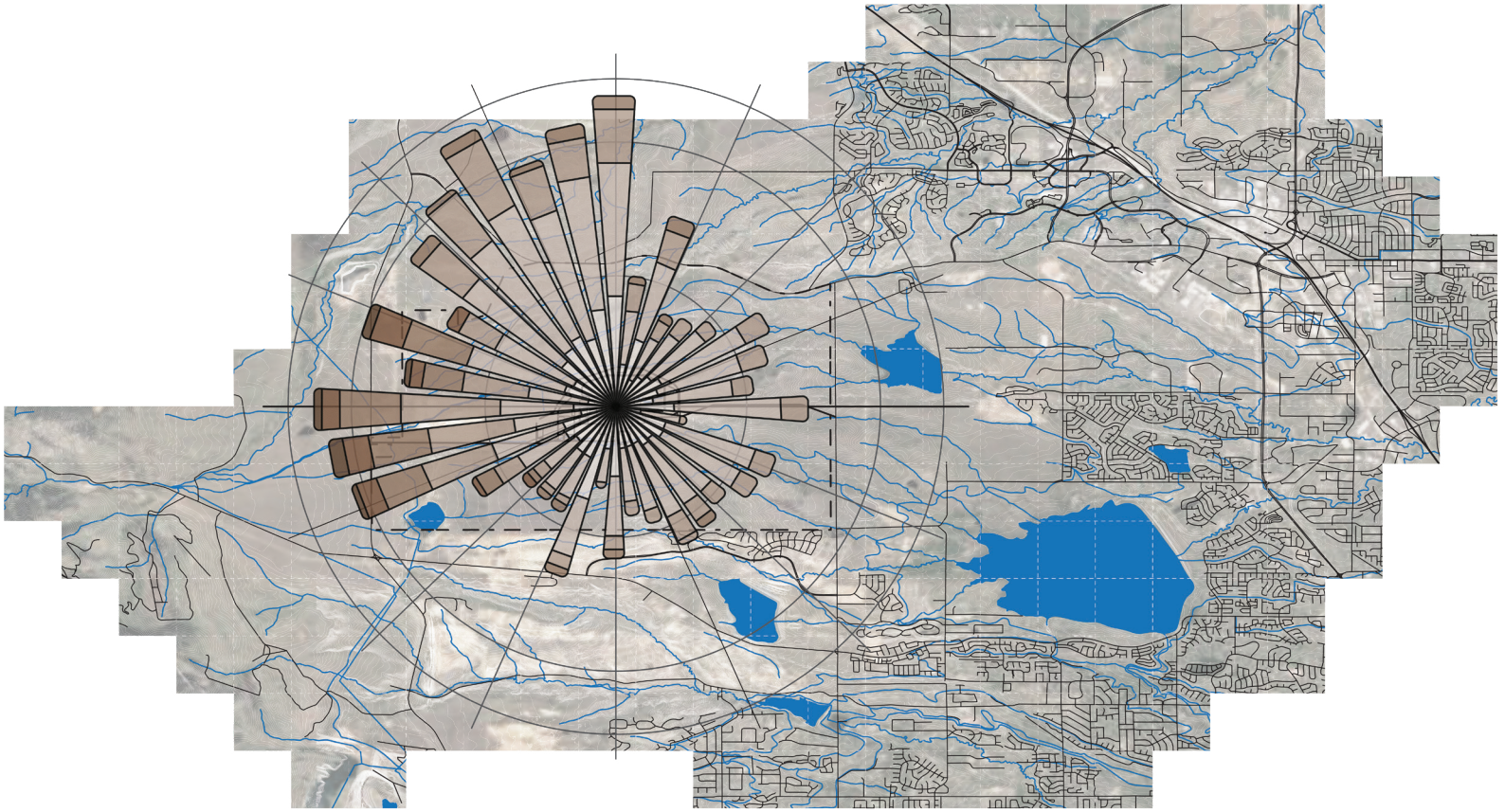
Figure 35 | Site Plan Showing Existing Conditions at Rocky Flats

the pre-wounded: natural state

Rocky Flats lies at the base of the Rocky Mountains on the dry eastern plains of Colorado high above sea level. According to the U.S. Fish & Wildlife Service the site is home to a variety of habitats including grasslands, woodlands, and wetlands.[11] The grasslands include the rare xeric tall grass prairie, which exists in few locations around the state and provides habitat for a diverse range of species.[12] The Colorado Natural Heritage Program indicates more specifically, that the site contains a foothills shrub land ecosystem consisting of trees and shrubs, it is found at the lower areas of the Rocky Mountains (Figure 36).[13] This ecosystem is mixed with foothills prairie grassland which includes a variety of tall and short grasses that feather out in strips along the base of the foothills.[14]

Many species of animals live on the site, including elk, deer, black bears, coyotes, and the endangered Preble's Jumping Mouse.[15] Birds, reptiles, amphibians and insects inhabit the site as well in a testament to its biodiversity.[16] Two creeks flow across the site; North Walnut Creek and South Woman Creek, both were used as sources of drinking water for the surrounding communities.[17] These creeks each flow east down the slope of the landscape towards Standley Lake, and the Great Western Reservoir. The site is also battered by strong westward winds that ferociously sweep down the eastern slope of the eastern Rockies, called "Chinooks" or "snow-eaters" by locals (Figure 37).[18] The winds blow with such force that they can melt snow due to the heat they generate and have been known to knock tall vehicles over (Figure 38).[19]

Figure 36 | Rocky Flats Habitat



Key
Wind Speed

4 mph 39 mph

0 mi 1 mi 2 mi

Figure 37 | Prevailing Winds Map

Humans also inhabited Rocky Flats prior to the construction of the plant; they included Native Americans, and a number of ranching families who arrived as pioneers in the mid 1800's. The land was occupied sporadically by the Native Americans for thousands of years before the arrival of European settlers, and a small number of artifacts have been found around the site.[20] Though information is scare, Great Plains Tribes including the Arapahoe, Cheyenne, and Ute occupied the high and dry eastern plains of the state.[21] All three tribes adopted the nomadic hunter and gatherer lifestyle as settlers encroached on them, and fiercely resisted the Europeans until eventually being forced off their lands and onto reservations in the late 19th century.[22] Tribal leaders surrendered the bulk of their Colorado territory to the United States government in 1861 with the Treaty of Fort Wise.[23] It is worth noting that Colorado was home to the Sand Creek Massacre, an atrocity committed by settlers against the Cheyenne and Arapahoe nations in 1864.[24] Based on maps of the territories held by the various tribes the Ute's were most likely the nomadic occupants of the Rocky Flats site (Figure 39).[25]

As the Native Americans were forced from their land, several families began homesteading the site east of the soaring peaks of the Rocky Mountains. The wide expanses of tall grass parries provided excellent land for raising cattle. The Church family, drawn by the 1850's gold rush began ranching on the site in 1861, raising dairy cows (Figure 40).[26] Several years later, in 1868 the Scott family established a homestead on the site, raising cattle until being forced off the land by the Atomic Energy Commission in 1951.[27] Later on in the 1940's the Lindsay family began using the land to raise their cattle on the sparsely populated site.[28]

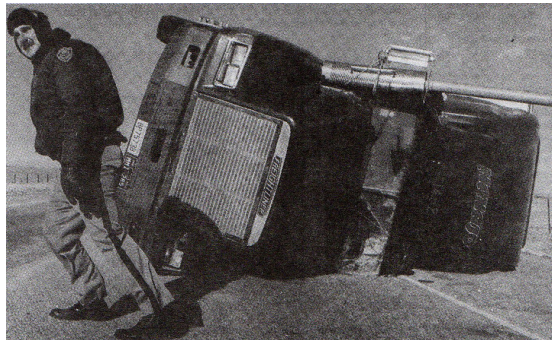


Figure 38 | A Truck Overturned by the Winds

In 1951 the AEC began purchasing the land that would become Rocky Flats from the various ranching families, offering them prices well below market value, and using national security priorities to force them to sell.[29] The settlers having forced the Native Americans from their lands were now forced off the site by the Federal Government in the name of national defense. This final act began to transition the site from its natural pre-wounded state to the post-wounded contaminated state.

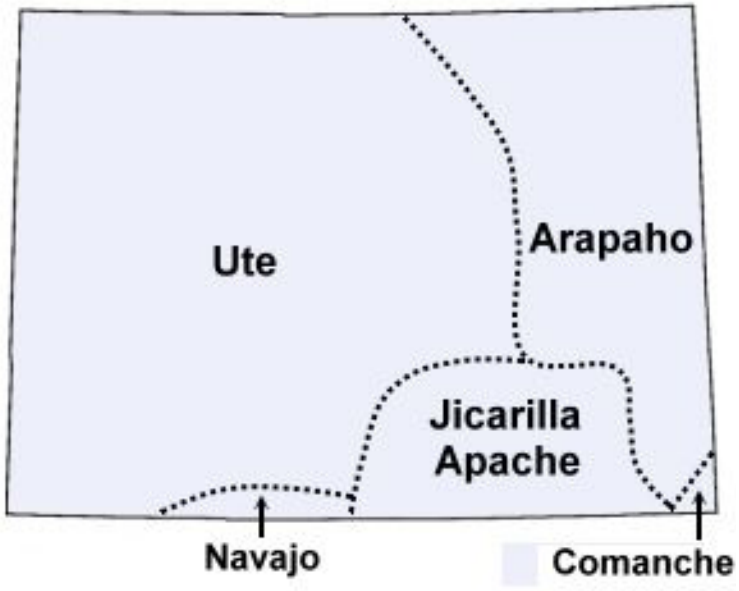


Figure 39 | Lands of the Colorado Tribes

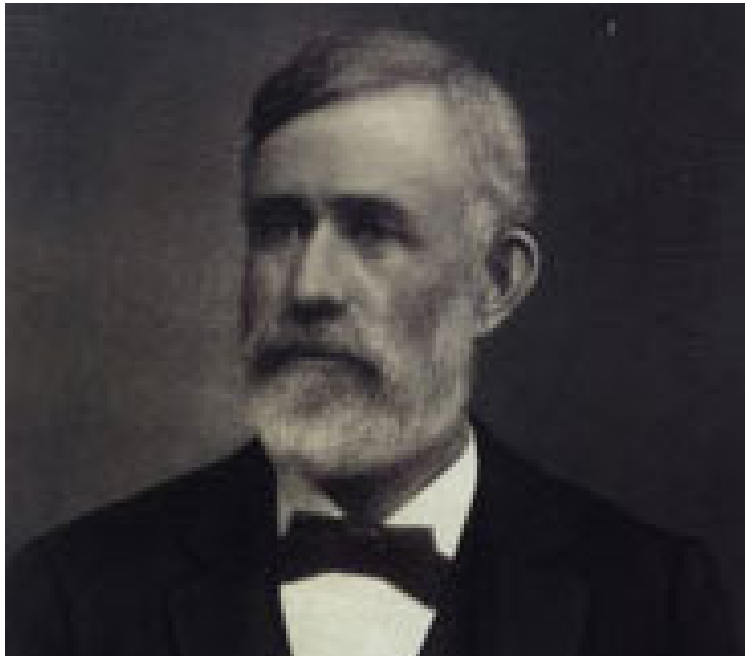


Figure 40 | George Henry Church

the post-wounded: contaminated state

Although there is a valid argument the site left its natural state and became wounded by the atrocities committed against the Native Americans by the settlers, that issue lies outside the scope of this thesis. Rather, the wounded state of the Rocky Flats is defined through the impact of the Cold War on the area. Therefore, the landscape enters its wounded state when the Atomic Energy Commission began construction of the plant. The industrial site covered 384 acres with a ten square mile buffer zone and included hundreds of buildings.[30] Contaminants including plutonium, tritium, carbon tetrachloride, beryllium and depleted uranium were all released during routine plant operations (Figure 41). Along with day to day operations, several incidents and practices at Rocky Flats led to contamination infiltrating in the air, soil, and ground water around the plant.

The most significant accidents at the facility were the 1957 fire and 1969 Mother's Day fire, both caused by plutonium left overnight in glove boxes spontaneously combusting. The 1957 fire began in Building 771 and released toxic smoke for thirteen hours that drifted towards Denver after fire crews mistakenly tuned on the buildings ventilation system (Figure 42).[31] The 1969 Mother's Day fire started under similar circumstances in Buildings 776 and 777, where plutonium was processed. It too released toxic smoke into the atmosphere for six hours due to the ventilation system.[32] Both fires released an unknown amount of plutonium into the soil and air around the plant and the DOE kept the fires secret for many years.

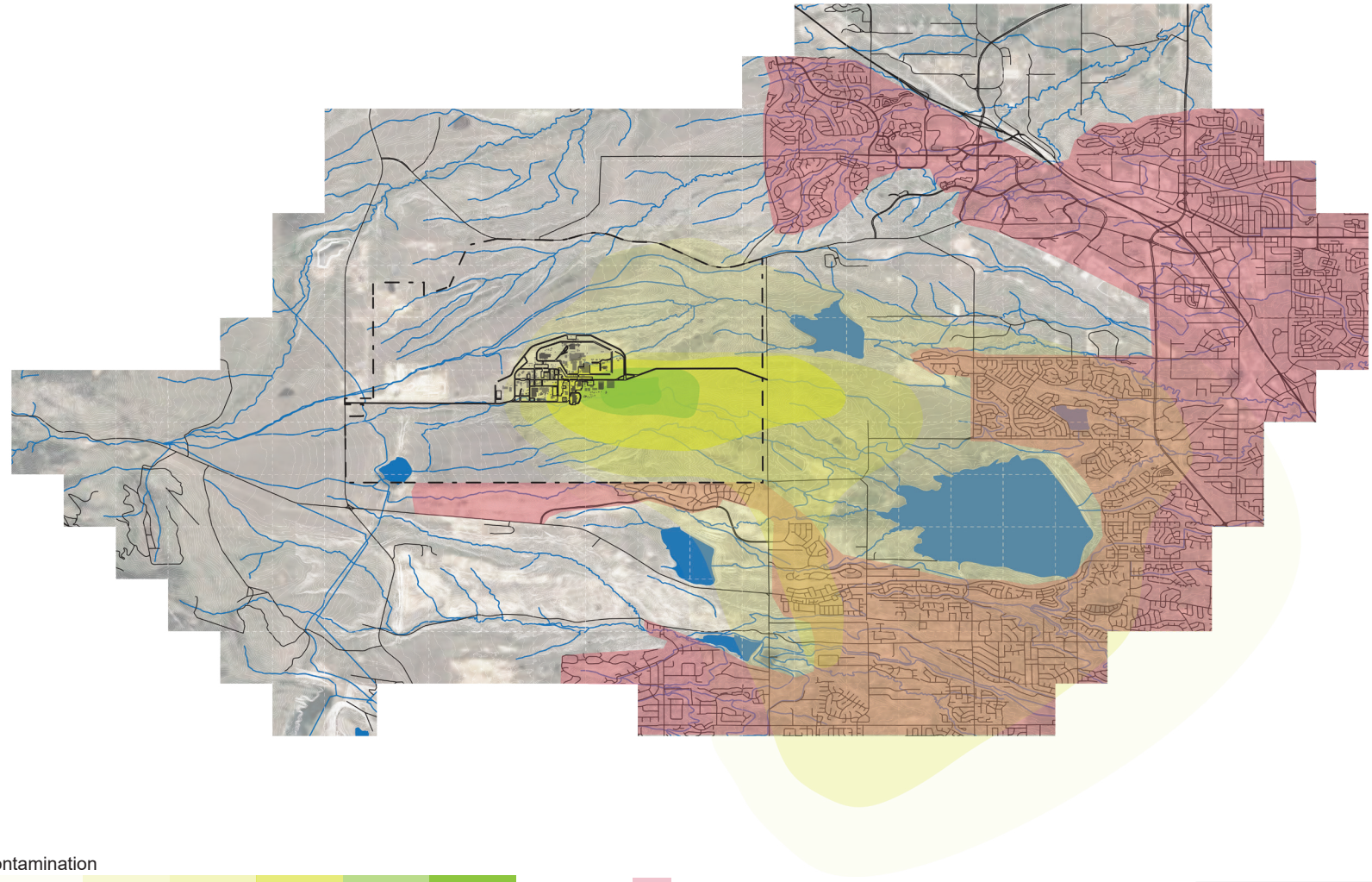


Figure 41 | Map Showing the Extent of Plutonium Contamination in the Soil

In addition to the fires, nuclear waste was stored outdoors in oil drums in the 903 area. The drums corroded due to the waste inside and the harsh Colorado climate, they leaked radioactive toxins into the dusty soil.[33] Despite efforts to slow the spread of the toxic dust with an asphalt pad and gravel, the soil was eventually blown east of the plant by the Chinooks spreading beyond its buffer zone.[34] The Pad 903 area became one of the most heavily contaminated areas of Rocky Flats (Figure 43).

As the arms race with the Soviet Union escalated, quotas at Rocky Flats increased and the production of weapons trumped safety, as waste generated by manufacturing accumulated throughout the facility. Some rooms, known as “infinity rooms” by workers, were so irradiated that the levels of contamination exceeded the scales of radiation measuring devices. Managers stored waste in 178 known sites around the plant when it could not be shipped elsewhere, often dumping raw waste or drums filled with toxic sludge into trenches and covering them with dirt.[35] Plant operators also struggled with the handling of liquid waste as they attempted to use solar evaporation ponds and spraying fields to manage the toxic liquid.[36] Eventually the decision was made by the DOE to drain the ponds and mix the waste with concrete to create a substance called “Pondcrete.”[37] Theoretically, the substance would harden, immobilizing the waste and allowing it to be shipped to burial sites elsewhere.[38]

Unfortunately, after storing thousands of blocks of Pondcrete out in the open officials discovered the sludge had failed to harden and leaked toxins into the watershed on the site;

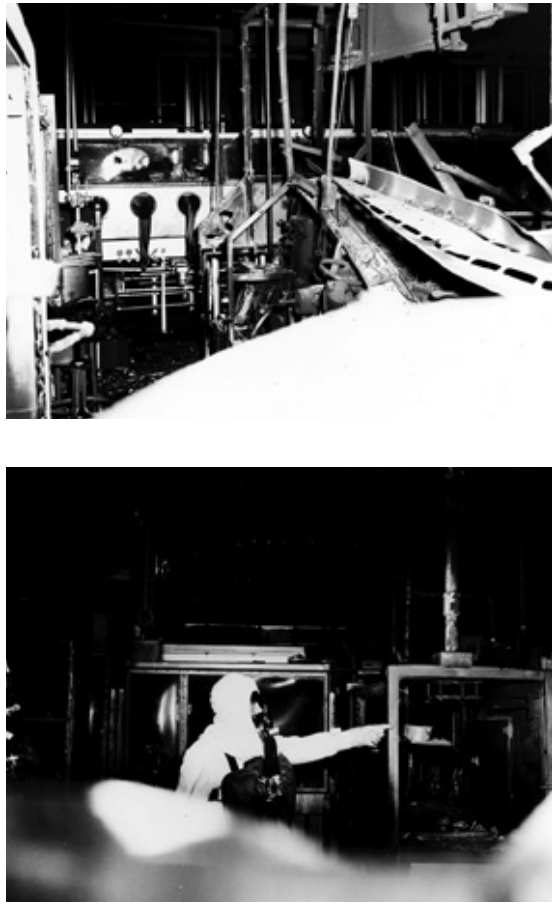
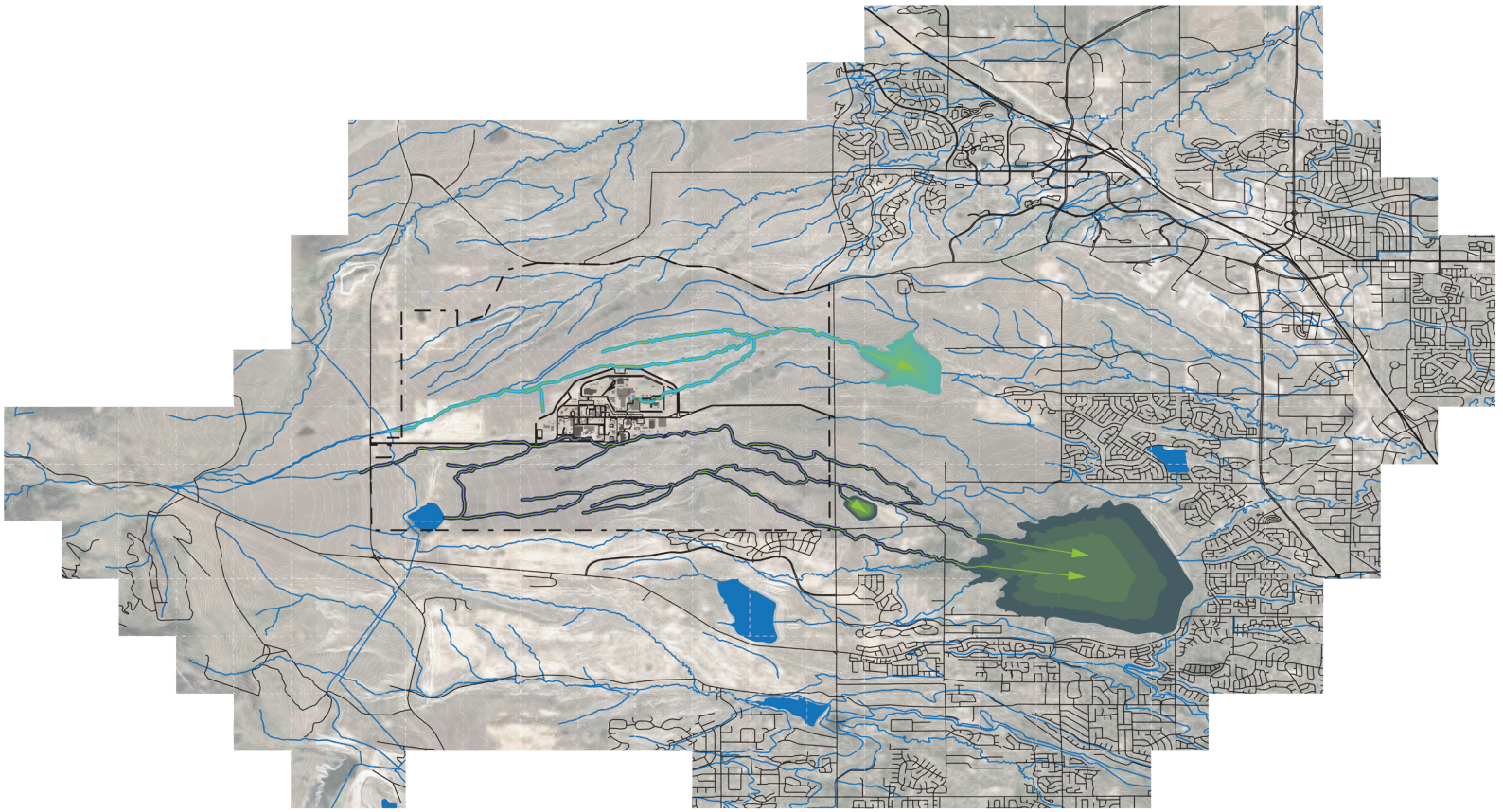


Figure 42 | Damage from the 1957 Fire

however the blocks of sludge remained exposed to the elements until remediation efforts began.[39] In 1973 tritium was accidentally released into Walnut Creek and flowed into the Great Western Reservoir.[40] This incident is just one of countless other unintentional releases that led to contamination of the sediments in the creeks on site and the larger bodies of water downstream (Figure 44). An unknown amount of depleted uranium was processed on site, and unlike plutonium its quantities were not rigorously tracked.[41] The depleted uranium still at Rocky Flats represents one of the remaining mysteries on site, as researchers and scientists are unable to determine quantities or fate of the substance. Though it is difficult to know the exact amount of each contaminant released; it remains indisputable that the summation of the incidents mentioned, and countless others led to the extensive contamination surrounding the plant (Figure 45).

In addition to contaminating the environment, the release of radioactive particulates from the plant had adverse effects on the health of both plant employees and people living nearby. However, the effects of exposure were more severe for the employees who handled the material directly than the neighbors of Rocky Flats. Residents living downwind were so concerned about the contamination that they filed the now dismissed class action lawsuit against Rocky Flats, Cook v. Rockwell International. Studies conducted by the Colorado Department of Public Health in 1999 found that an increased cancer risk did in fact exist for those living downwind of the plant during its operation.

Figure 43 | Oil Drums Stored on the 903 Pad



Key

Walnut Creek

Great Western Reservoir

Woman Creek

Standley Lake

0 mi 1 mi 2 mi

Figure 44 | Map Showing the Contaminated Hydrology at Rocky Flats

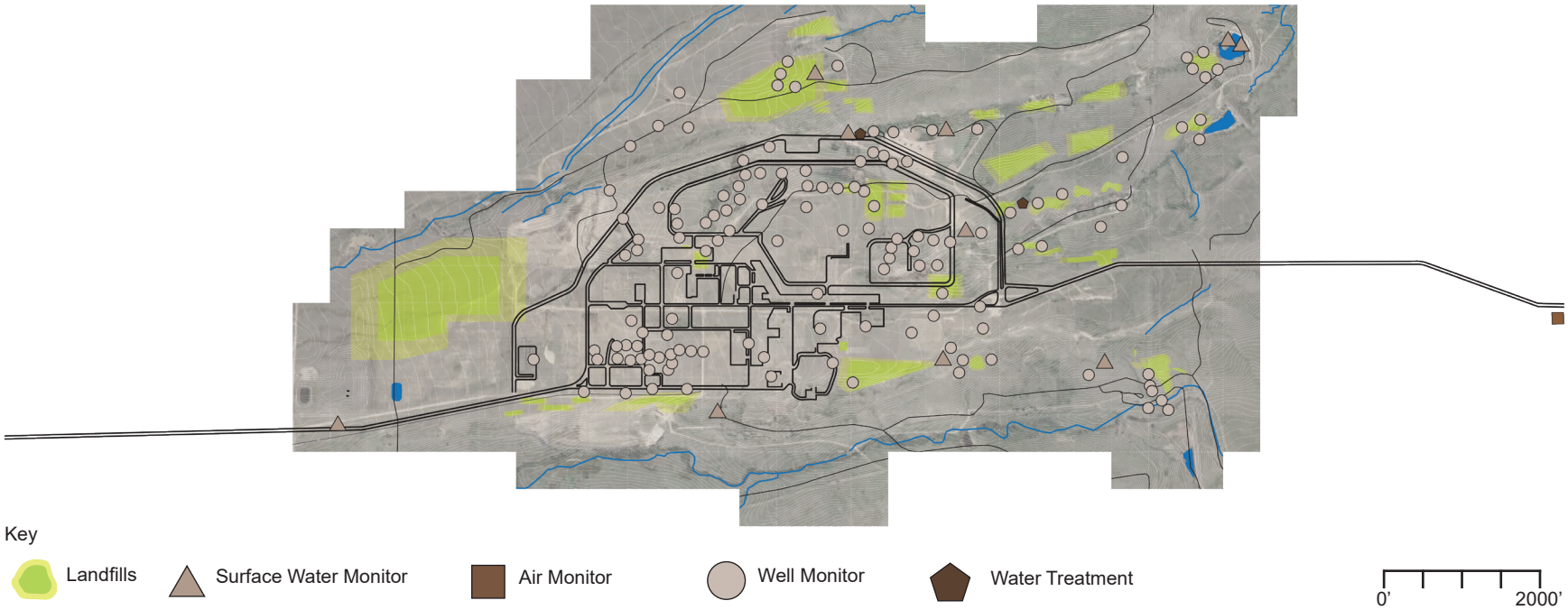


Figure 45 | Map of Landfills and Monitoring Stations

The study found the risk was most severe for people living southeast of the plant from 1953-1989 who spent a significant amount of time outdoors (Figure 46).[42] They also determined the most severe risk was associated with those living near Rocky Flats during the fires, when the largest amount of plutonium was released.[43] Their research indicates inhalation of airborne difficult to detect plutonium particles represented the most severe exposure vector, because plutonium spreads from the lungs to other organs.[44]

Although the risks associated with living near the plant were historically greater; a 2016 report found that cancer rates were no higher in areas surrounding the plant, save for one region, but the correlation with Rocky Flats was inconclusive.[45] Ultimately the Colorado Department of Public Health studies indicate that exposure remains a risk associated with the site, but it is a statistically insignificant one compared to other causes of death. Despite this, controversy remains about the correlation of risk as numerous environmental and citizens groups have challenged these findings.

Unlike the murkier nature of the risks associated with living near the site, many former Rocky Flats staff members were stricken with cancers and other illness allegedly because of their time at the plant. Chronic Beryllium disease, a syndrome similar to the black lung, was the most apparent work-related illness at the plant.[46] The radioactive metal released toxic dust as it was machined into bomb components. Workers inhaled the dust as it was spread through vents at the plant.[47] According to Len Ackland of the University of Colorado Boulder, 115

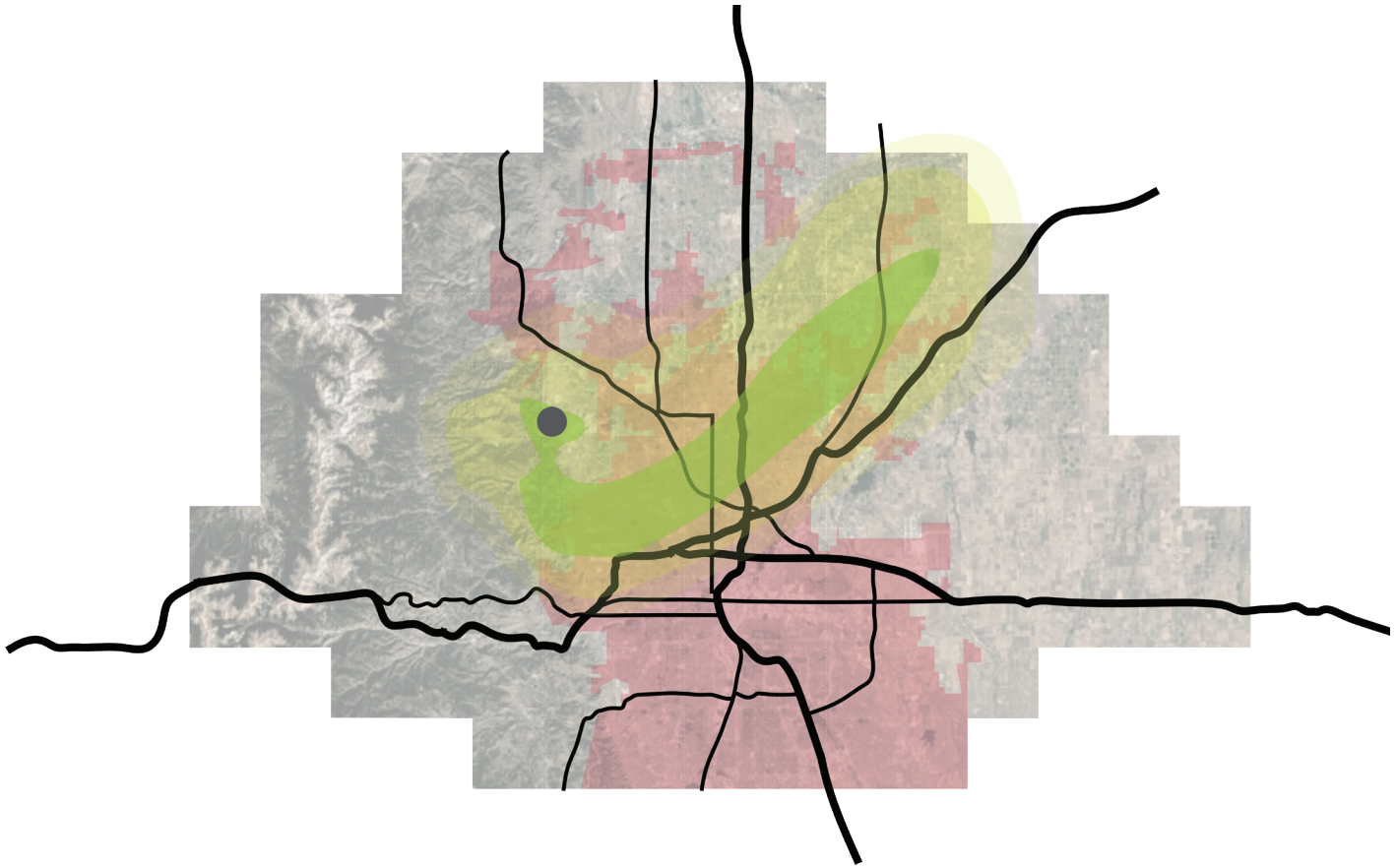


Figure 46 | Increased Cancer Risk Map

workers had contracted the illness, many of whom have already died, and 200 more were at risk of developing the disease.[48] Cancers stemming from radiation exposure can take decades to manifest and the exact causes of the illness may be difficult to determine because lifestyle choices may play a role as well.

Considering this fact, the exact causes of cancers in former employees of Rocky Flats are less apparent, nevertheless there are many cases of workers developing them. Don Gabel worked at Rocky Flats operating a plutonium furnace near a highly radioactive pipe and was exposed to radiation numerous times through the course of his work at the facility.[49] He died in 1980 after developing a large tumor on his head; tests conducted prior to his death indicated that radiation had altered the chromosomes in his brain and blood.[50] Author of *An Insider's View of Rocky Flats Urban Myths Debunked*, and former employee, Farrel D. Hobbs, disputes claims of wrongdoing in his book. However, the author admits many fellow workers have battled "devastating diseases" and out of respect for them he states his wishes to remain agnostic on the subject.[51] Hobbs himself, suffered two bouts of cancer after retiring from the plant, but he maintains they were not caused by his career at Rocky Flats.[52] Hobb's desire to remain neutral about the illnesses, reflects the difficulty of determining the extent of health damage caused by the plant.

The work conducted at Rocky Flats undoubtedly damaged employee health, and many other cases like Don Gabel's exist, furthermore working with plutonium carries inherent risks

Figure 47 | Workers in a Plutonium Storage Room

(Figure 47). Regardless of the disputes about the environmental and human damage caused by Rocky Flats, the plant wounded the landscape and exposing its legacy will serve to heal its contaminated state.

the reclaimed: scarred state

Proceeding from the analysis of the site in terms of its wounded and post wounded state the new reclaimed scarred state of the site emerges. The new mutant tissues of the scar layer themselves upon the past tragedy of the site as they coalesce into a space for dark tourism. These spaces are guided by design strategies based on the roles they play in exposing the history of Rocky Flats while simultaneously protecting visitors.

The design strategies of viewing, learning, and monitoring guide the program of the new reclaimed scarred state allowing Rocky Flats to function as a dark tourism site (Figure 40). Furthermore the intervention seeks opportunities to reclaim the site and prevent future contaminant release. Viewing and learning address the need to make history real through viewing ruins and the educational objective of the project. Monitoring allows users to interact with the contamination and experience the DOE's continuing efforts to contain it within the boundary of the site .In forming the scar tissue; viewing, learning, and monitoring support the reclamation of Rocky Flats while bringing some closure to its legacy.

DOE documents indicate that a number of areas within the boundaries of Rocky Flats are at risk of releasing more contamination into the environment. This component of the intervention seeks to address one of these areas enabling the project to reclaim the site by preventing further degradation. The viewing, learning, and monitoring design strategies become components that serve in revealing the plant's lost history (Figure 48). Viewing and learning are combined into a single space allowing users to view excavated ruins of the facility while learning about its history. Viewing, the act of looking or observing something, is enabled at Rocky Flats by the ruin viewing enclosure, while learning occurs simultaneously around it. The structure will allow visitors to experience a direct visual relationship with the irradiated ruins of the plant. Viewing plays an important role in facilitating dark tourism as visitors come in close

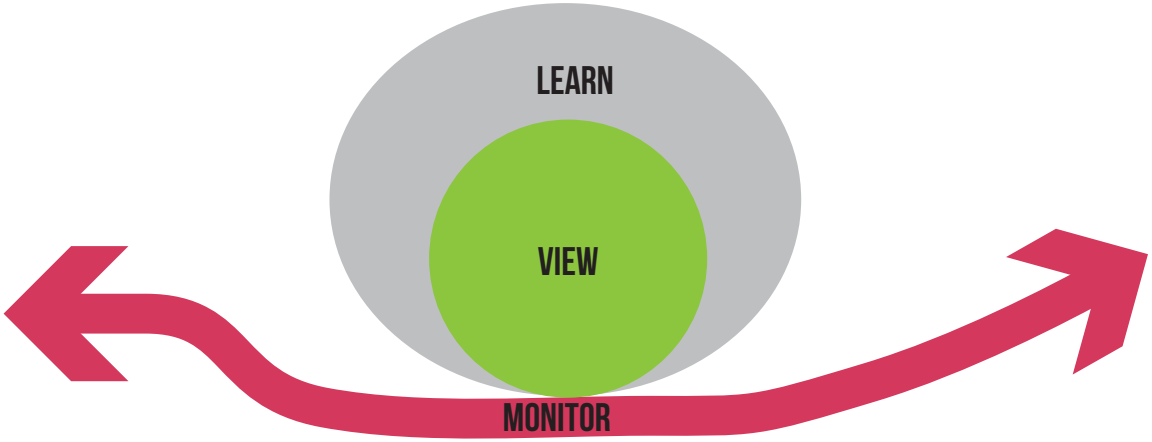


Figure 48 | View, Learn, and Monitor

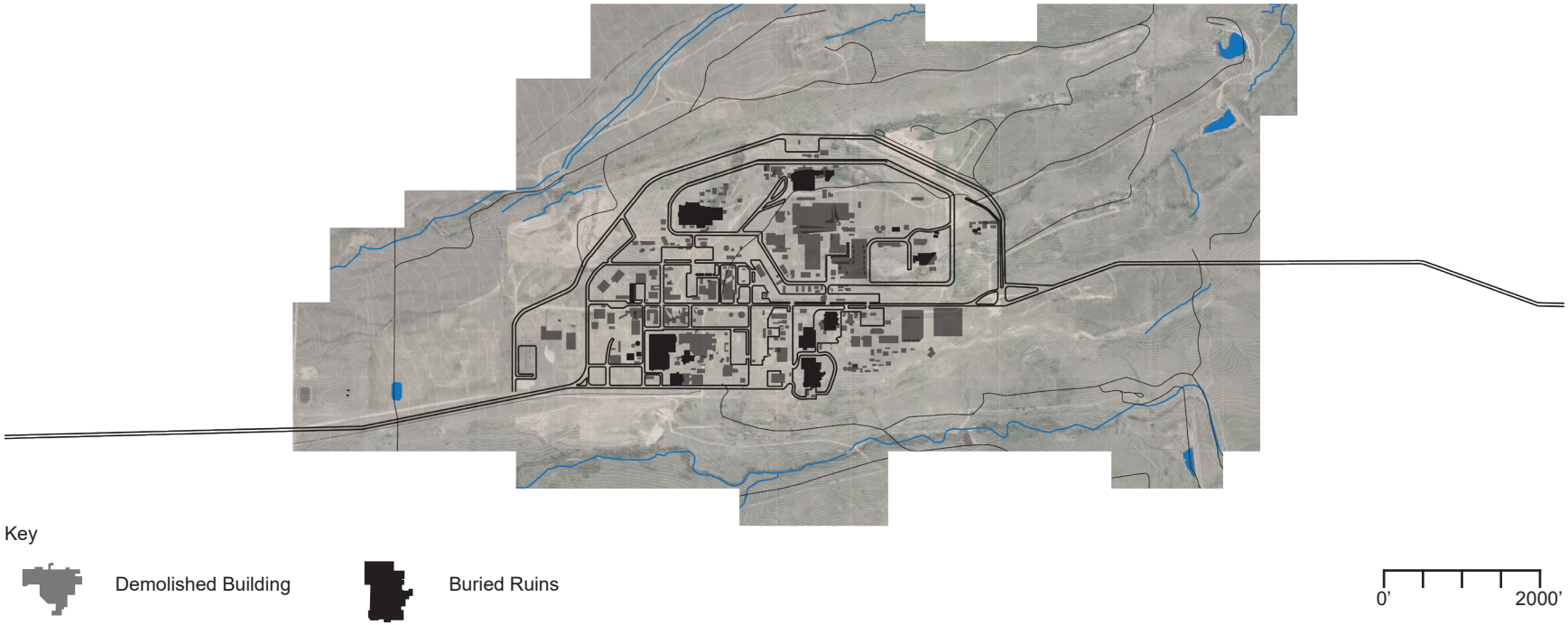


Figure 49 | Map Showing Demolished Building Footprints and Locations of Buried Ruins

contact with the structure and are protected behind radiation shielded assemblies. The close relationship between guests and the ruins serves in revealing history, as direct experience with a relic of the past makes history real.

Monitoring transforms the private DOE run stations scattered across the site into publicly accessible interventions (Figures 45, 50). These stations allow the visitor to interact with and understand ongoing efforts to monitor existing contamination in the soil, water, and air. Space for guest interaction with the DOE scientists engaged in monitoring is also created within the stations, as the two user groups share the spaces. Transparency in the ongoing monitoring efforts allows the public to understand the severity of the contamination remaining on the site while experiencing its existence through the measurements taken. The contaminants function as a form of ruins for the users, as these particles are the physical reminders of the history of the plant.

Viewing, learning, and monitoring play crucial roles as design strategies forming scar tissue over the wound and creating a new life for Rocky Flats . Reclamation occurs as the intervention addresses areas of need on the site in seeking to prevent new contaminant releases. The direct interaction and intimate relationships created by these design strategies inject authenticity into the experience of the visitor. Reclamation prevents environmental damage protecting human beings and the landscape from Rocky Flats. The creation of these

Figure 50 | Existing Monitoring Station

relationships through architectural intervention and the reclamation efforts shifts the site from its post wounded contaminated state into its new reclaimed scarred state.

Glove Boxes were sheet metal and plexi-glass enclosures welded together end to end with conveying systems inside, forming the assembly lines in the plant (Figure 51).
The walls were punctuated with lead lined rubber gloves that allowed workers to safely machine plutonium and other hazardous materials. The devices were connected to ventilation systems that pulled the air out of the boxes creating a vacuum to prevent contaminated particles from leaking out of the shielded enclosures. The ventilation systems contained a series of filters to prevent particles from escaping the plant. These devices served as the first line of defense protecting workers from radiation and toxic dust created during manufacturing operations. Furthermore, materials left in glove boxes started both the 1957 and 1969 fires at Rocky Flats, releasing radioactive smoke.[53] Glove boxes have become iconic parts of the imagery associated with the site, and were the location of the two biggest accidents at the plant.


Figure 51| Glove Box in Use

Considering the significant role glove boxes played in the history of the plant and the thesis objective of exposing history; these enclosures form the basis of the design concept enabling viewing, learning, and monitoring. During operations at Rocky Flats the glove boxes protected human beings and the environment from the toxic materials they contained. Since the glove boxes failed to prevent the spread of the contaminated particles human beings must now be in a protective enclosure to visit the site. The design concept stems from the idea of the

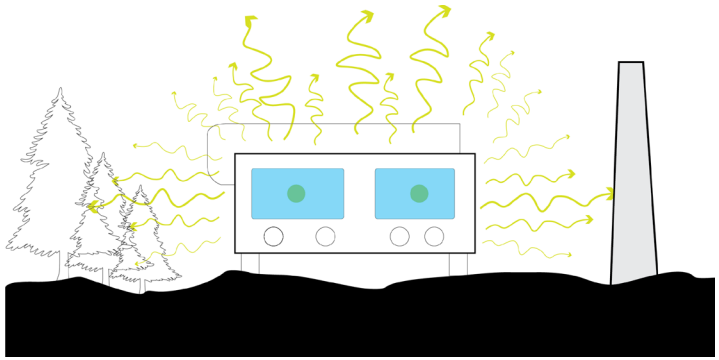
glove box, as the architecture forms a protective enclosure between users and the contaminated ruins of the plant and the damaged landscape in the new reclaimed scarred state of Rocky Flats (Figure 52).

The glove box protects visitors from the remaining contamination as they experience the site and its unearthed history. In shielding the visitors, the architecture as glove box allows the site to be experienced safely. Furthermore, the concept serves to visually reinforce the new scar tissue formed by reclamation. They highlight the present risks caused by the past use of the site, making the invisible contamination read through experientially as visitors are contained within the glove boxes on the site. In forming the basis of the initial design concept for the architectural intervention at Rocky Flats, the glove box creates a conceptual justification for protecting users as history is exposed through experiencing the site.

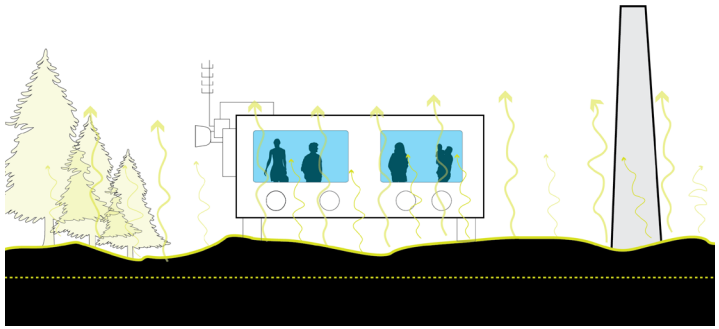
conclusion

The design methodology for addressing Rocky Flats fulfills the objective of reclaiming the installation and bringing its history to light. The direct experience of the past afforded by bringing guests to the landscape helps memorialize the legacy of the scarred site. Applying the concept of scarring to the landscape informs the reading of the site in two states. The pre-wounded natural state illustrates the fact that Rocky Flats was once a nondescript space along the front range until the complex was constructed. Once the plant opened and began damaging human beings and the environment, the site entered its post wounded contaminated state.

Pre-Wounded: Natural State



Post-Wounded: Contaminated State



Reclaimed: Scarred State

Figure 52 | Glove Box Conceptual Diagram

Although most of the contamination has supposedly been removed the site remains wounded due to the ongoing controversy. The proposed intervention shifts Rocky Flats into the reclaimed scarred state as it heals the past through dark tourism supported by the design strategies of viewing, learning, and monitoring. Furthermore, the design proposal supports reclamation of the site by addressing areas of need indicated by the DOE through the prevention of further contaminant releases.

Each component plays a role in raising awareness of the site through education, interaction with the ruins, and glimpses into the perennial monitoring operations while reclaiming the landscape. Serving in the overarching goal of education through history, the design strategies bring authenticity to the experience, as the reclamation strategy allow this goal to be practically achieved. The concept of the glove box protects visitors while highlighting the contaminated reality of the site through intimate interaction. These enclosures along with reclamation efforts emphasize the very real impact the invisible contamination leaked from Rocky Flats continues to have on the landscape (Figure 53).

Figure 53 | “Infinity Room” Clean Up

In revealing the buried history of Rocky Flats, the design intervention seeks to heal the past while serving as a warning to future generations about the activities conducted at the plant and preventing future contaminant release. Reclaiming the facility provides an approach for confronting the remaining Cold War sites around the United States. Although many do not

have traumatic pasts like Rocky Flats, these silent monuments of the Cold War littered across the American landscape impacted their sites locally, while serving in a decades long geopolitical struggle. Exposing their history through reclamation is a worthy cause because of the significant role they played, and the methodology outlined above provides the opportunity to reveal it.

---

1 Ackland *Making a Real Killing*, 49-50.
2 Ibid., 58.
3 Iverson, *Full Body Burden,* 214.
4 Ibid., 213.
5 John Aguilar, “Nearly 300,000 Colorado Public School Students Now Barred from Making Field Trips to Rocky Flats,” The Denver Post, April 28, 2018, , accessed June 12, 2018, https://www.denverpost.com/2018/04/29/rocky-flats-school-field-trips-ban/.
6 Carroll, Vincent. “The Rocky Flats Scare Brigade Gains a New General.” The Denver Post. June 07, 2018. Accessed June 12, 2018. https://www.denverpost.com/2018/06/08/the-rocky-flats-scare-brigade-gains-a-qualified-lackey/.
7 Tom Vanderbilt, *Survival City*, 11-12.
8 Ibid., 11-12.
9 Len Ackland, “Open Wound from a Tough Nuclear History,” in *Remedies for a New West: Healing Landscapes, Histories, and Cultures*, by Sharon K. Collinge, Andrew Cowell, and Patricia Nelson Limerick (Tucson, AZ: Univ. of Arizona Press, 2009), 260-261.
10 Ackland, “Open Wound from a Tough Nuclear History,” 260.
11 “About the Refuge - Rocky Flats - U.S. Fish and Wildlife Service,” U.S. Fish & Wildlife Service, , accessed April 20, 2018, https://www.fws.gov/refuge/Rocky_Flats/about.html.
12 Ibid.
13 *Ecological Systems of Colorado: Rocky Mountain Lower Montane-Foothills Shrubland*, publication, College of Natural Resources: Colorado Natural Heritage Program, Colorado State University (Fort Collins, CO: Colorado Natural Heritage Program, 2005), 1.
14 *Ecological Systems of Colorado: Western Great Plains Foothills and Piedmont Grassland*, publication, College of Natural Resources: Colorado Natural Heritage Program, Colorado State University (Fort Collins, CO: Colorado Natural Heritage Program, 2005), 1.
15 About the Refuge - Rocky Flats - U.S. Fish and Wildlife Service,” U.S. Fish & Wildlife

Service, , accessed April 20, 2018, https://www.fws.gov/refuge/Rocky_Flats/about.html.
16 Ibid.
17 United States, U.S. Fish & Wildlife Service, Rocky Flats National Wildlife Refuge, *Rocky Flats National Wildlife Refuge: Resource Inventory* (Washington, D.C.: U.S. Fish and Wildlife Service, 2003), 12.
18 "Winds," National Parks Service, , accessed June 13, 2018, https://www.nps.gov/romo/winds.htm.
19 Iverson, *Full Body Burden*, 6-7.
20 About the Refuge - Rocky Flats - U.S. Fish and Wildlife Service," U.S. Fish & Wildlife Service, , accessed April 20, 2018, https://www.fws.gov/refuge/Rocky_Flats/about.html.
21 Linda Alchin, "Southwest Culture," Facts, Clothes, Food and History", January 16, 2018, accessed June 13, 2018, https://www.warpaths2peacepipes.com/history-of-native-americans/history-of-colorado-indians.htm.
22 Ibid.
23 Ackland *Making a Real Killing*, 9.
24 Ibid., 9.
25 Linda Alchin, "Southwest Culture," Facts, Clothes, Food and History", January 16, 2018, accessed June 13, 2018, https://www.warpaths2peacepipes.com/history-of-native-americans/history-of-colorado-indians.htm.
26 Ackland *Making a Real Killing*, 10-11.
27 About the Refuge - Rocky Flats - U.S. Fish and Wildlife Service," U.S. Fish & Wildlife Service, , accessed April 20, 2018, https://www.fws.gov/refuge/Rocky_Flats/about.html.
28 Ibid.
29 Ackland *Making a Real,* 64.
30 Ibid., 79-80.
31 Iverson, *Full Body Burden*, 27-30.
32 Ibid., 38-39
33 United States, Colorado Department of Public Health and Environment, Health Advisory Panel, *Summary of Findings: Historical Public Exposure Studies on Rocky Flats* (Denver, CO: Colorado Department of Public Health and Environment, 1999), 12.
34 Colorado Department of Public Health and Environment, Health Advisory Panel, *Summary of Findings: Historical Public Exposure Studies on Rocky Flats,* 12.
35 Ackland *Making a Real Killing*, 138-139
36 Ibid.*,* 141.
37 Iverson, , *Full Body Burden,* 172.

38 Ibid., 172.
39 Ibid., 178-180.
40 Colorado Department of Public Health and Environment, Health Advisory Panel, *Summary of Findings: Historical Public Exposure Studies on Rocky Flats,* 14.
41 Ibid., 14.
42 Ibid., 17.
43 Ibid., 18.
44 Ibid., 15.
45 United States, Colorado Department of Public Health and Environment, *Rocky Flats Cancer Incidence Supplement 2017* (Denver, CO: Colorado Department of Public Health and Environment, 2017), 1.
46 Ackland *Making a Real Killing: Rocky Flats and the Nuclear West* (Albuquerque: University of New Mexico Press, 2002), 148.
47 Colorado Department of Public Health and Environment, Health Advisory Panel, *Summary of Findings: Historical Public Exposure Studies on Rocky Flats,* 14.
48 Ackland *Making a Real Killing,* 148.
49 Iverson, *Full Body Burden*, 184-185.
50 Ibid.*,* 184-185.
51 Farrel D. Hobbs, *An Insider's View of Rocky Flats: Urban Myths Debunked* (U.S.: CreateSpace, 2010), 122-124.
52 Hobbs, *An Insider's View of Rocky Flats,* 122.
53 Iverson, *Full Body Burden*, 357.

Figure 54 | Building 881 Under Construction

Figure 55 | Aerial View of Architectural Intervention

04 the reclaimed state

The architectural intervention at Rocky Flats shifts the site into its reclaimed scarred state, revealing the lost history of the base and reclaiming the site (Figure 55). First and foremost, the project must grapple with the vast scale of the former plant, which covers 384 acres including the ten square mile buffer zone around the Central Operating Unit. Considering this vast scale, the interventions are strategically sited to not only support the viewing, learning, and monitoring design strategies, but also to address ongoing environmental concerns through reclamation. The southern hillside at the edge of the COU represents a cross section of these goals (Figure 56). The hillside contains the buried ruins of Building 881 and two landfills containing toxic waste from the plant. Existing DOE monitoring stations line the approach to this area from the historical east and west base access roads, further supporting the program of the intervention.

Due to Rocky Flat's size and the fact the base is surrounded by highways, the project is conceived as a series of interventions along a path meant to be experienced from an automobile, as patrons embark on a journey through the site (Figure 57). The path is given no directional hierarchy in order to provide visitors equal access from the east and west sides. The project is accessed by the historic east and west entrances to Rocky Flats. This decision references the history of the plant by connecting these entrances with a new road skirting the southern hillside. Access to the site is signaled by two monitoring stations acting as landmarks at each entrance. Once the visitor turns on to the road, their experience at Rocky Flats begins as the journey through the site unfolds before them.

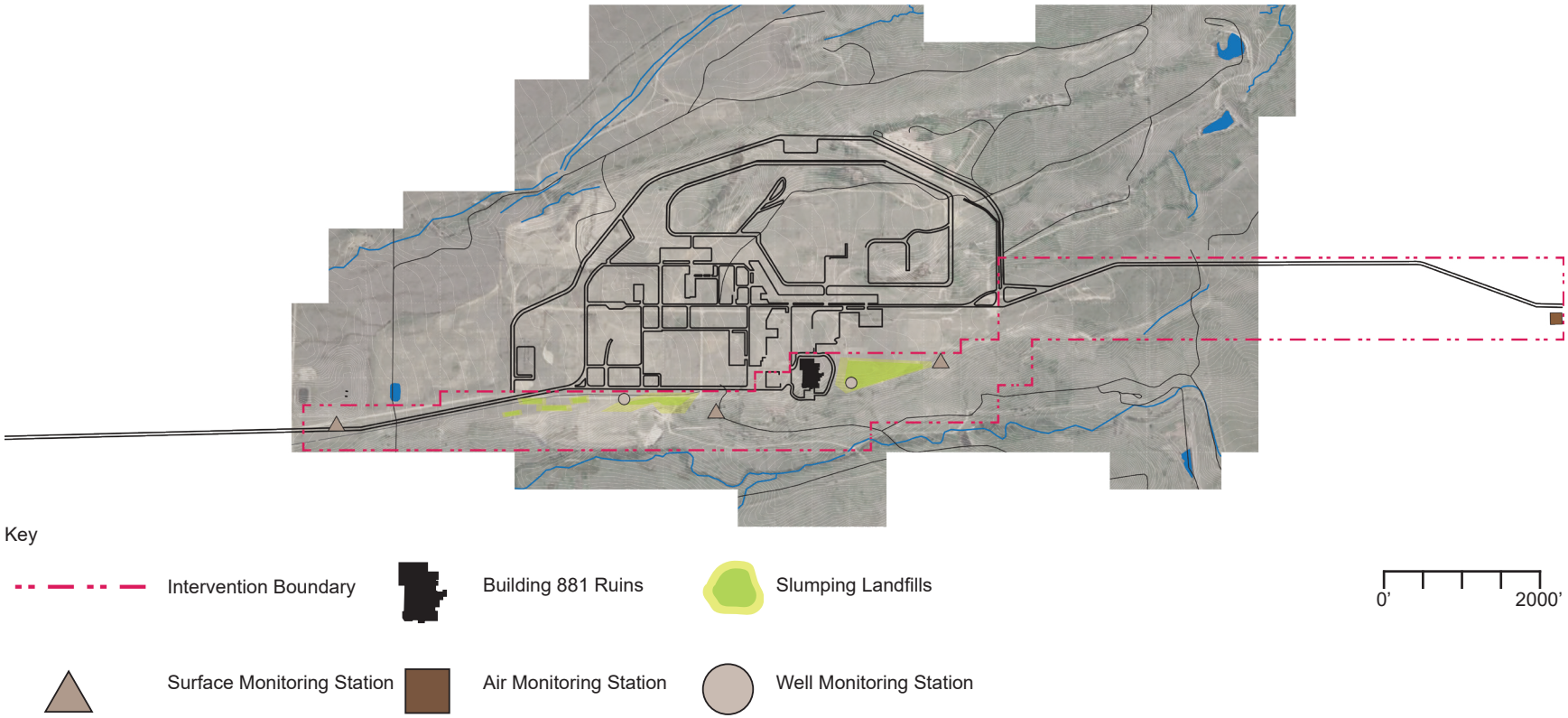


Figure 56 | Map Showing Demolished Building Footprints and Locations of Buried Ruins

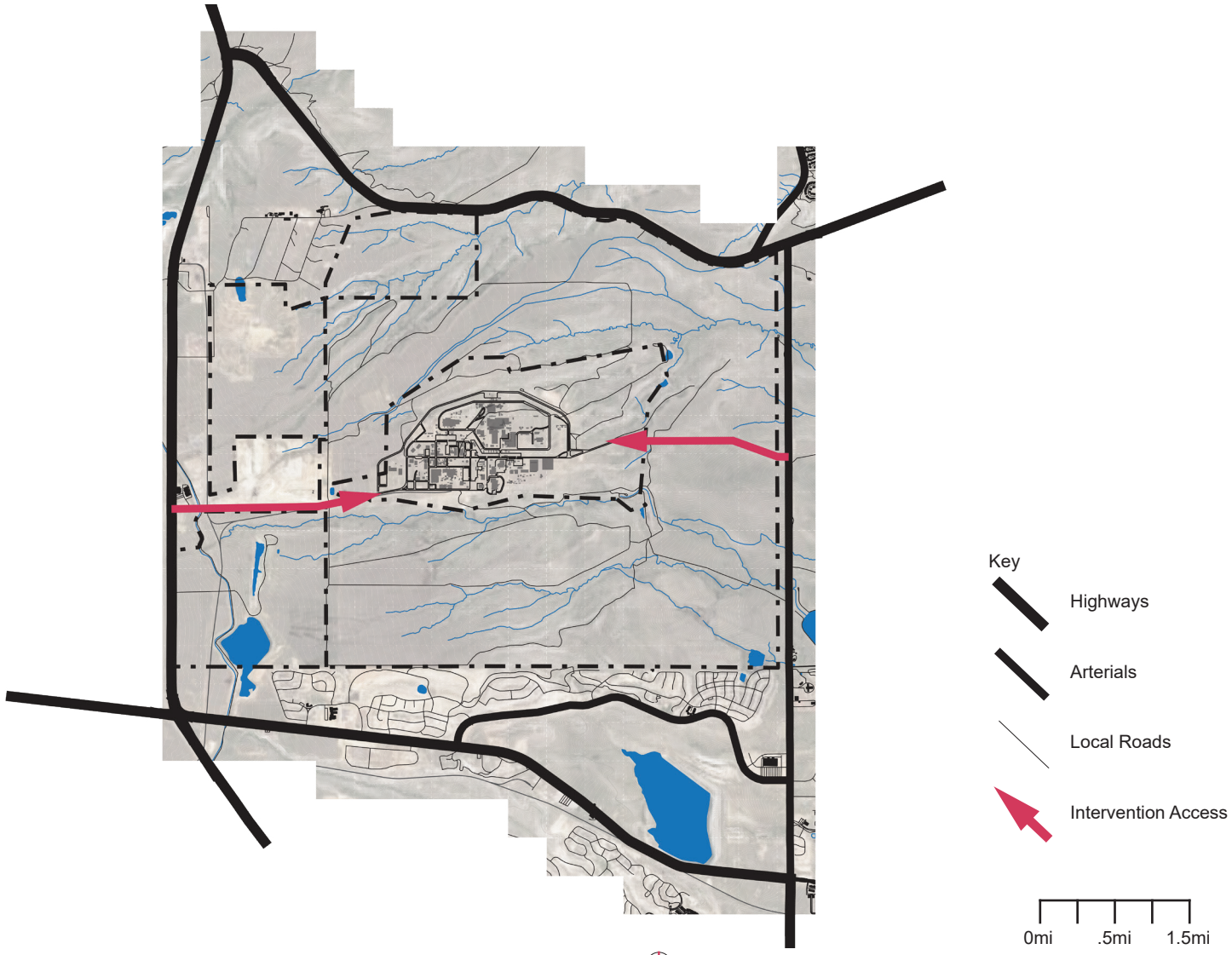


Figure 57 | Site Plan Showing Circulation and Access to Rocky Flats

This journey is comprised of four primary components working in unison to create a unified dark tourism experience at Rocky Flats (Figure 58). The first is a new road connecting the historic east and west entrances to the site. Second a retaining wall terraces the southern hillside stabilizing two slumping landfills, while creating a substantial visual marker for the site. The third component consists of six DOE monitoring stations transformed into publicly accessible spaces creating nodes along the path through the site; east and west of the main building housing the ruin. Finally, this building, the View/ Learn facility is perched on the hillside, breaking the line of the retaining walls and enclosing the excavated ruins of building 881. These structures serve the goal of raising public awareness of the history and ongoing monitoring efforts at Rocky Flats through perilous place style dark tourism.

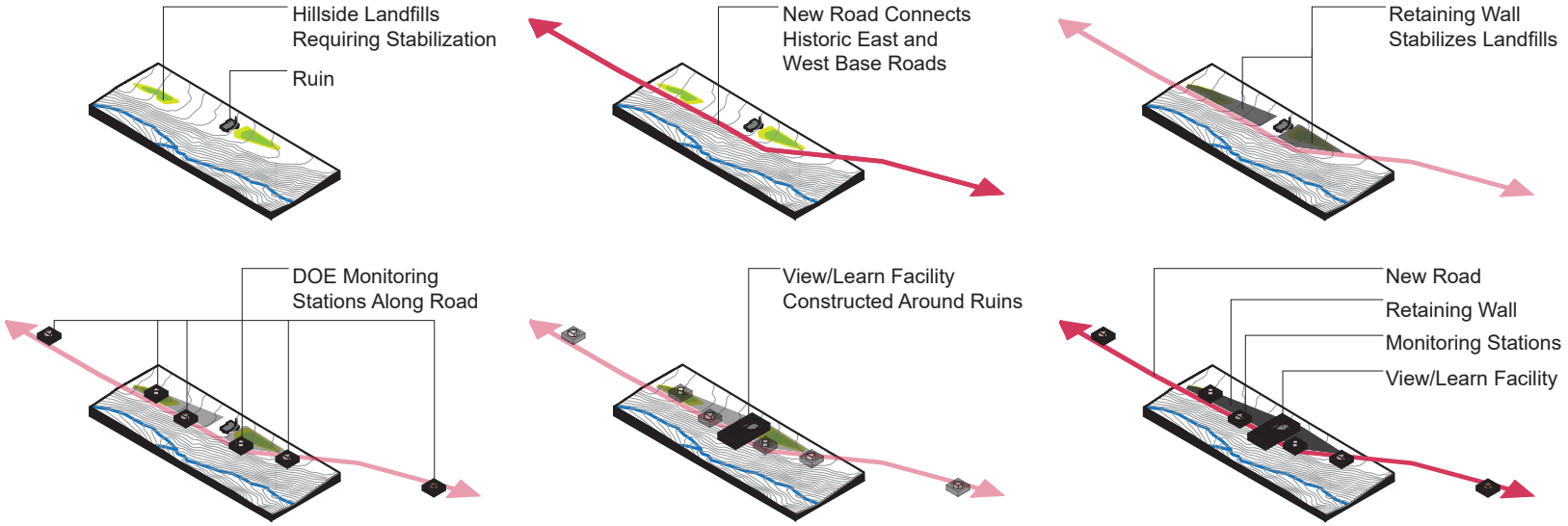


Figure 58 | Site Confiugration and Components Diagram

casks

During plant operations at Rocky Flats waste was buried in several landfills throughout the site. Although many of the landfills have been removed two large burial sites remain on the hillside skirting the southern edge of the COU. Designated as Original Landfills or OFL's by the DOE, these areas contain waste from the plant, construction debris, toxic solvents, and radioactive particulates.[1]

DOE documents reveal that during recent heavy precipitation events, the OFLs have begun showing signs of slumping, cracking, and depressions as ground water has peculated into the soil. This development prompted concerns about further contaminant release into the groundwater and Woman Creek[2]. The documents indicate the DOE has ongoing concerns about the hillsides as well as plans for extensive stabilization operations to prevent further degradation of the hill. The western landfill is estimated to contain 160,000 cubic yards of debris mixed with contaminated soil, while the amount in the eastern one remains a mystery due to a lack of documentation.[3]

Considering these revelations about the hillside instability and the location of the buried ruins of building 881, the southern hillside was selected as the site of the intervention (Figure 60). Furthermore, the excavation of the subterranean ruins and subsequent construction of the Viewing and Learning facility will result in the removal of 6,341,992 cubic feet of contaminated

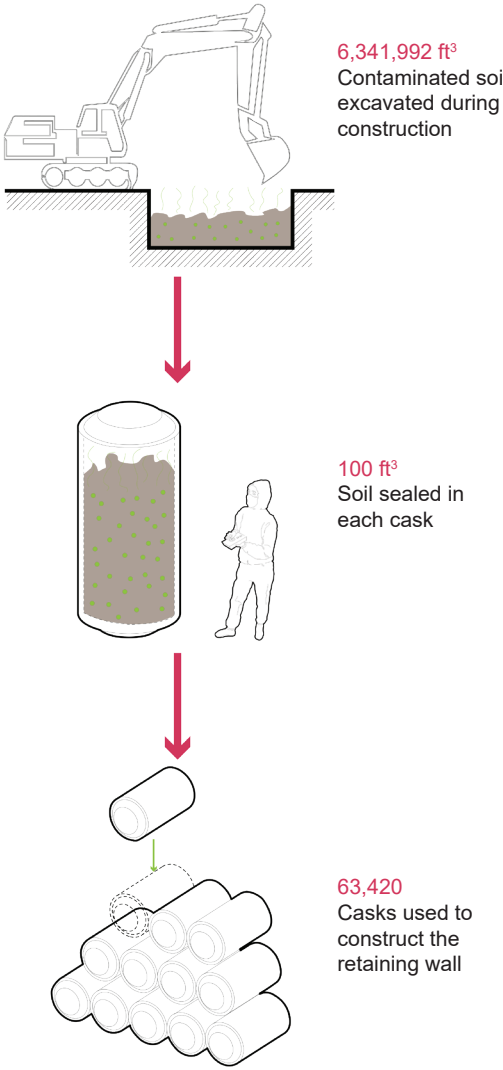


Figure 59 | Cask Diagram

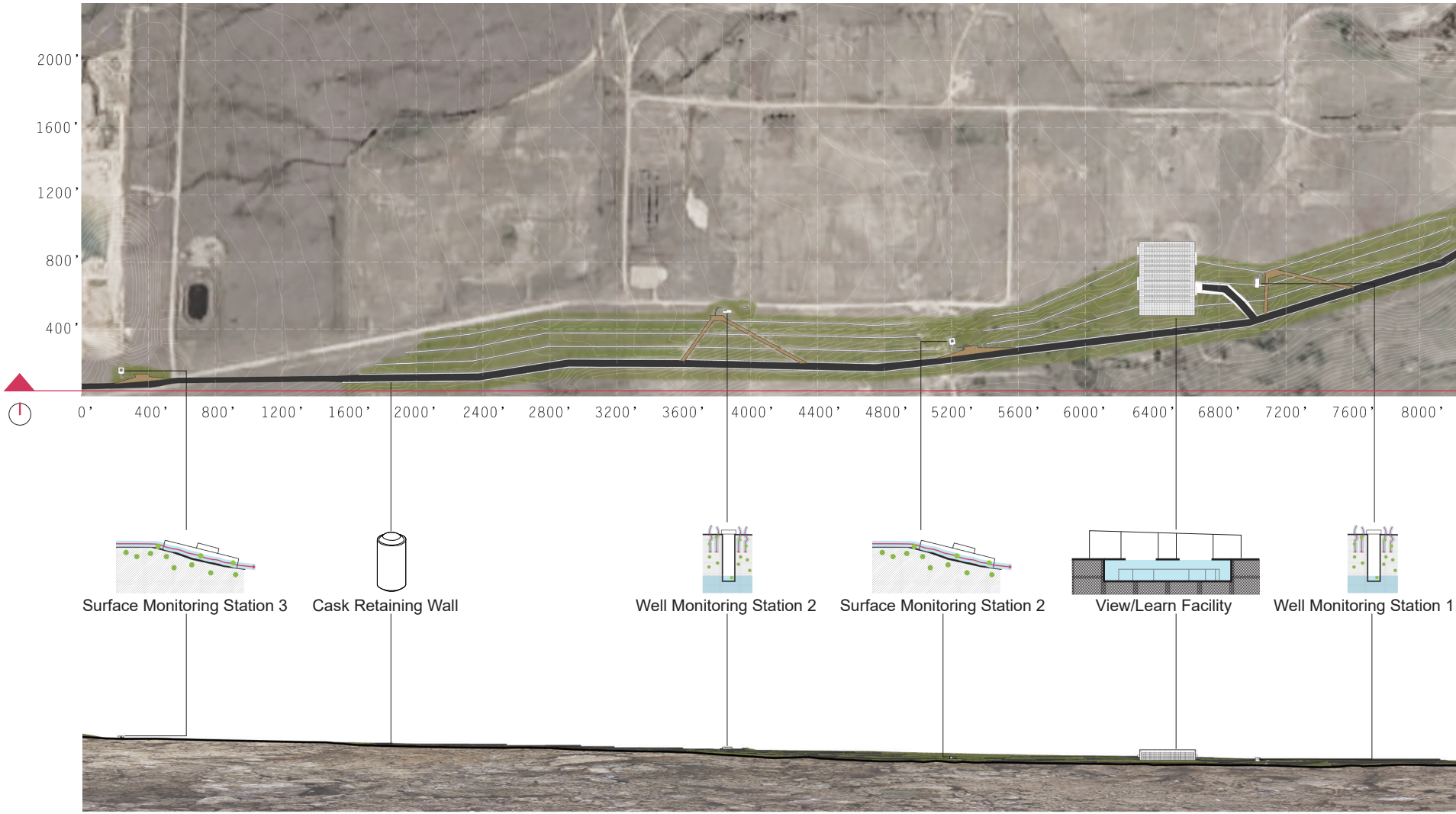


Figure 60 | Site Plan & Site Section

reclaimed state

soil (Figure 59). Intended as the primary component of the reclamation efforts at Rocky Flats a retaining wall stabilizes the southern hill side and is built out of radiation proof casks filled with contaminated soil generated by construction operations addresses both issues.

The 63,420 casks, each containing 100 cubic feet of soil, allow the waste generated by excavation to remain on site and put the soil to use in preventing the erosion of the southern hill side; mitigating the DOE's concerns about the further release of contamination. The cylindrical form of the casks references the oil drums of waste left exposed on pad 903. Mimicking spent nuclear fuel rod dry storage casks, the soil is contained in a lead lined steel shell encased in concrete and sealed by an outer steel skin, to prevent the transmission of radiation or leakage of soil (Figure 61).[4]

However, a slight risk of leakage remains heightening the perilous place nature of the site. The layers of the wall create a terraced hillside over seven thousand feet long forming the support for the new road through the site (Figure 62,63). The walls are split where roads are needed for access to the monitoring stations, and intersect the Viewing and Learning facility. At locations where surface monitoring stations are located the walls disappear into the hillside in order to channel water towards the monitoring stations.

The vast scale of the wall visible from both the ground and the air marks the scar on the site as it becomes the new mutant tissue formed from the pre-wounded and post wounded state

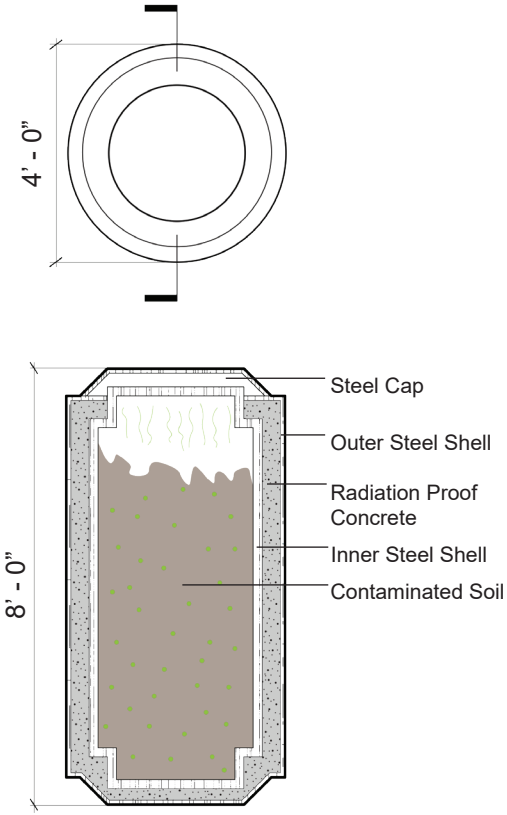


Figure 61 | Cask Plan & Section Cut

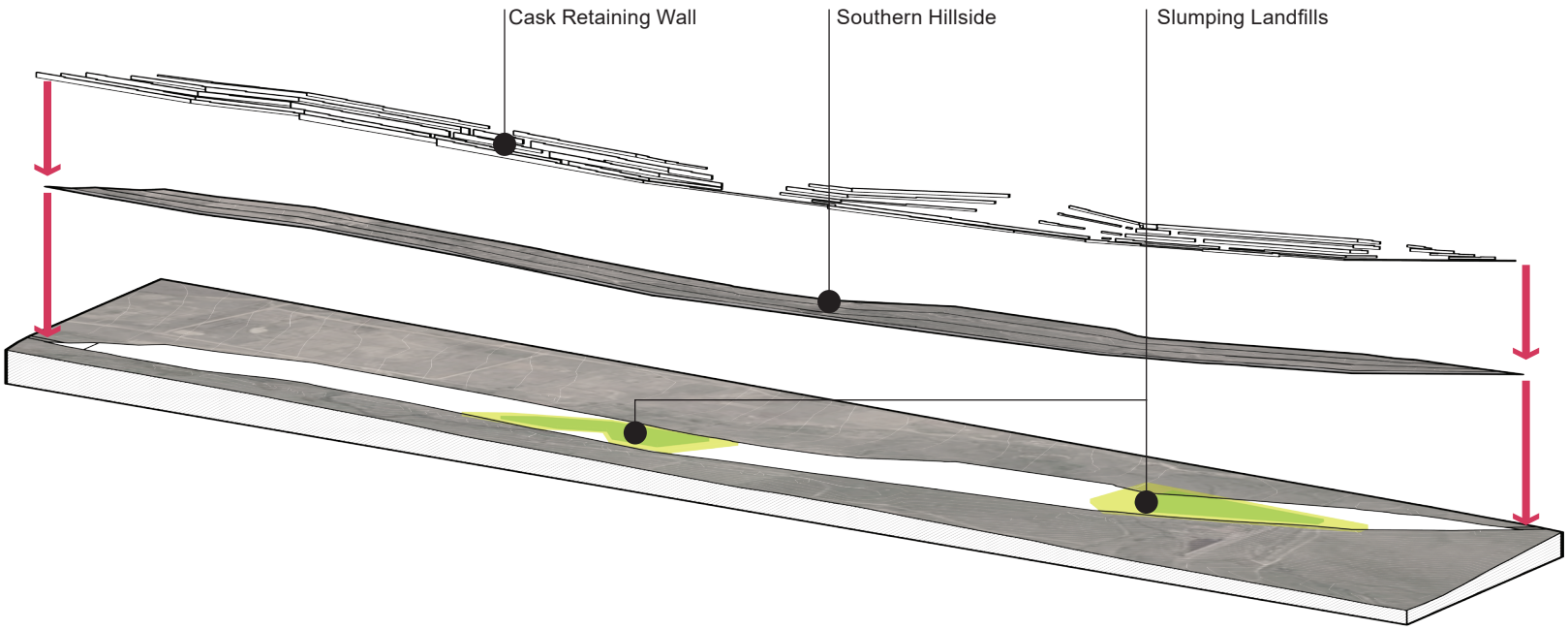


Figure 62 |Axonometric View of Retaining Wall

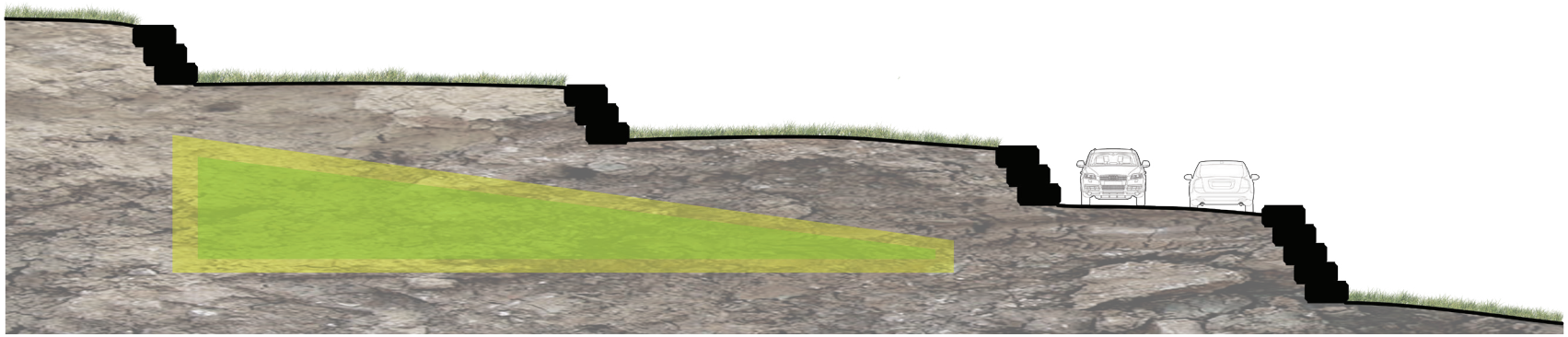


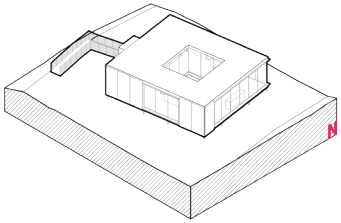
Figure 63 | Typical Retaining Wall Section

of the site. It serves as a unifying element connecting the architectural interventions while the interplay between the scale of the wall, the size of the casks, and the interventions experientially reinforces the massive size of the site to create an experience where the visitor is overwhelmed by the vastness of the landscape.

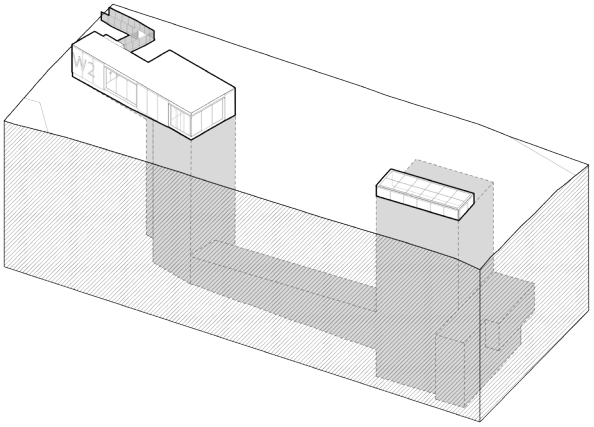
monitor

As part of its ongoing site operations the DOE maintains monitoring stations across Rocky Flats. These stations monitor the air, surface water run off, and groundwater with wells for radioactive particles from the base. Visitors to Rocky Flats encounter a series of six stations as they traverse the site. Three are located to the west of the View/Learn facility, and three are located to the east. The stations allow the public to understand the ruins in the form of contamination and the DOE's mission to prevent any further releases from the site.

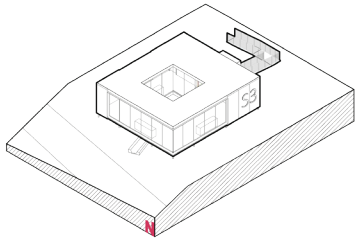
Conceptually the stations become glove boxes as they protect visitors from the contamination present on the site. The hermetically sealed stations are elevated above the ground plane and are accessed by traveling up a ramp and proceeding through an airlock. Each is derived from a five-foot by five-foot spatial grid to create a unity of form and proportion. The similarity of the structures indicates their programmatic role within the site allowing the visitor to understand that the interventions are part of a series of structures dedicated to the monitoring operations (Figure 64).



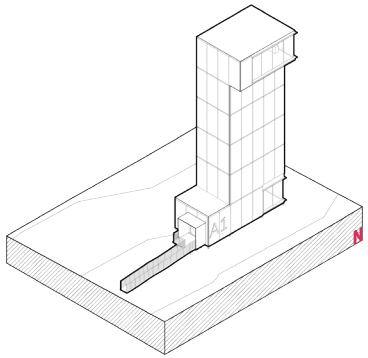
Surface Monitoring Station 2



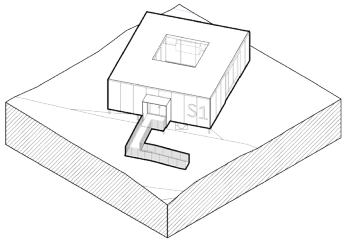
Well Monitoring Station 2



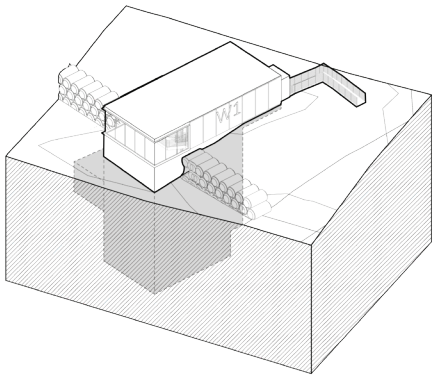
Surface Monitoring Station 3



Air Monitoring Station



Surface Monitoring Station 1



Well Monitoring Station 1

Figure 64 | Axonometric Views of the Monitoring Stations

The stations act as technical objects clad with industrial metal panels, placed on the landscape in order to monitor the virtually eternal contamination on the site. Their technical aesthetic references the panelized glove box systems used in the base. Each station engages the ground plane based on the type of contamination they seek to monitor. The air, surface, and well typology each contain an additional piece of program beyond the monitoring information itself.

Upon approaching the site on the eastern side from Indiana street the visitor encounters the air monitoring tower. This station acts as a landmark signaling the entrance to the base from the east with its tall slender form (Figure 66). Its prominence above the ground plane provides the height necessary for the air monitoring equipment to detect any wayward radioactive particles. When visitors pass through the air lock into the structure, they are invited to climb the stairs or utilize the elevator to reach the top platform (Figure 65). Reaching the top level of the tower affords the patron with sweeping views of Rocky Flats to the northwest and the Rocky Mountains to the west. This allows visitors to understand the vast scale of the site while creating a spatial relationship to the air being monitored by lifting them high above the ground plane.

A series of three surface water run off monitoring stations occupy the site, two are located within the retaining wall, and the third marks the western entrance to the base. Water is channeled from the levels of the retaining wall towards the two stations within it in order to

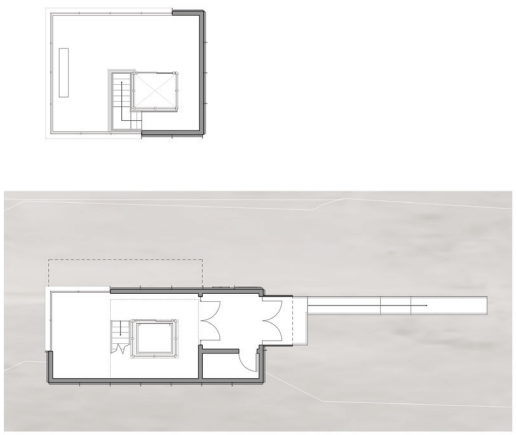


Figure 65 | Air Monitoring Station Plan

Figure 66 | View Approaching the Air Monitoring Station

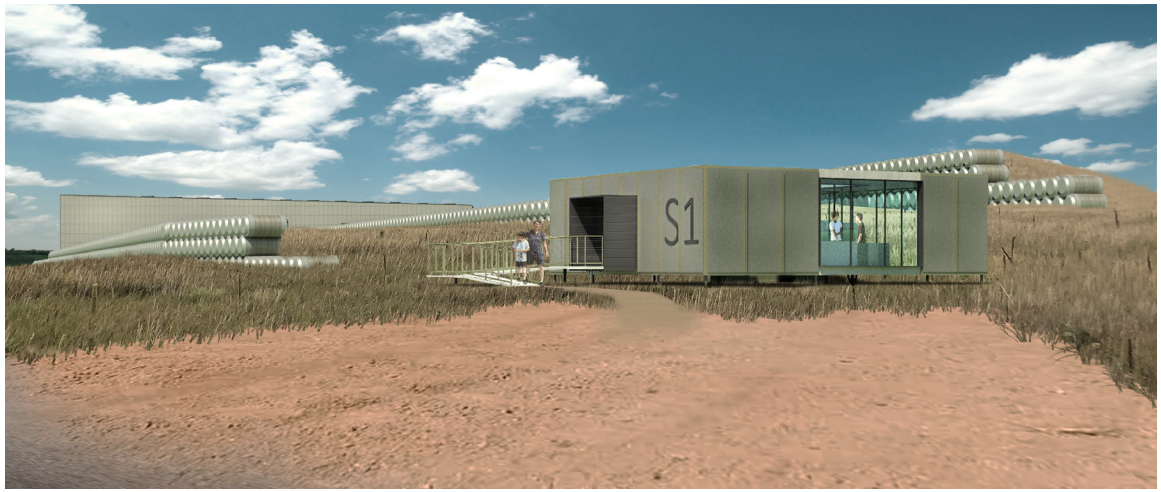
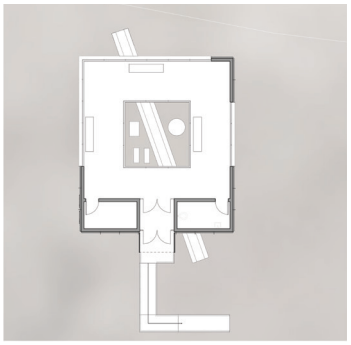
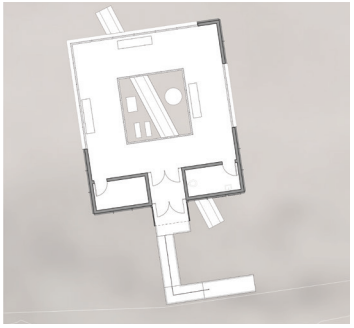


Figure 67 | View of Surface Monitoring Station 1

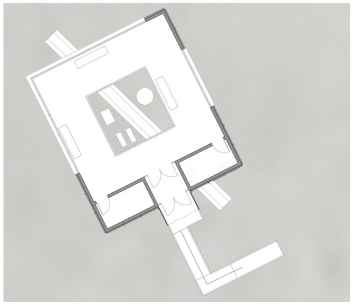
Figure 68 | View of Surface Monitoring Station 2



Surface Monitoring Station 3



Surface Monitoring Station 2



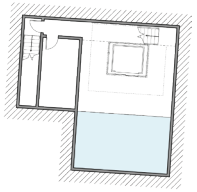
Surface Monitoring Station 1

Figure 69 | Surface Monitoring Station Plans

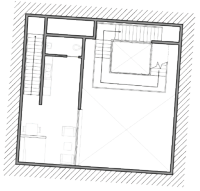
monitor the landfills below for releases of contaminants (Figure 67). These elements sit on columns above the ground plane to allow runoff to pass underneath and through the trough in the center containing the monitoring equipment (Figure 68). Taking on the form of a box with a central opening, the buildings surround the trough allowing visitors to circulate around the void as they view the readouts from the equipment on screens. Intended as rest stops on the site, each station contains a small restroom to offer visitors relief as they journey through the intervention (Figure 69).

Two wells are bored into the landscape below the landfills to monitor the ground water table for contaminant releases. These wells engage the ground plane by punching below the

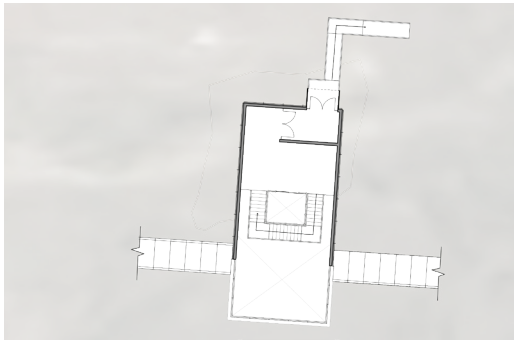
Figure 70 | View of Chamber Well Interior from Sleeping Chamber



Well Level



Sleeping Level

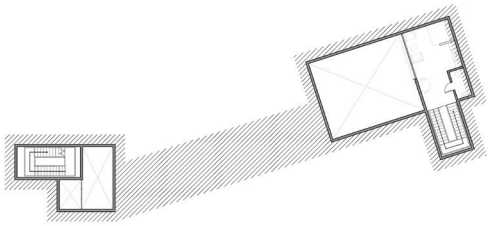


Level One

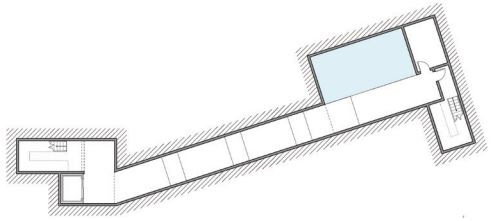
Figure 71 | Chamber Well Monitoring Station Plans

Figure 72 | View of Linear Well Interior

Level One



Sleeping Level



Well Level

Figure 73 | Linear Well Monitoring Station Plans

surface to the water table below, bringing the visitor into direct contact with the groundwater. With the interest of enhancing the dark tourism experience of the wells patrons may choose to spend a night in the sleeping chambers in overlooking the water below (Figure 70). Two typologies are employed in response to the changing depth of the water table across the site and to vary the experience of the well stations. The chamber station lies to the east of the View Learn facility at the top of the retaining wall. Visitors pass through the air lock and are immediately able to look down the chamber into the bottom of the well before proceeding down the stairs to the well platform where screens display readouts from the monitoring operations (Figure 71). The south facade is glazed to provide daylight to the entry level and to allow light down into the well, providing a sense of the depth below the ground plane to the visitor.

West of the View Learn Facility, sits the linear well monitoring station, this station hides the well from immediate view (Figure 72). Guests enter the station and proceed down to the well platform level. Once at the well platform the visitor is led down a ramp into the well chamber itself (Figure 73). A skylight in the well chamber allows natural light into the space and emphasizes the depth of the structure below grade. Screens displaying information readouts give visitors an indication of the monitoring operations occurring within the well.

Monitoring stations add a degree of transparency to the DOE's mission at Rocky Flats, serving to demystify the operations of the often secretive agency. They provide direct access to the contamination at the site, making the abstract contaminated microscopic particles real to

the viewer, supporting the sites mission in raising awareness about Rocky Flats. Furthermore, they help the public understand the vast infrastructure and advanced technology required to prevent further contaminant releases (Figure 74). They embrace the new state reclamation creates on the site, and play a crucial role as part of the intervention.

Figure 74| View of Surface Monitoring Station 3 Exiting the Site

Figure 75 | Exterior View of View/Learn Facility Southern Facade

view/learn

Perched on the southern hillside of the COU, the View/Learn facility encloses the excavated ruins of building 881 (Figure 75). The facility provides the primary dark tourism space where visitors view the ruins of the building; while learning about the history of Rocky Flats through a variety of lenses. Site selection was driven primarily by the need for a subterranean ruin to excavate and its proximity to the slumping landfills. The building becomes a part of the mutant tissue of the scar, both marking the ruin and creating spaces for dark tourism. It houses laboratories and office space for the DOE, the museum exhibitions overlooking the ruin viewing pool, museum offices, and educational spaces in the form of classrooms and an auditorium.

Building 881 at Rocky Flats was a large complex buried in the hillside where employees processed and machined uranium components for nuclear weapons (Figure 76). According to plans of building 881, the basement ruin is nearly three hundred feet in length and two hundred and fifty feet in width. DOE documents indicate the building was demolished with explosives and collapsed into its basement after being decontaminated.[5] However due to the high probability that the ruins are still contaminated with radiation, the View/Learn facility embraces the concept of glove box in order to protect patrons from the ruin. The architecture and the enclosure surrounding the ruin become the container protecting patrons as the experience the space.

Figure 76 | Building 881

The solution to visitor protection is derived from an examination of the pools at nuclear power plants where spent fuel rods are stored. According to the United States Nuclear Regulatory Commission spent fuel rods are stored in concrete pools with steel lined interiors below a twenty-foot deep shield of water (Figure 77). Water provides adequate radiation shielding from the rods, allowing power plant employees to safely work above. The pools are monitored for radiation levels and water is constantly pumped through to cool the rods[6].

In order to meet the technical challenge of excavating the radioactive ruins of building 881 and the potential release of more contaminants during construction, the building employs a prefabricated ten-foot-deep truss space frame system. This structure not only allows a clear span of two hundred feet over the pool, but aids in the construction sequence required to complete the facility. Construction is broken down into eight steps in order to mitigate radiation exposure and the release of contaminated particles (Figure 78).

First the subterranean ruins of building 881 lie below the southern hillside of the COU. The area around the ruin is excavated to the level of the below grade parking garage and the walls of the pool enclosure and building are constructed. Next the underside of the ruin is excavated by tunneling and shoring in order to build the underside of the pool. The prefabricated truss space frame is then constructed around the still unexcavated ruin and a temporary

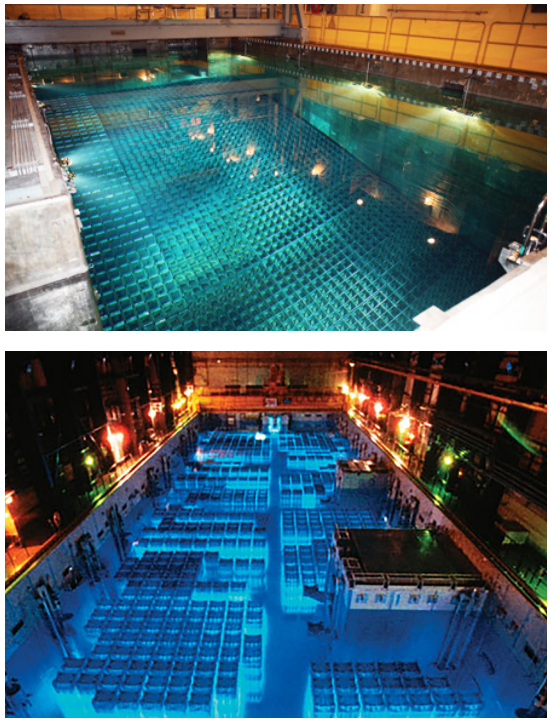
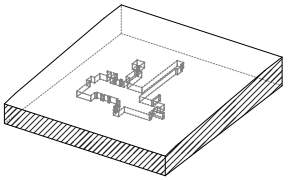
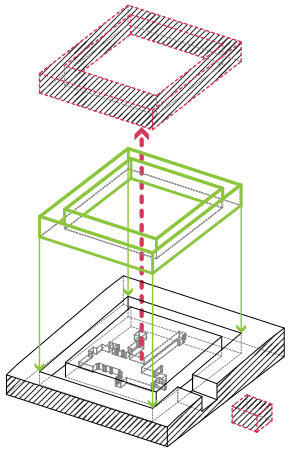


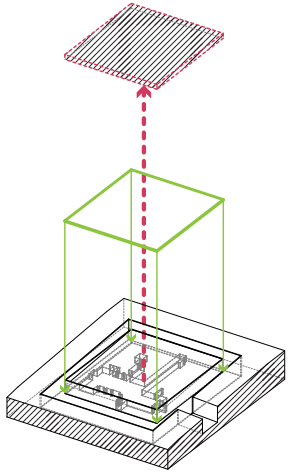
Figure 77 | Fuel Rod Cooling Pools



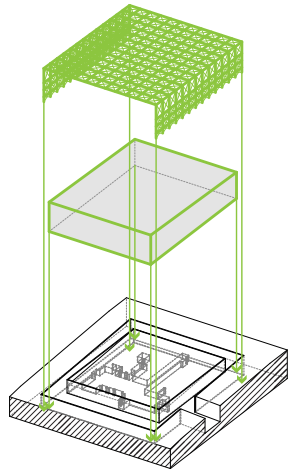
1. Buried ruin of Building 881



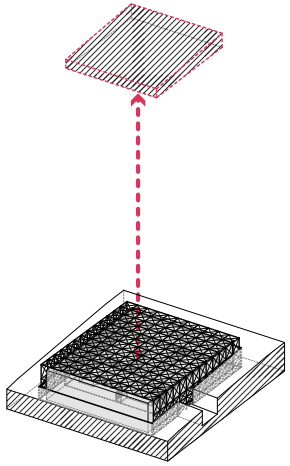
2. Sides and entry excavated, exterior walls and pool walls built



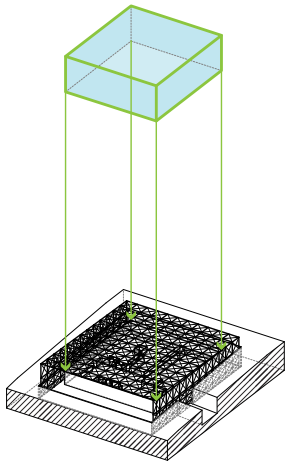
3. Underside of ruin tunneled out, pool bottom constructed



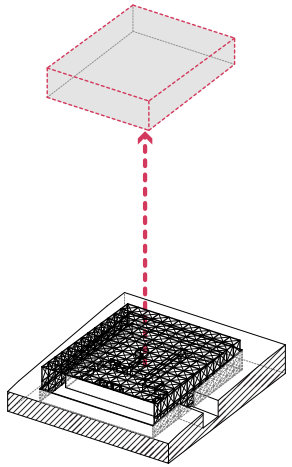
4. Space frame truss structure built and temporary enclosure installed



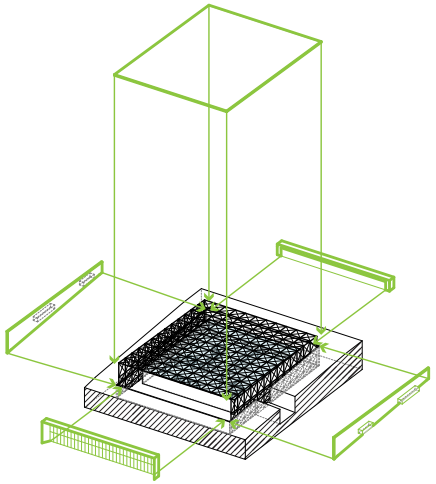
5. Ruin excavated



6. Pool Filled



7. Temporary enclosure removed



8. Structure clad and remainder of building constructed

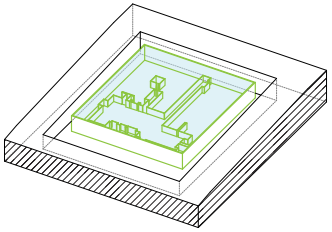
Figure 78 | View/Learn Facility Construction Sequence Diagram

enclosure is placed on the underside of the structure.

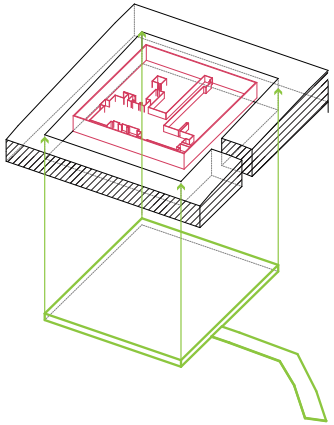
The ruin is then excavated under the protection of the temporary enclosure. All soil from the construction process is placed into the radiation proof casks for use in the retaining wall. Following the excavation of the ruin the pool is filled with water forming the radiation barrier. Once the water is in place the space frame truss is decontaminated and the temporary enclosure is removed. The space frame truss structure is then clad and the remainder of the building is constructed. Following the sequence outlined above, the View/Learn facility is then ready to be opened to the public as the pool functions like a glove box using water to create a radiation barrier between the ruin and the inhabited spaces on the upper levels.

The building is organized into four main programmatic volumes, with system chases, restrooms, and vertical circulation spaces pushed to the edges to take advantage of the twelve-foot deep space frame truss structure (Figure 79). These volumes are stacked with parking on the bottom, followed by the pool and support spaces, with the office and education volume above to the south, and the museum space on the northern side. The form of the building slopes down towards the north, compressing the museum space focusing it to views of the base's footprint. It opens up towards the south allowing maximum daylight into the offices, labs, and classroom spaces in this area.

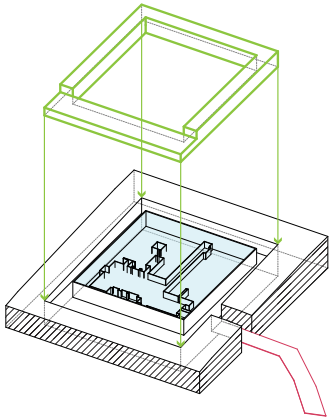
Conceived as a stealth monolithic box the building embraces the secretive nature of the former plant to create an experience of unexpected spaces within (Figure 80). Industrial metal



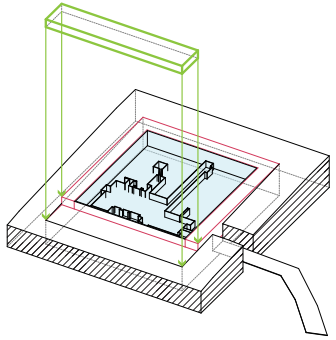
Pool Enclosure



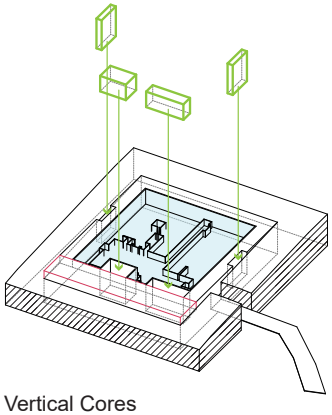
Parking Volume



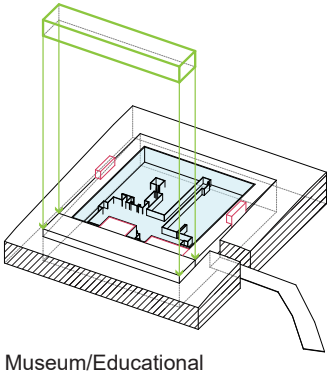
Support Spaces



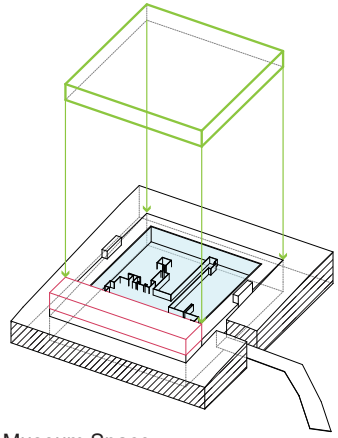
DOE Offices & Labs



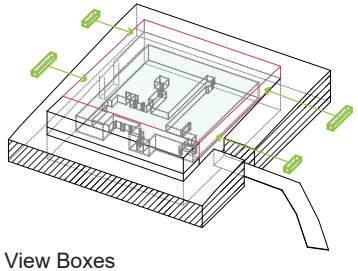
Vertical Cores



Museum/Educational



Museum Space



View Boxes

Figure 79 | View/Learn Facility Component Diagram

paneling clads the exterior as a reminder of the industrial legacy of the former plant and the highly technical nature of the building within. The glazed transparent north and south facades allow light from the pool to leak out at night, creating an eerie glowing object in the landscape as the plant did during its operation. The nighttime glow creates a visual relationship with the neighboring Candelas housing development to the south. The box is punctuated by cantilevered

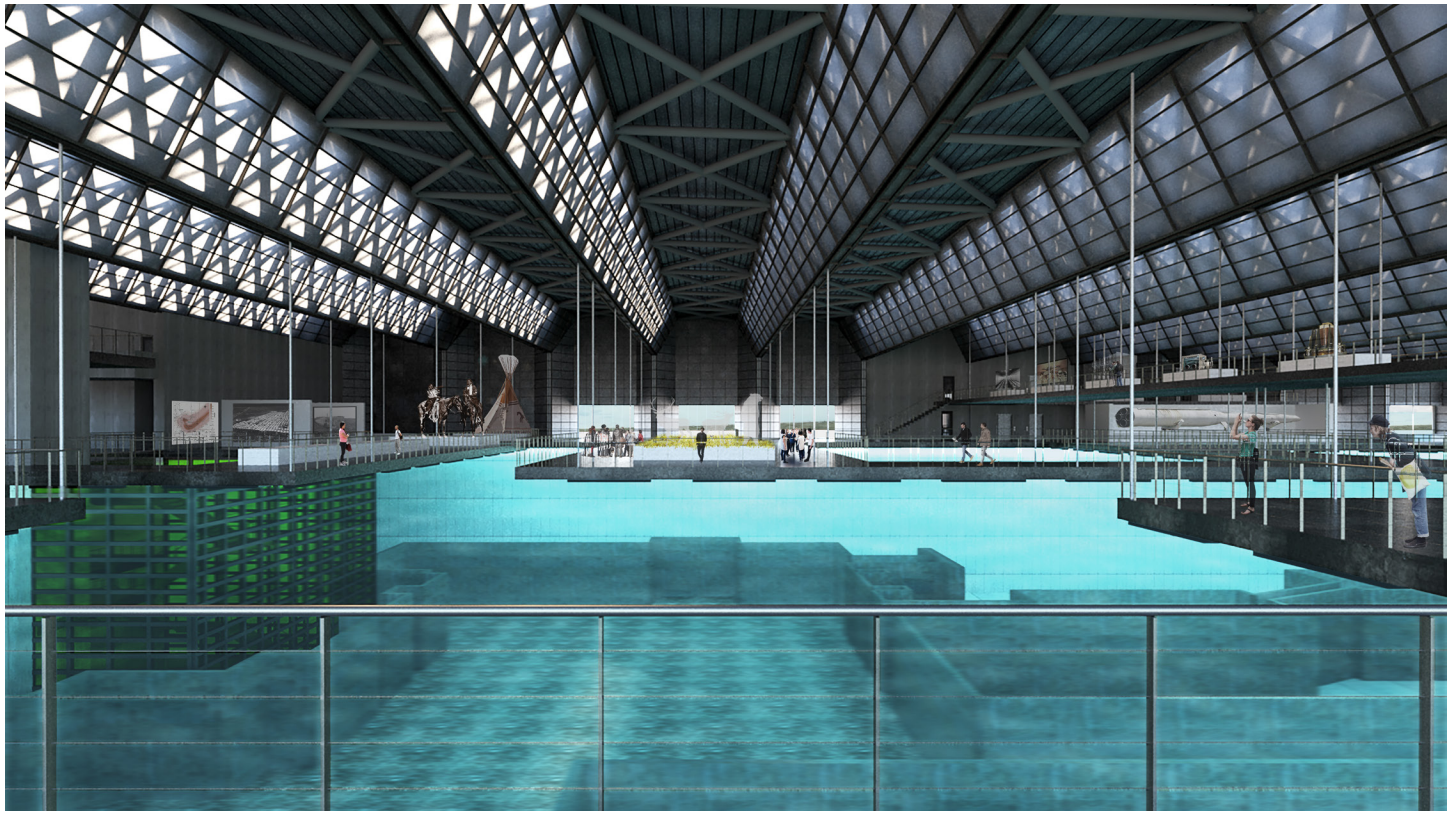


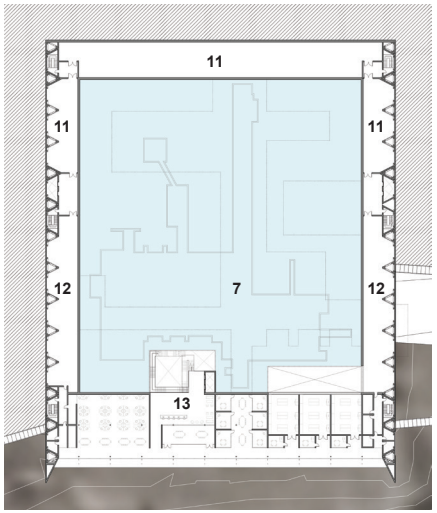
Figure 80 | Interior View Overlooking the Ruin Pool

viewing platforms on the east and west facades that create views related to the museum exhibitions within.

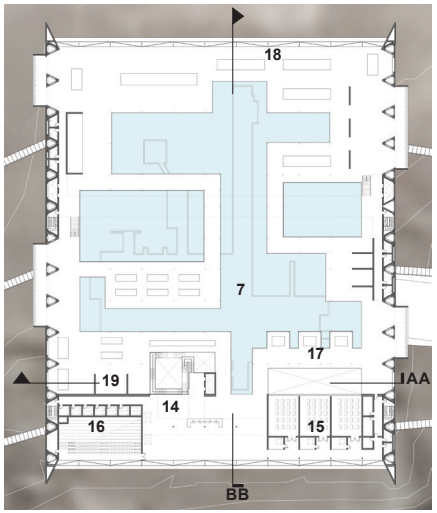
Visitors enter by turning off the main road and down a driveway into the parking level below the pool. The experience is analogous to entering a hidden military base in reference to the secretive history of the site (Figure 81). This level is divided into a zone for employee parking to the south and patron parking to the north and is penetrated by two light wells providing daylight to mark the entrance to the facilities up above. Support spaces including mechanical rooms, the pool control room, museum storage rooms, and additional water tanks for pool water occupy the below grade spaces around the enclosure.

Above the support spaces, the DOE offices and labs, museum offices, as well as educational spaces occupy the volume to the south to take advantage of natural light. The northern volume of the building provides space for the museum itself and the floors are hung over the pool from the vast truss system above, forcing visitors to walk over and across the glowing ruin pool below. A sense of serenity and calm is created in the museum space and the ruin is given reverences as the visitor circulates through the exhibits back into the lobby space. Soft northern light enters this area through skylights integrated with the trusses above.

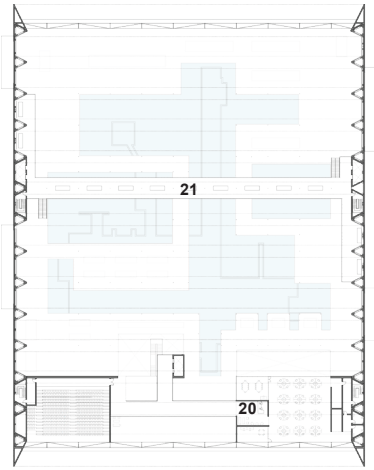
The museum space above the pool is divided into three zones meant to be experienced as a procession through the space. As the patron passes from the parking level up through the



Level One



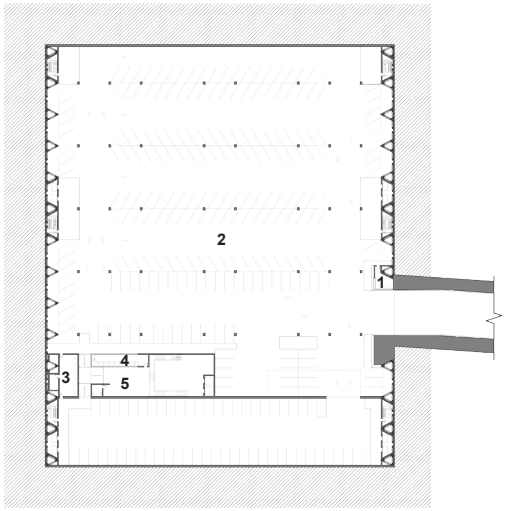
Level 2



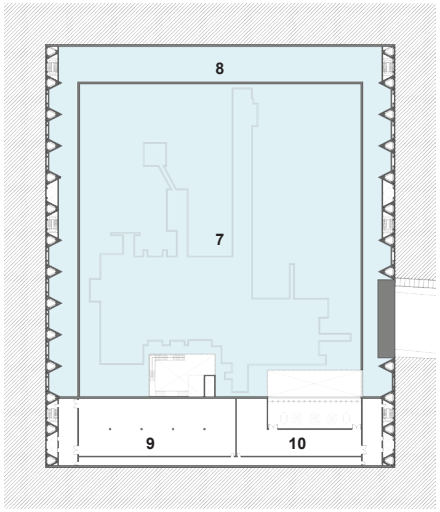
Level 3

Program

1. Entry Gate
2. Visitor Parking
3. Guard Station
4. Admissions
5. Entry Lobby
6. Staff Parking
7. Ruin Pool
8. Water Tank
9. Mechanical Room
10. Pool Control Room
11. Museum Storage
12. Pool Mechanical
13. DOE Offices & Labs
14. View/Learn Lobby
15. Classrooms
16. Auditorium
17. Art Exhibit
18. History Exhibit
19. Nature Exhibit
20. Museum Offices
21. Ruin Cross Over



Parking Level



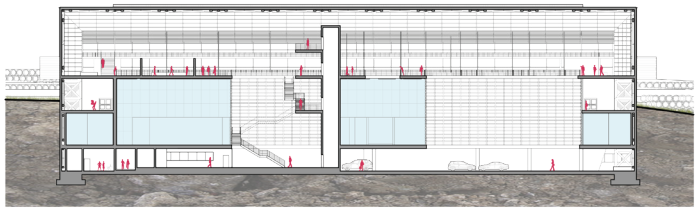
Ruin Level

0’ 60’ 120’ 180’ 240’ 300’

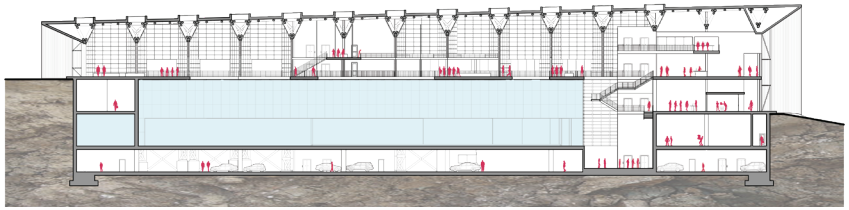
Figure 81 | View/Learn Facility Plans

pool light well, they enter the lobby and are treated to a sweeping view of Candelas to the south. Proceeding north and into the pool volume the patron first encounters the art exhibitions which convey the human and cultural impact of the site. Rocky Flats inspired artwork by Jeffery Gipe and other local artists is displayed in this space as cultural artifacts of the plant's controversial history. A view platform cantilevered off the side of the building orients views to Denver to create a visual connection with the community adversely effected by Rocky Flats.

The patron then passes by vertical circulation cores and restrooms into the history exhibit curated by the Rocky Flats Cold War museum (Figure 83). This area contains exhibits about the history of the Cold War, the operations in the plant, and information about the building 881 ruin below. The glazed northern facade and sense of compression created by the form emphasize its relationship to the demolished base to the north. The viewing platforms in this part of the space provide additional views of the base to the east and west offering visitors the closest visual relationship to the rest of the plant within the site.



Section AA: Transverse Cut



Section BB: Longitudinal Cut

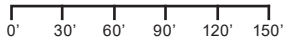


Figure 82 | View/Learn Facility Section Cuts

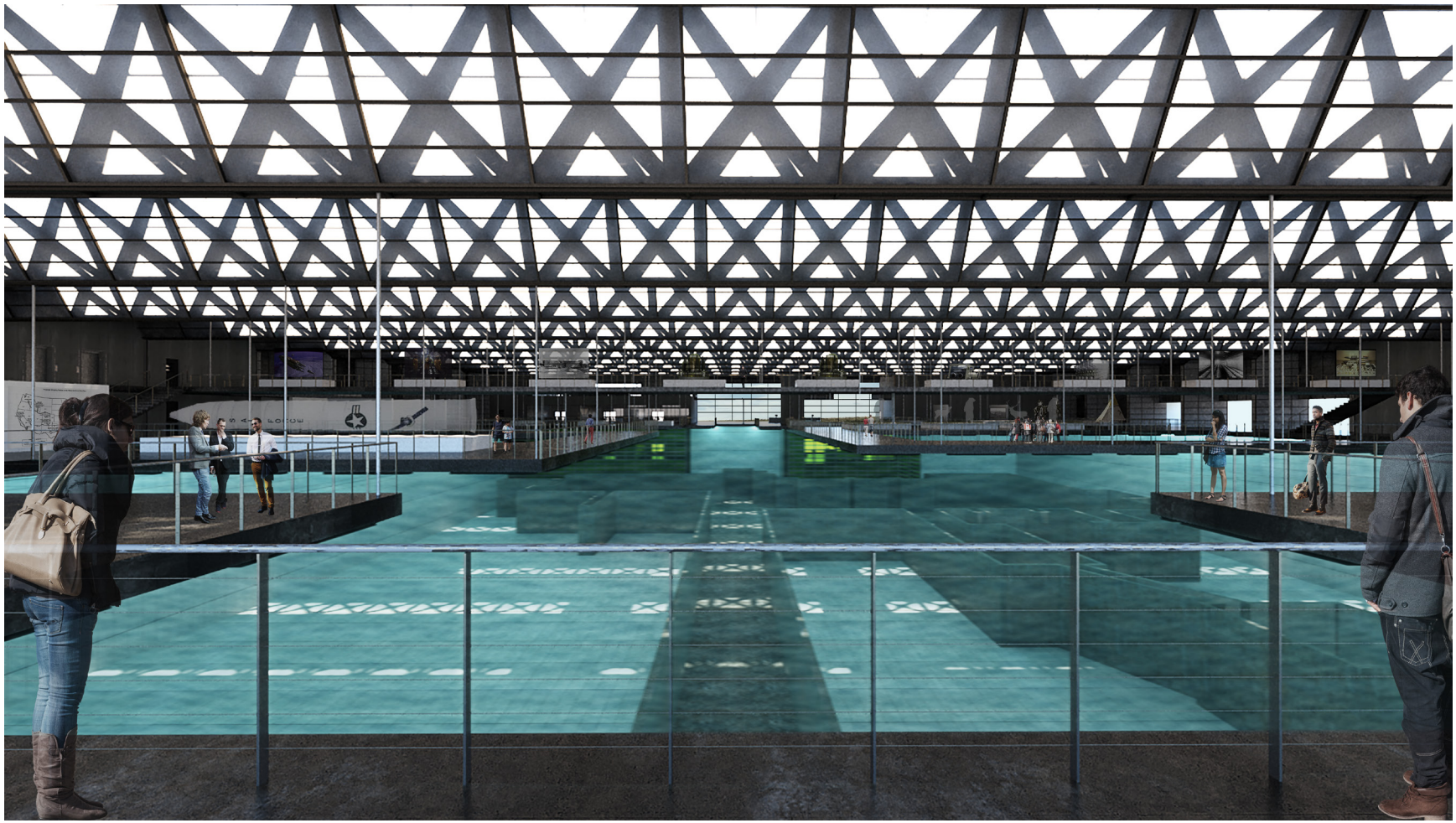
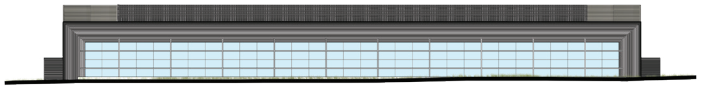


Figure 83 | Interior View Overlooking Ruin Pool from the History Exhibit

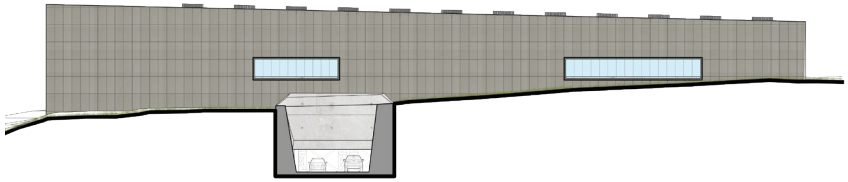
Passing by another block of vertical circulation and restrooms the visitor transitions into the ecology exhibit. This area is divided into two zones, one contains exhibits about the ecology around the plant and its pre-wounded natural state, and one displaying information about the contamination and post wounded contaminated state. The viewing platform in this area creates a relationship with the Rocky Mountains to the west, the most prominent natural feature on the front range and source of the Chinooks.

Integrated into the cask retaining wall and flanked by the monitoring stations, the building becomes a prominent feature in the reclaimed scarred state of the landscape at Rocky Flats. Its size reflecting the important role the building plays as part of the scar on the wounded landscape. The structure provides a primary space for the dark tourism experience as visitors move through the exhibits above the radioactive pool. Interaction with the ruin and the museum spaces bring the history and impact of Rocky Flats to life fulfilling the objective of raising public awareness of the site through its new state of existence.

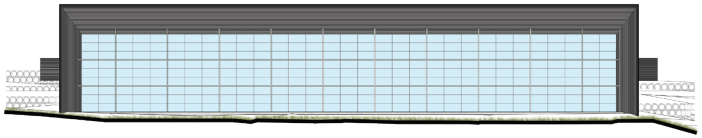
1 United States of America, U.S. Department of Energy, Office of Legacy Management, *Original Landfill Path Forward*, RFS ed., vol. LMS, S15241 (2017), 1.
2 U.S. Department of Energy Office of Legacy Management, *Original Land Fill Path Forward*, 1.
3 Ibid.,7.
4 “Spent Fuel Pools,” United States Nuclear Regulatory Commission - Protecting People and the Environment, , accessed November 13, 2018, https://www.nrc.gov/waste/spent-fuel-storage/pools.html.
5 United States of America, United States Governement, Government Accountibility Office, *Nuclear Clean Up of Rocky Flats DOE Can Use Lessons Learned to Improve Oversight of Other Sites’ Cleanup Activities*, 06th ed., vol. GOA, series 3532 (Wasington DC: GOA, 2006), 13.
6 “Spent Fuel Pools,” United States Nuclear Regulatory Commission



Elevation: North



Elevation: East



Elevation: South

Elevation: West

0’ 30’ 60’ 90’ 120’ 150’

Figure 84 | View/Learn Facility Elevations

Figure 85 | Interior View of Museum Lobby

05 conclusions

Nuclear proliferation during the Cold War had an undeniable impact on the United States both culturally and physically. The relics of the conflict remain strewn across the landscape in varying states of decay and obfuscation, as the history of the Cold War fades into memory. However, the threat proliferation poses remains ever present as global tensions continue to simmer. Altough these issues no longer dominate the headlines, controversy over the nuclear program in North Korea, the ongoing conflict between India and Pakistan, as well as recent advances in hypersonic missile technology indicate the threat still remains. In the fast paced news cylce of the twenty first century it seems as though concerns about nuclear proliferation have faded to the background of the public consicousness .Preserving the memory of the Cold War and recognizing the unique form of environmental contamination the production of these weapons created is critical in order to remind the public of the devastating consequences of continuing nuclear proliferation.

This thesis argues that reclamation offers an approach which accepts the reality of the situation on at these installations and presents an opportunity to recover their history, returning it to public consciousness. In understanding the architectural interventions as part of a scar marking the landscape and signifying healing. The proposed design seeks to generate a new life for the site preventing the loss of the past and accepting the damage done by a painful history. Analysis of the site in terms of the pre-wounded natural state, the post-wounded contaminated state, and the shift into the new reclaimed scarred state provides the groundwork for the transformative process guiding the intervention. This process allows dark tourism to

occur on the site which frames the events at Rocky Flats and the Cold War as both tragic and dangerous, ideally allowing the project to fulfill its educational objective (Figure 85).

The theoretical proposistion and design proposal presented in this thesis raises additional questions about the relationship between residents of Denver and Boulder to a reclaimed Rocky Flats. Would public concern over nuclear proliferation and radioactive contamination be great enough to support such an ambitous design proposal. The feasability of constructing the View/Learn facility certainly presents issues in terms of funding, construction worker saftey, and further contaminant release during excavation. Perhaps a samller scale intervention provides a more grounded less idealistic approach. Deeper exploration into the relationship between citizens and Rocky Flats would provide an indication of the current level of interest in the site as well as potential users. This information may reveal that a more modest architecctural intervention would be sufficient to acheive the goals outlined in this thesis. It is entirely plausible that one monitoring station, perhaps the air monitoring tower, has the power to reclaim the site. Regardless of scale and feasability, architecural interventions at Rocky Flats have far more potential to preserve the history of the site than the current proposal for a wildlife reserve.

All questsions aside, the theoretical framework and site analysis methodology presented in the previous chapters can provide a model for reclaiming other sites like the Hanford Reach in Washington, or Nixon's pyramid in South Dakota. Shifting these sites into

their reclaimed scarred states will memorialize their histories and create new existences that allow them to serve a role educating the public.The history embedded in this legacy serves to honor those who sacrificed their health knowingly or unknowingly in pursuit of nuclear weapons. Furthermore, the contamination remaining at these bases as highlighted by reclamation, provides a dire warning about the consequences of both the production and use of these weapons. Ultimately, the project responds the warning embodied in George Santayana's famous aphorism " those who cannot learn from history, are doomed to repeat it." Reclaiming these sites provides the opportunity to learn from the mistakes of Cold War history. In an age where technology affords humanity unprecedented destructive capabilites perhaps architecture can serve a role in preserving history and heed Santayana's prescient warning (Figure 86).

Figure 86 | A Russian Jet Testing a Nuclear Capable Hypersonic Missile

06 bibliography

“About the Refuge - Rocky Flats - U.S. Fish and Wildlife Service.” U.S. Fish & Wildlife Service. Accessed April 27, 2018. https://www.fws.gov/refuge/Rocky_Flats/about.html.

Ackland, Len. *Making a Real Killing: Rocky Flats and the Nuclear West*. Albuquerque: University of New Mexico Press, 2002.

Ackland, Len. “Open Wound From a Tough Nuclear History.” *In Remedies for a New West: Healing Landscapes, Histories, and Cultures*, by Sharon K. Collinge, Andrew Cowell, and Patricia Nelson Limerick, 248-61. Tucson, AZ: Univ. of Arizona Press, 2009.

Aguilar, John. “Nearly 300,000 Colorado Public School Students Now Barred from Making Field Trips to Rocky Flats.” The Denver Post. April 28, 2018. Accessed June 12, 2018. https://www.denverpost.com/2018/04/29/rocky-flats-school-field-trips-ban/.

Alchin, Linda. “Southwest Culture.” Facts, Clothes, Food and History”. January 16, 2018. Accessed June 13, 2018. https://www.warpaths2peacepipes.com/history-of-native-americans/history-of-colorado-indians.htm.

Berger, Alan. *Reclaiming the American West*. 1st ed. New York: Princeton Architectural Press, 2002.

Carroll, Vincent. “The Rocky Flats Scare Brigade Gains a New General.” The Denver Post. June 07, 2018. Accessed June 12, 2018. https://www.denverpost.com/2018/06/08/the-rocky-flats-scare-brigade-gains-a-qualified-lackey/.

Colorado Experience: Colorado’s Cold War (Rocky Flats). Directed by Julie Speer. Produced by Michael A. Dondero. United States: Rocky Mountain PBS Public Broadcasting Network, Inc., 2014. Television. October 17, 2014. Accessed May 10, 2018. https://www.youtube.com/watch?v=EVskMECXJ0U.qualified-lackey/.

Dark Circle. Directed by Judy Irving, Ruth Landy, and Christopher Beaver. United States: New Yorker Films, 1982. DVD.

Ecological Systems of Colorado: Rocky Mountain Lower Montane-Foothills Shrubland. Publication. College of Natural Resources: Colorado Natural Heritage Program, Colorado State University. Fort Collins, CO: Colorado Natural Heritage Program, 2005. 1-3.

"Estonian National Museum / DGT Architects (Dorell.Ghotmeh.Tane)." ArchDaily. June 06, 2016. Accessed April 15, 2018. https://www.archdaily.com/788767/estonian-national-museum-dgt-architects.

Finley, Bruce. "Rocky Flats May Soon Open for Recreation, but the Feds Skipped a Study on Plutonium Exposure and the Risk It Poses to Cyclists and Hikers, Lawsuit Says." The Denver Post. May 02, 2018. Accessed May 14, 2018. https://www.denverpost.com/2018/05/02/rocky-flats-plutonium-exposure-lawsuit/.

Hobbs, Farrel D. *An Insider's View of Rocky Flats: Urban Myths Debunked*. U.S.: CreateSpace, 2010.

Iversen, Kristen. *Full Body Burden: Growing up in the Nuclear Shadow of Rocky Flats*. First ed. New York: Crown Publishers, 2012.

Lennon, J. John., and Foley, Malcolm. *Dark Tourism*. London: Continuum, 2000.

Leoni, Claudio. "Peter Zumthor's 'Topography of Terror.'" *Architectural Research Quarterly* 18, no. 2 (2014): 110–22. doi:10.1017/S1359135514000426.

Moore, Rowan. "Estonian National Museum Review – Touching and Revealing." The Observer. January 01, 2017. Accessed April 15, 2018. https://www.theguardian.com/artanddesign/2017/jan/01/estonia-national-museum-review-touching-and-revealing-dgt-dorell.

"Rocky Flats Home." Rocky Flats Cold War Museum. Accessed June 1, 2018. http://www.rockyflatsmuseum.org/.

"Rocky Flats Home." Rocky Flats Cold War Museum. Accessed June 1, 2018. http://www.rockyflatsmuseum.org/.

"Rocky Flats Glows." Rocky Flats Glows. Accessed April 12, 2018. https://rockyflatsglows.com/.

Sharpley, Richard., and Stone, Philip R. *The Darker Side of Travel the Theory and Practice of Dark Tourism. Aspects of Tourism,* No. 41. Tonawanda, NY: Channel View Publications, 2009.

"Spent Fuel Pools." United States Nuclear Regulatory Commission - Protecting People and the Environment. Accessed November 13, 2018. https://www.nrc.gov/waste/spent-fuel-storage/pools.html.

Spier, Steven., Tschanz, Martin, and Richters, Christian. *Swiss Made: New Architecture from Switzerland*. 1st ed. New York, NY: Princeton Architectural Press, 2003.

Storm, Anna. *Post-industrial Landscape Scars*. Basingstoke, Hampshire: Palgrave Macmillan, 2016.

Schwartz, Stephen I. *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons since 1940*. Washington, D.C.: Brookings Institution Press, 1998.

Thiel, Insa. "Entrée into past Times: Estonian National Museum in Tartu." Detail-online.com. April 14, 2018. Accessed April 15, 2018. https://www.detail-online.com/article/entree-into-past-times-estonian-national-museum-in-tartu-29380/.

Treib, Marc. Spatial Recall: Memory in Architecture and Landscape. New York; London: Routledge, 2009.

United States. Colorado Department of Public Health and Environment. *Rocky Flats Cancer Incidence Supplement 2017.* Denver, CO: Colorado Department of Public Health and Environment, 2017.

United States. Colorado Department of Public Health and Environment. Health Advisory Panel. *Summary of Findings: Historical Public Exposure Studies on Rocky Flats*. Denver, CO: Colorado Department of Public Health and Environment, 1999.

United States of America. U.S. Department of Energy. Office of Legacy Management. Original Landfill Path Forward. RFS ed. Vol. LMS. S15241. 2017.

United States. US Department of Energy. Office of Legacy Management. *Rocky Flats Fact Sheet*. July 25, 2017. Accessed April 12, 2018. https://www.lm.doe.gov/Rocky_Flats/Documents.aspx.

United States of America. United States Government. Government Accountability Office. Nuclear Clean Up of Rocky Flats DOE Can Use Lessons Learned to Improve Oversight of Other Sites' Cleanup Activities. 06th ed. Vol. GOA. Series 3532. Washington DC: GOA, 2006.

United States. U.S. Fish & Wildlife Service. *Rocky Flats National Wildlife Refuge*. Rocky Flats National Wildlife Refuge: Resource Inventory. Washington, D.C.: U.S. Fish and Wildlife Service, 2003.

Vanderbilt, Tom. *Survival City: Adventures among the Ruins of Atomic America*. Chicago: University of Chicago Press, 2010.

"Winds." National Parks Service. Accessed June 13, 2018. https://www.nps.gov/romo/winds.htm.

Woods, Lebbeus. *War and Architecture = Rat I Arhitektura*. Pamphlet Architecture; 15. New York, NY: Princeton Architectural Press, 1993.

Worster, Dondal. *Under Western Skies: Nature and history in the American West*. New York; Oxford: Oxford University Press, 1994.