

Mining the Midden:

A Facility for Dynamic Waste Harvesting at the
Cedar Hills Regional Landfill

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A thesis

submitted in partial fulfillment of the
requirements for the degree of
Master of Architecture

University of Washington

2012

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Program Authorized to Offer Degree:

Architecture

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ACKNOWLEDGEMENTS

The development of this thesis owes tremendous gratitude to the guidance and perspective provided by Brian McLaren and Brad Khouri. Gracious thanks also to Josh Distler for his uniquely qualified perspective as an architect and a geologist in weekly desk critiques; Louisa Iarocci for her engaged investment early on during research preparation; Rob Hutchison for his interest and enthusiasm; Chris Meek for his encouragement and positive motivation; my fellow studio mates for countless late-night critical eyes, inspiration and camaraderie; my family and friends for their thoughts, support and laughs; and, especially, Jenn, for everything.



Figure 1.1 (Above) View of active fill area at the Cedar Hills Regional Landfill.

Figure 1.2 (Below) Diagram of thesis problem statement. The general public has no visual or cognisant connection to the landfill.

CHAPTER 1: INTRODUCTION

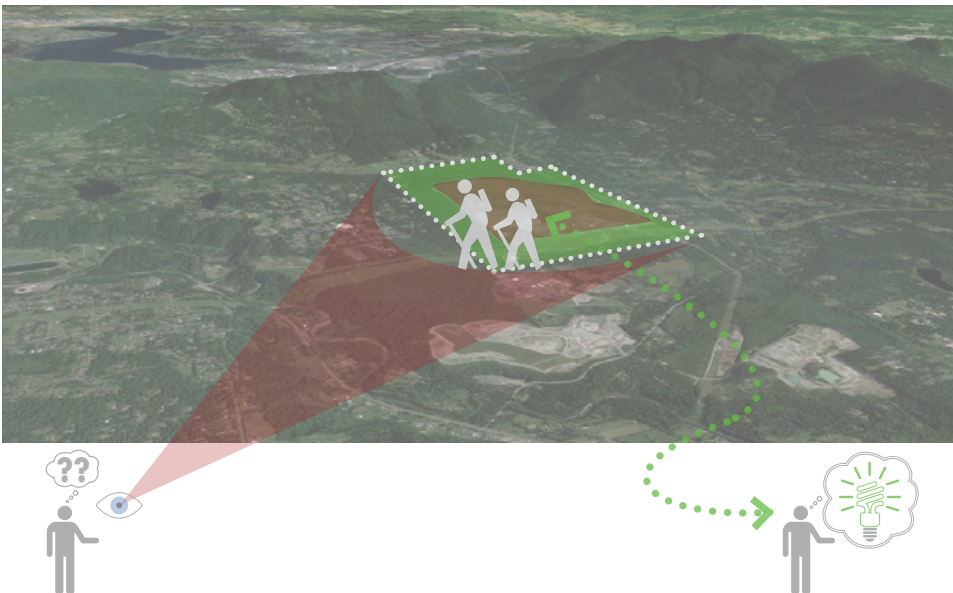
As the final resting place of a majority of the nation's solid waste, sanitary landfills are an underappreciated and undervalued, and often forgotten form of public land. Landfills present a unique opportunity as a contemporary cultural artifact preserve and a material and energy resource. The current perception of landfills is that these waste landscapes are a blight which should be hidden from public view (fig. 1.2). This position presents a problem; specifically that the public has no connection or understanding of where the waste that they create goes to "die". As constantly evolving tombs acting as time capsules, scientists and artists study landfills as geographic and cultural landscapes, which serve as telling records of our modern culture. These topographically dynamic middens exist as a unique typology of public land not typically accessible or visible to the same public which collectively created them. A combination of public engagement, observation, and interpretation within these sites is essential to creating a deeper connection to the shared ownership and responsibility citizens have in the creation and perpetuation of these modern middens.

This thesis aims to shift the perception of the landfill from out of sight, out of mind to one of exposing these spaces as multi-faceted resources. It examines how architecture can play a role in making their cultural value as public lands better understood. In making the end-point of our waste stream transparent, the truths of our culture will be exposed, exhibited, and exploited. This facility will allow the public to experience and engage in the process of landfill mining, as well as the sorting and documentation of mined waste. Also revealed is the transformation of the landfill through materials



Fig. 1.3 (Above) View from the highest point of the Cedar Hills Regional Landfill looking north to picturesque mountainous setting.

Fig. 1.4 (Below) Diagram of basic thesis proposition: if people can physically and visually experience to the landfill, they will be more conscious of their connection to the site.



recovery and waste-to-energy processes. Excavating through layers of our cultural history creates opportunities to learn from the past to inform future practices and policies. By experiencing the landfill as public land, we as citizens create our own personal understanding of these culturally significant places as a product of a society of consumption and waste, thereby hopefully instilling a sense of collective ownership and responsibility of our contributions to it (fig. 1.4).

Programmatically, the architectural intervention provides a working laboratory for the science of landfill archaeology in conjunction with and parallel to a materials recovery facility and a waste-to-energy plant. The public experience will traverse these processes as an engaged observer, enhanced by moments of direct engagement and interpretation of active areas of the mining operation, views into the sectional cut of the landfill cultural artifacts exhibited. The building is set within a void created by the act of mining, letting the necessary armatures of retainment and shoring become the framework for the structure itself. Placing the structure inside and creating “windows” into the strata of the excavated cut links the building functions back to the landfill mining process, exposing their interdependent existence.

CHAPTER 2: MINING FOR THE GREATER GOOD!

LANDFILL AS CULTURAL SIGNIFIER

Archaeology is the science of studying people and cultures by analyzing their artifacts, records and waste. This science is dependent on the significance and care put into the art of excavation. Ancient middens, or old dumps of domestic waste, from around the world have provided archaeologists with evidence of the everyday lives of countless past cultures. This legacy has continued to the present day with contemporary anthropology, specifically the Garbage Project. Started by Dr. William Rathje and a group of his anthropology students at the University of Arizona in 1973 (Figure 2.1), this academic study was based on the belief that truths about our present day culture could be found within our garbage.¹ The Garbage Project, a collective of practitioners of the emerging science, began sorting and documenting fresh waste from landfills in order to expose patterns of our cultural consumption. Their work was critical to the emergence of a new specialized social science of modern waste known as Garbage Archaeology², which in practice merges aspects of anthropology, sociology and social psychology, bringing a social science dealing with past cultures into contemporary times.

When Dr. Rathje and his Garbage Project group began receiving criticism that their work was not true archaeology because their time was spent sorting and documenting only fresh trash, they responded by digging into landfills.³ The installation of methane vents in landfills across the nation in the 1980's provided a timely catalyst. The previously discarded core samples removed for this purpose were typically discarded as insignificant gave the Garbage Project an opportunity to expand their study beyond

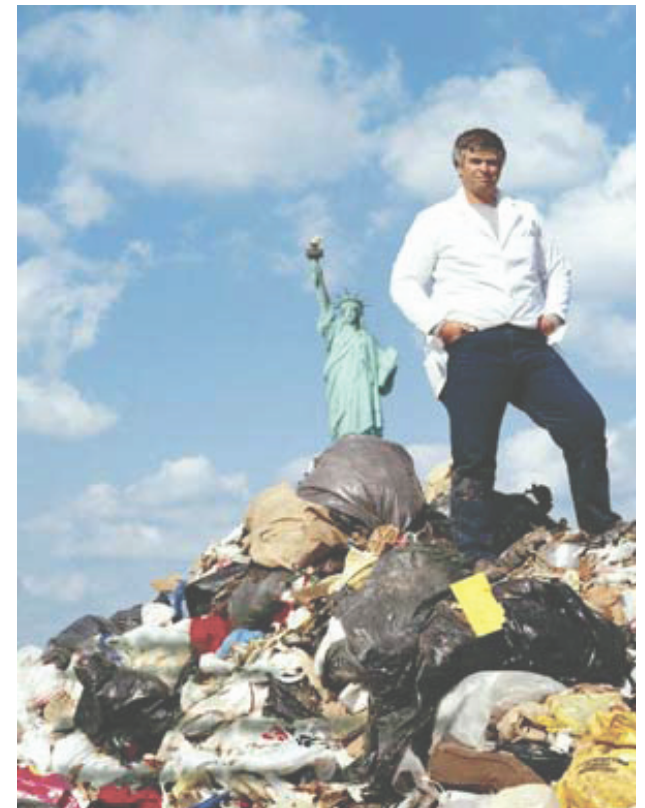


Figure 2.1 Dr. William Rathje standing on a garbage barge in New York City.

fresh refuse into the depths of our landfills. From 1987 to 1995, archaeologists excavated, sorted and documented thirty tons of waste from fifteen landfills across the continent (fig. 2.2), representing various climatic regions and topographical, geological and hydrological situations.⁴ The unexpected findings of these archeological digs provided irrefutable evidence that has served to educate scientists and policy makers about truths in our trash. The work of the Garbage Project has influenced municipal solid waste management and policy, providing support for the effectiveness of curb-side recycling programs and educating people on other waste reduction strategies.⁵ Not only was the garbage in the landfills not decomposing in the ways and at the rates previously thought, the proportions of specific types of waste were not consistent with previous assumptions being made at the time.

The Garbage Project has proved to be an invaluable source of knowledge about our contemporary society, in terms of our consumption and waste habits, providing hard data that has changed the way we think about and dispose of our trash. As Dr. Rathje has said, “what people have owned -- and thrown away -- can speak more eloquently, informatively, and truthfully about the lives they lead than they themselves ever may.”⁶ The social science of Garbage Archaeology has enabled society to understand consumer waste stream patterns and affect change. This practice requires methodical documentation of our refuse and its reconstruction as a form of living history. This process of mining the midden or contemporary sanitary landfills is capable of revealing truths about our culture and impacting societal norms and policy.

Most sanitary landfills in the U.S. keep time logs and detailed records of the layout of their sites, that show areas filled with a specific classification of waste, such as household, construction demolition and appliances, and at what general elevation. The topography of landfills is very dynamic: filling, compacting, sinking, and repeating. These logs are essential to the selection of an appropriate site for excavation, making possible parallel studies of differing waste streams. Starting in the 1960’s waste characterization studies focusing on basic identification have become a common practice for municipal governments to study types and quantities of waste over periods of time, often with the intent to educate and inform



Figure 2.2 *The Garbage Project were the first to mine contemporary landfills, from 1987 until 1995.*

the public (fig. 2.3).⁷ The work of the Garbage Project is distinct from these more standardized studies because of its focus on culture, linking the intricacies of brand names with quantities of consumer waste. The original impetus for these archaeologists was to determine if differences existed when comparing what people admitted to consuming in surveys and what they actually had consumed given the evidence of their packaging.⁸

The work of the Garbage Project, and the science of Garbage Archaeology in general has helped to not only provide factual statistics but to reconstruct the stories of this society of mass-consumption. Performed with relatively few people and minimal resources, the work of these scientists is as unending as trash creation, and as societal patterns shift and evolve evidence of these changes will continue to appear in our trash. Until the consumption of packaged goods is minimized, Garbage Archaeology can continue to provide valuable insights into society's collective behavior and promote policy to reduce our waste volumes. The future of this profession relies partly on continued funding and support through higher education and government aid but also on public awareness and appreciation. The latter can be stimulated by creating an environment that allows the public to observe the process of garbology and the archaeologists involved in this work. A physical facility would allow both groups to better comprehend society's garbage as a collection of cultural signifiers, and appreciate the complexity of our sanitary landfills as a type of shared public space.

LANDFILL AS SOCIO-ECONOMIC RESOURCE

If the science landfill archaeology reveals the value of our modern midden as a cultural resource, then Waste-to-Energy (WtE) and Waste-to-Material (WtM) operations see landfill waste as an economic resource, a raw material that can be converted to new forms of energy and materials. Landfill Mining has been practiced primarily as the extraction of landfill gas, which is then either burned for heat energy or

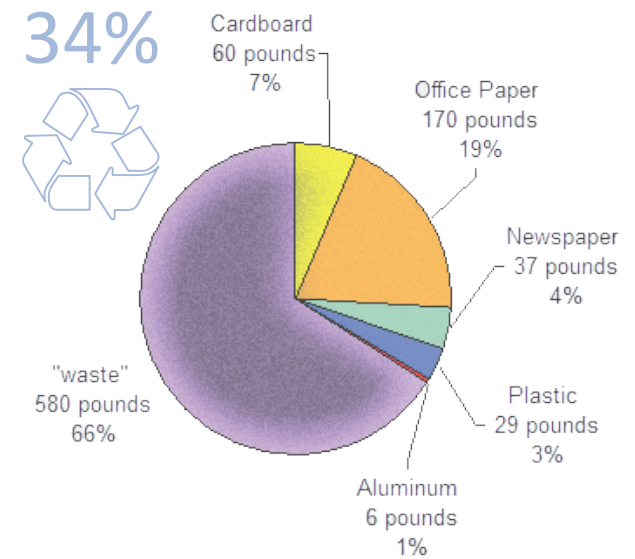


Fig. 2.3 EPA findings showing that 34% of total weight of American domestic solid waste can be recovered for recycling.

steam production, or refined into methane quality pipeline gas. A limited quantity of expensive metals have also been excavated from landfills, and there is evidence to show that mining older sections of landfills can produce more aluminum than bauxite mines. The fairly recent activity of Enhanced Landfill Mining (ELFM) is part of a comprehensive and holistic approach to waste reduction and improved recycling rates of materials slated for landfills or incinerators.

This approach regards landfills as “temporary storage” facilities, rather than permanent sites so mining both operational and closed landfills is seen as “essential to deal with the (waste) legacy of the past.”⁹ In this way, waste-to-energy and waste-to-material facilities are regarded as the primary means of exploiting landfills as mines. This would involve intensive and costly sorting and shredding in order to maximize materials recovery, but converting waste to energy through plasma gasification has been proposed for energy production (recovery). Environmental models have shown that up to 15% reductions in greenhouse gas emissions are possible over the life-cycle of a landfill, creating a strong argument against a “do nothing” approach.¹⁰ Factoring in the socio-economic benefits of industry, jobs, locally produced energy and material stock, and potential land reclamation, mining our landfills becomes an obvious next move.

Recyclable waste is currently processed within a network of materials recovery facilities, or MRF’s, but municipal solid waste goes directly to landfills and incinerators. While recycling programs have significantly reduced waste, valuable materials can still be recovered from municipal solid waste. Excavation moves back in time, with the increase in mining of landfills, many recoverable materials will surface from the decades before recycling became as common and prevalent. Material recovery facilities only began to emerge in the United States during the 1970s¹¹. Clean versions accept only commingled recyclable materials while dirty MRFs accept municipal solid waste, separating out recyclables before sending the remaining waste to a disposal facility like a landfill or incinerator. The material recovery rates of a dirty facility can be high, however, the process of sorting 100% of the waste stream is inherently

more labor-intensive and more spatially complex. The introduction of water to a facility that processes solid waste transforms organic matter into a liquid solution appropriate for anaerobic digestion, another waste-to-energy technology¹². Combining 'wet' and dirty processing of solid waste could provide optimal recovery of material and cultural artifacts.

The bringing together of these two in one facility constitutes a continuously dynamic process that exposes the patterns of our collective cultural consumption as in garbage archaeology, only now alongside the process of recovering usable materials. The sharing of space and tasks between sorters as scientists and sorters for material recovery can promote cross-pollination of knowledge and a more holistic approach to the evolution of waste management practices. By allowing public observation of these processes, a more comprehensive understanding of our waste stream can be compiled, exposing not only waste as cultural artifacts, but also raw material for reuse. This combined experiential opportunity would advance the conscious connection between citizens and their garbage production by literally letting them see it get picked apart.

Waste that is unable to be recovered for material reuse within a material recovery facility has the potential into a usable energy source. Waste-to-energy Incineration plants have been around for over a century, much less time than the idea of burning garbage for heat and/or steam energy.¹³ Most of the currently operational facilities of this type in the US are incinerators that burn trash to create heat energy which is most often turned into electrical energy. While reducing landfill waste this practice has significant design challenges and negative ecological impacts including the creation of toxic ash, the consumption of fossil fuel to sustain the process and the emission of greenhouse gasses and other toxins.¹⁴ In sharp contrast, the proven yet still emerging technology of Plasma Gasification waste-to-energy seems almost too good to be true. This process does not burn but heats the waste feedstock up to temperatures ranging from 4000-10,000 F°, until it gasifies into a viable and fairly clean fuel source called SynGas, which can then be refined or converted into heat and electrical energy. Plasma Gasification provides a safe

option for destruction of hazardous waste and creates no harmful emissions or toxic waste, only its slag byproduct that can be used as an aggregate in the construction industry. Plasma gasification systems produce all overhead energy required for the energy generation process, with various surplus, while reducing the volume of garbage 150:1, with no requirement for a smokestack, only steam towers.¹⁵

These Plasma Gasification plants are currently very expensive, which is likely the major deterrent keeping them from becoming more widespread. However, this technology is becoming increasingly more viable with the rising costs of designing and constructing new landfills and maintaining existing landfills to increase capacity, coupled with the energy and revenue production. In St. Lucie, FL, the largest planned waste-to-energy facility in the world in 2006 has since succumbed to economic stresses caused by the recession, with the project terminated after being value engineered down to one-sixth of its originally planned capacity and energy production before construction ever began.¹⁶ The forward looking approach of the local city government in conjunction with GeoPlasma, Inc. provides a valid precedent for the waste-to-energy facility and landfill mining proposed by this thesis. The St. Lucie Proposal, also included “mining and gasifying the existing landfill waste [and]... [projecting that] it will take approximately eighteen years to reclaim the landfill site, or empty the landfill.”¹⁷ This emerging technology makes possible the processing of landscapes of waste as resources to reclaim space and remediate the contamination of these sites.

Energy production can be seen as cyclical by merging a waste-to-energy process based on plasma gasification technology with land fill archeology research and materials recovery. The mining of the landfill garbage by scientists provides pre-sorted waste for material recovery, after which the remaining garbage is used as feedstock for making energy, which in turn provides the power for the operation of the facility. Generating sufficient surplus to send power back into the grid, this process could not only offset of fossil-fuel generated power but also eliminate the need for additional future non-renewable power plants. The environmental and social benefits also include the reduction of the volume of sanitary

landfill, as well as the reclamation of land and the creation of jobs in the construction and operation of the facility. The ability to handle both existing and future garbage on-site reduces public concern, eliminates outsourcing of waste, and its associated financial burdens, creating a sense of ownership as the landfill is seen as a collectively created democratic space for the public to experience. In its physical form and the processes it houses, the facility for landfill mining can serve as a public landmark of waste—in its various forms, from visible artifact to invisible energy, from artistic installation to the networks of power. Garbage thus becomes an anthropogenically created rapidly “renewable” resource for energy production. In the present moment of insecure energy resources, the local production of clean energy from waste can instill pride in the local community and further reinforces the notion of landfill as a unique typology of public land, shared by scientists, workers, and visitors; all consumers and spectators on some level.



Fig. 3.1 Chris Jordan - *Packing Peanuts* (2009),
Depicts 166,000 packing peanuts, equal to the
number of overnight packages shipped by air in the
U.S. every hour.

CHAPTER 3: PRECEDENT ANALYSIS

GARBAGE AS MANUFACTURED ART

While garbage archaeologists have helped to create an understanding of the composition of trash as and qualitative artifact and quantitative resource, artists have sought to capture the expressive qualities of waste for its aesthetic value. These artistic representations can be further explored as expressions of the mining process as both cultural signifier and as a socio-economic opportunity.

Seattle-based artist Chris Jordan works through the medium of abstract photo-collages which are influenced by pointillism and Chuck Close's later work of colorful gridded portraits. In his series *Running the Numbers: An American Self Portrait*, Jordan creates images from arrangements of thousands of small items that are the waste of societal mass consumption.²² The exact number of a specific group of artifacts relates directly to a mathematical statistic about resource or product use or disposal. Jordan's work is visually compelling while quietly providing a stronger, more pointed message by representing the statistical impact of consumption. Jordan's website states that, "edge-walking the lines between art and activism, beauty and horror, abstraction and representation, the near and the far, the visible and the invisible, his work asks us to consider our own multi-layered roles in becoming more conscious stewards of our complex and embattled world."²³ These visually captivating fields of waste create micro-episodes of abstract landscapes, as in *Packing Peanuts* of 2009 (fig. 3.1). In the abstracted abysses presented by Jordan, the viewer is more intimately connected with the actual impact of societal patterns and an endless field rather than a figurative image crop. The represented statistic seems to extend beyond the borders

of the frame, a mere snapshot of the continual cycle of consumerism which Jordan has chosen to expose aesthetically. Chris Jordan's images of the abstract landscapes of waste provide the inspiration for this thesis in its examination of the landfill image, site, and mining operation/installation.



Fig. 3.2 Alan Sonfist - *Pool of Earth* (1975, 50 ft. dia. x 1m high).

Forming their own unique category of *public* earthworks, landfills reveal things about our society's relation to our garbage, despite incessant grassy coverings and remote locations. The work of land artists in the 1960's and early 1970's provides a model for intervening on landscapes of waste. Michael Auping notes the first generation earth artists like Michael Heizer, Robert Smithson and Christo, were more focused on aesthetic intentions rather than exposing the environmental impact of the exploitation of natural resources. The so-called second generation responded to this minimalist approach with attempts to remediate or restore some environmental situation. For example, Alan Sonfist, in his *Pool of Earth*, 1975, (fig. 3.2) created a simple circular berm of stone, filled with soil, set within the environmental catastrophe of a chemical waste dump, to collect windblown seeds and encourage new life on the desolate waste landscape.²⁴

In the summer of 1979, a project entitled *Earthworks: Land Reclamation as Sculpture* was organized by the King County Arts Commission in metropolitan Seattle, Washington. Herbert Bayer's *Mill Creek Canyon Earthworks*, 1979-82, in Kent, WA, (fig. 3.3) transformed a badly eroded canyon into a park which also functions as a floodplain and storm water retention for the stream flowing through the site.²⁵ While acknowledging the importance of these works as art, Morris "warned of the moral dilemmas that artists would face in undertaking these projects: that their work might be used to aid or disguise questionable resource development policies".²⁶ This conscious reading of potentially negative impact of "beautifying" our waste landscapes highlights the social responsibility to educate by revealing the destructive past of these sites, through transparency, remediation and re-appropriation. The collective benefit of these types of reappropriated projects can be lost if people are not made aware why reclamation was necessary in the first place. The loss of connection between society and its waste landscapes simply perpetuates the

collective “anesthesia” that Chris Jordan speaks of. Architecture provides the potential to help the public confront the physical truths of collective creation of our landfills, where the residue of our lifestyles goes not to die, but to wait and perpetuate.



Fig. 3.3 Herbert Bayer - Mill Creek Canyon Earthworks (1979-1982).

RECLAIMED WASTE LANDSCAPES: Fresh Kills & Hiriya

The most common strategy for reappropriating modern sanitary landfills has been to cap them and reclaim as parks, resulting in the loss of their connection to their previous lives. In their competition-winning design proposal for Fresh Kills Park in Staten Island, James Corner's Field Operations has switched the paradigm of approaching the design of a park in a landfill. Instead of covering up an existing landfill with a new park, the proposal seeks to incorporate the old dump into new fabric by acknowledging its past history and utilizing its embodied resources.²⁷ Acknowledging the reality of the complex processes at play in Staten Island's giant landfill, Corner honestly admits that the NYC Sanitation Department, which deals with a complex array landfill infrastructural issues, will maintain a presence on the site for decades to come. He makes an economic reading of this phenomena, "Thus, Fresh Kills is no-man's-land, or no-corporate-man's-land anyway, and the way we design a park there says a lot about how we confront land we have screwed up and how cities might be designed in the future."²⁸ Despite its status as a "no-man's-land", he argues the future of Fresh Kills Park can not only attract people from the dense urban context for recreational uses but also educational ones. Creating a dialogue between the history of the site as a landfill and its new use (fig. 3.4), people can find meaning through this experience that will elevate their sense of personal responsibility in the creation of these democratic spaces of waste.



Fig. 3.4 James Corner Field Operations - *Fresh Kills Landfill* (2008-), Phasing of design implementations creates dialogue between existing and future uses and users.

Another recent design competition for reclaiming a large landfill as a public park is the Hiriya Landfill in Israel, exhibited in the Tel Aviv Museum in 1999. The entry designed by Mira Engler, author of *Designing America's Waste Landscapes*, displayed an approach that pre-dates Corner's scheme for Fresh Kills that highlights the processes of cleansing and healing in the landfill-scape. While her entry was not selected for an award or construction, Engler presents a compelling argument for the effect of the experiential qualities proposed by this thesis. "The first gesture [of uncovering the waste] releases the captivated processes of decomposition from inside the entombed mausoleum of dead commodities. It channels out the dying matter, or its excretions (i.e. methane gas and garbage juice), and re-unites it

conspicuously with natural systems of air and waterways” (fig. 3.5).²⁹ This reuniting can be exploited as a strong artistic statement but also for cultural, material, and energy resources. Also arguing for the role of public art in revealing waste landscapes is Mierle Laderman Ukeles, who has been working with the NYC Department of Sanitation and has been involved in both Hirona and Fresh Kills Landfill. Ukeles asks in her work: “can a public art process be engendered in these sites of degradation so that the public can participate in redeeming them? Can the art set out a path so that the public can re-connect with these public landscapes and belong to them in a powerful and positive way?”³⁰ Mining a landfill as a sculptural intervention, but also interpretive landscape will expose truths of our culture, which will be documented by archaeologists and used by artists, giving the public multiple readings and ways of connecting to the site. Only through excavations of artists, archeologists, and engineers can the landfill be fully mapped as a dynamic public land.

ARCHITECTURAL PRECEDENT ANALYSIS:

VALDEMINGOMEZ CITY-DUMP/RECYCLING PLANT FOR URBAN WASTE, Madrid, Spain, 1999.

As shown by Spanish architects Abalos and Herreros, architects can also play a major role in activating the landscapes of waste. Their masterplan proposal for the municipal landfill proposed a theory of “areas of impunity” for the design of the park that allows it to be understood as a place “for those unusual, extravagant and even disturbing areas that, like rubbish, are expelled from those consolidated parts of the city but which, without doubt, still form part of the urban character of the land.”³¹ While this landfill is situated on the outskirts of true urban density, the architects thus acknowledge the direct relation between the urban consumption and the resulting scale of this required infrastructure.

The Recycling Plant for Urban Waste is a major component of the masterplan, comprised of several buildings for the processing of municipal solid waste. As a materials recovery facility, the plant processes a waste stream composed of up to ninety percent recyclables. The remaining solid waste goes to the

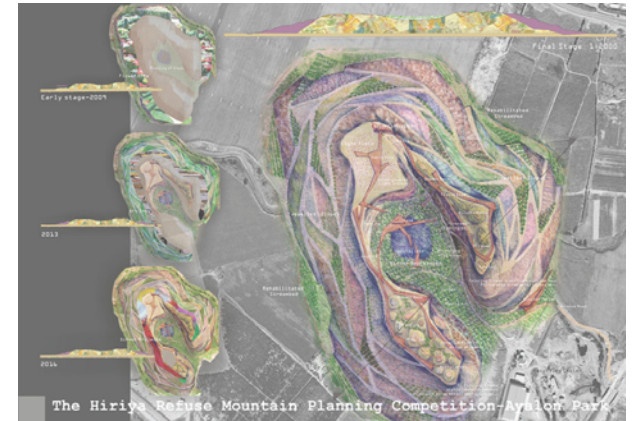


Fig. 3.5 Mira Engler - Design competition entry for the Hirona Landfill (2006).



Fig. 3.6 Abalos & Herreros Architects - Valdemingomez City- Dump/Recycling Plant for Urban Waste, Madrid, Spain (1999). Exterior view.

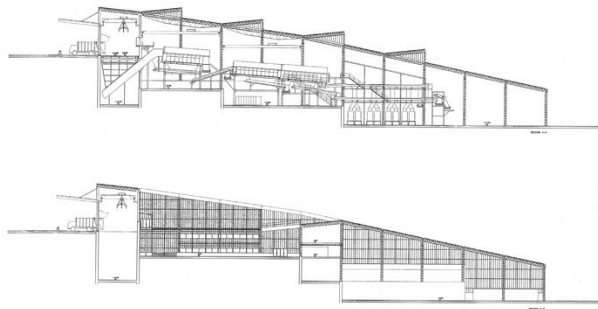


Fig. 3.7 Abalos & Herreros Architects - Valdemingomez City- Dump/Recycling Plant for Urban Waste, Madrid, Spain (1999). Sections.

adjacent landfill, and compostable organics have been used to restore parts of the site transitioning into park use. The primary structure rests as a group of terraces on the hillside, covered by a single shed roof that follows the slope of the terrain and encapsulates all the functions held within (fig. 3.6). The building section mediates technical demands of the processes and allow gravity to play a part in the organizational scheme (fig. 3.7). When the landfill reaches capacity, the building will no longer be needed. Designed with this lifespan in mind, the lightweight steel structure can be easily deconstructed for reuse and reassembly; polycarbonate panels can be unfastened and disassembled for reuse or recycled. Abalos and Herreros' environmentally and economically conscious responded to site and program, designing a building that embodies the recovery processes which it houses .

The primary goal of the recycling plant is to give transparency to the processes of waste disposal and in doing so engage its producers, the citizens of Madrid. In the project, the architects reveal what they call architecture's "ability to transform the hidden into the visible and the industrial into the public,"³² taking aspects of reality which are disregarded or avoided, and framing them in such a way that invites engagement.³³ This attitude suggests that rather than seeing waste as a necessary evil, the processes of disposal can be experienced in a way that offers enrichment, personal reflection, and interpretation of their connection to the waste stream for the public who are willing to engage with it.

CHAPTER 4: METHODS

SITE ANALYSIS AND SELECTION

The Cedar Hills Regional Landfill is located approximately 25 minutes from downtown Seattle, due south of Interstate 90 and Issaquah and due east of Sea-Tac airport and Renton in the Maple Valley area. Totalling 920 acres, the scale of this space is hard to comprehend, but easily stands out amongst adjacent forested areas in satellite images encompassing the entire Pacific Northwest (fig. 4.1). Given the scale of the site, the type and size of an appropriate intervention must be something that moves beyond the notions of a single static building to one that incorporates incremental time-based responses to the dynamically shifting and settling land of the midden. Mining the site will uncover artifacts, reveal cultural patterns and recoverable materials, but also help mediate between the scales of the site, the proposed intervention and the public visitor.

The landfill has accepted municipal solid waste from King County since 1965, and continues into this day. Following estimates in the Final 2001 Plan, this landfill was thought to potentially reach capacity and have to close in 2012, this year. Given a revised draft in 2009, the projected closure date was extended to 2018, due in large part to the “best management practices in daily landfill operations”, and the natural settling of the site through decomposition and compaction and waste reduction strategies including recycling programs.³⁴ In an attempting to extend the useful life of this landfill, a development plan with five action alternatives was produced in 2010 noting one option as the preferred alternative (fig. 4.2). All of the alternatives are primarily incremental in nature, with the preferred “Alternative 2” developing 56.5 acres,



Fig. 4.1 Cedar Hills Regional Landfill as seen from satellite view at the Metro-Area scale.

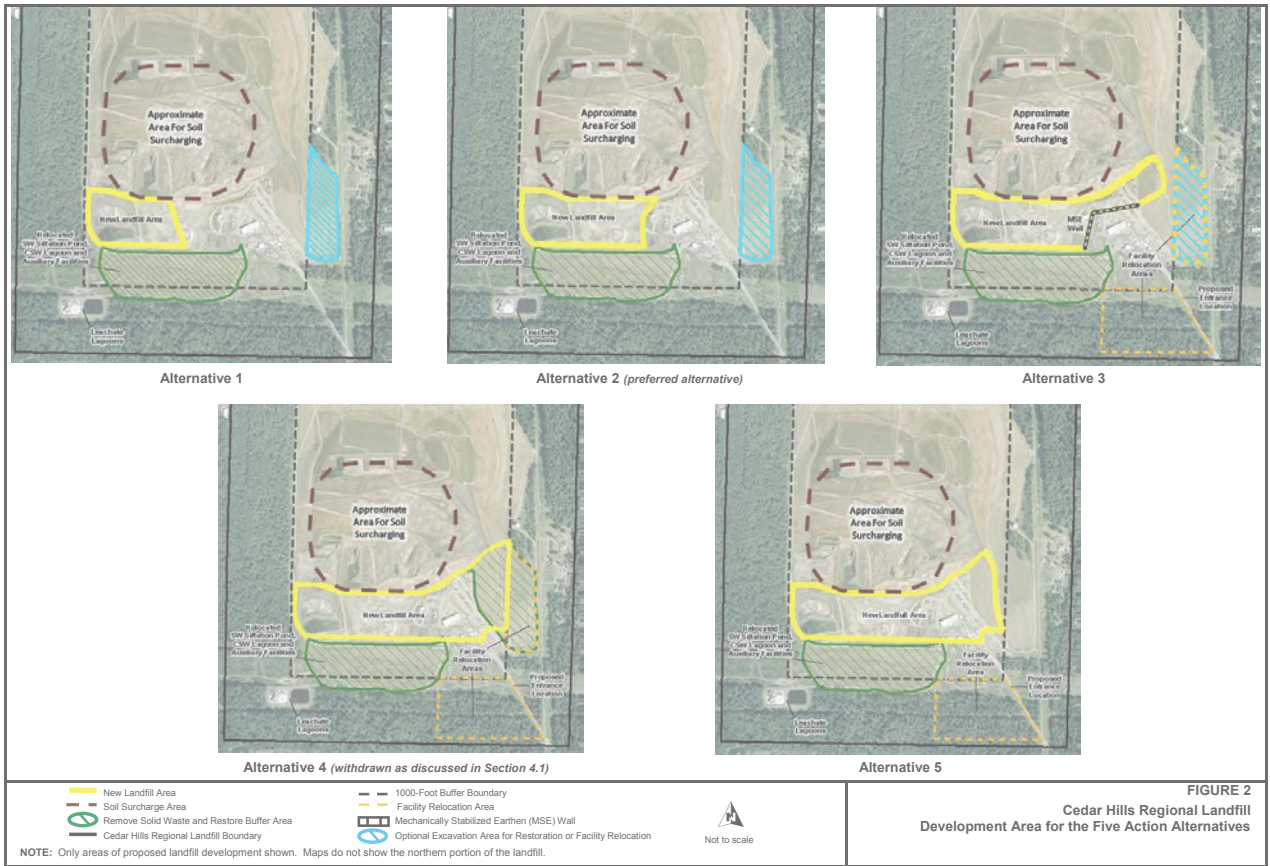


FIGURE 2
Cedar Hills Regional Landfill
Development Area for the Five Action Alternatives

Fig. 4.2 Five action alternatives proposed by King County Solid Waste Department for the life extension of the CHRL from the KCSWD's 2010 development plan.

including two new refuse areas that would extend landfill life for a mere five to six years. None of these options extend the life of the landfill for any longer than a decade, where at that time other arrangements would be necessary, such as King County beginning to export their trash in the way of Seattle.

The city of Seattle opened two modern sanitary landfills fourteen miles south of the city in the 1960s directly adjacent to Interstate 5, establishing trucking as the primary mode of garbage transportation. The Midway site opened in 1966 and Kent Highlands in 1968 but both were shut down in the early 1980s due to environmental concerns, reflecting a larger national trend. When these closures occurred, Seattle began transporting its garbage to the Cedar Hills Regional Landfill, which at that time was not designed for the increase in volume, and so requiring substantial modifications and upgrades. Costs for the work

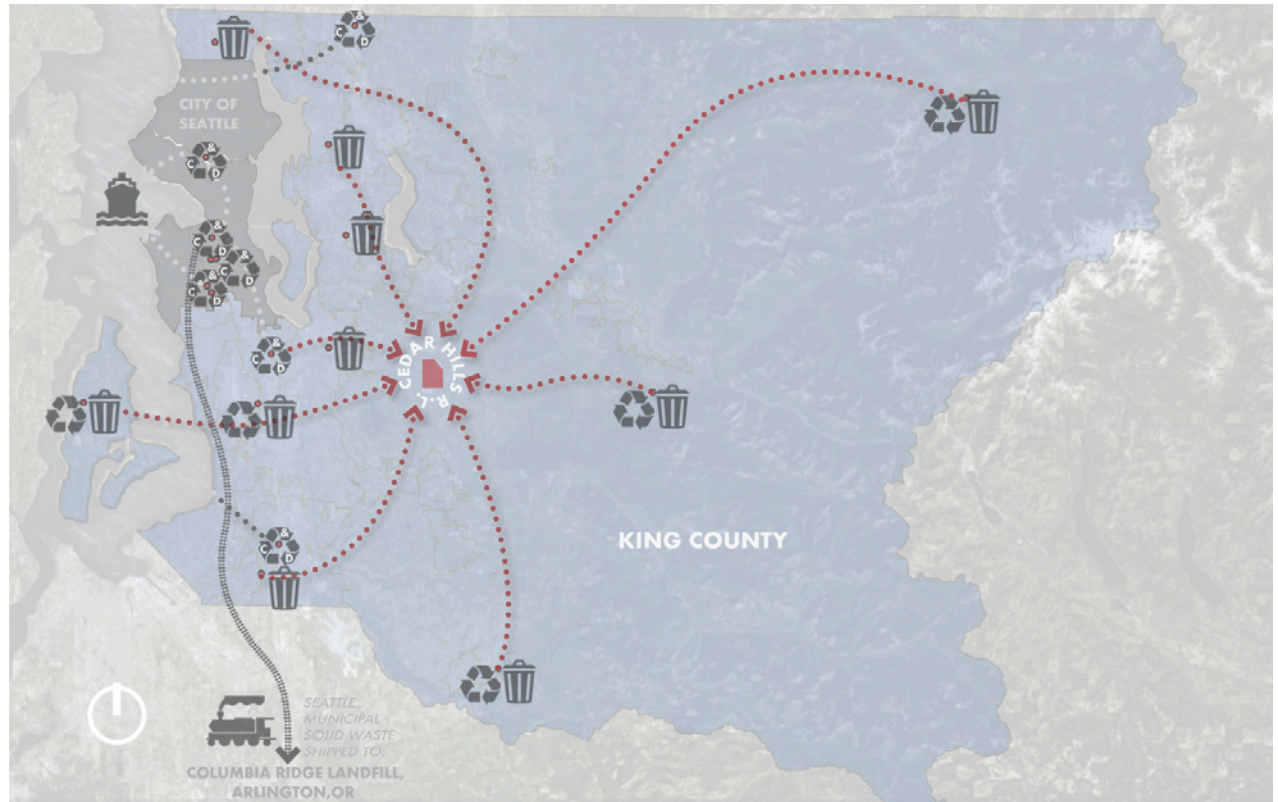


Fig. 4.3 King County and City of Seattle Solid Waste Infrastructure locations, and transportation routes and shipment methods.

were passed down to City of Seattle customers, resulting in a controversy that eventually would result in the creation of a new solid waste plan for Seattle, *On the Road to Recovery*, in 1989. In 1990, based on the findings in that plan, Seattle began shipping its solid waste to the Columbia Ridge Landfill in Arlington, Oregon, where it is still transported today.³⁵ The rest of King County outside of the City of Seattle continues to transport their waste via container trucks to the CHRL from a network of transfer stations throughout the county (fig. 4.3). As shown, many of these facilities also function as recycling centers and construction and demolition drop-off centers. These amenities increase the likelihood for recoverable materials not to be sent to the landfill, but they do not eliminate the huge opportunity to recover materials and cultural artifacts from our waste stream.

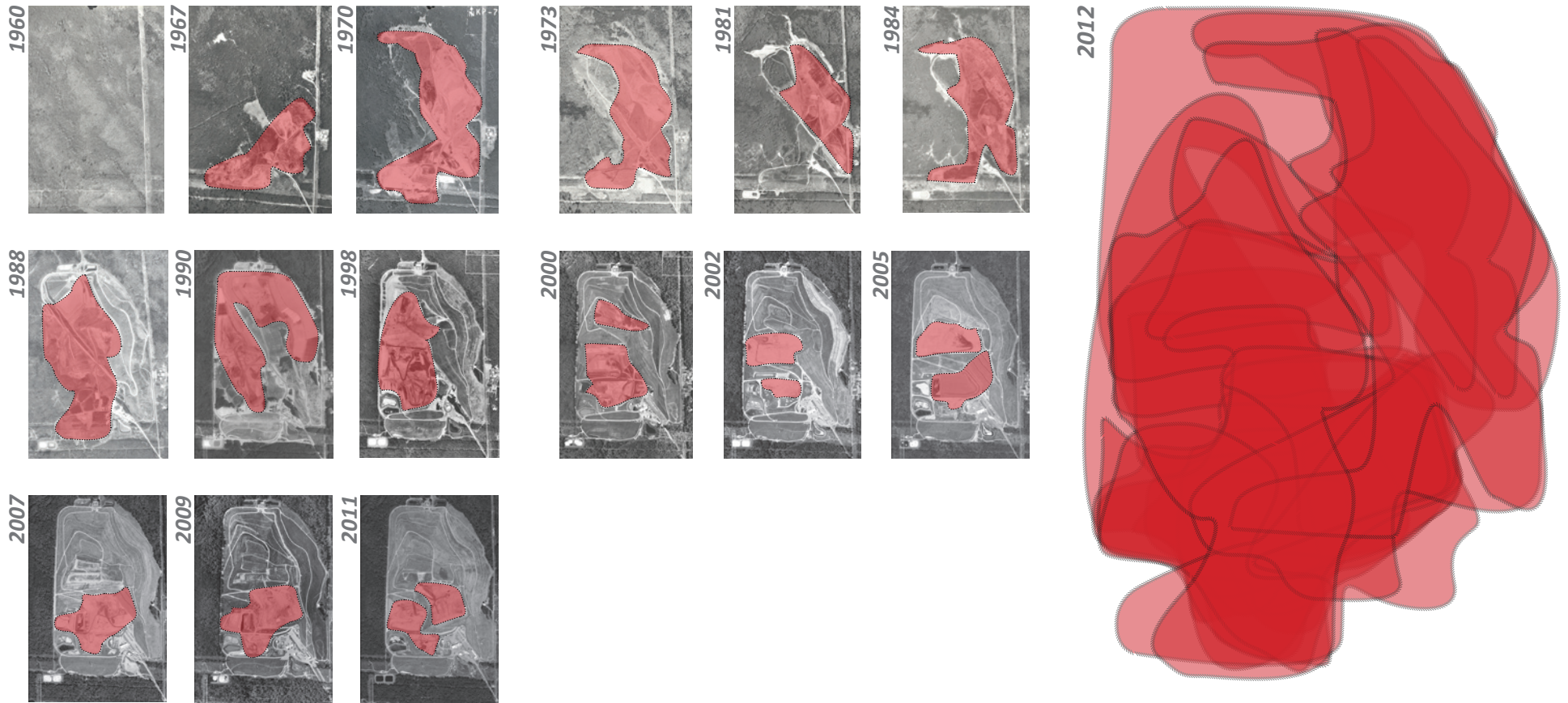
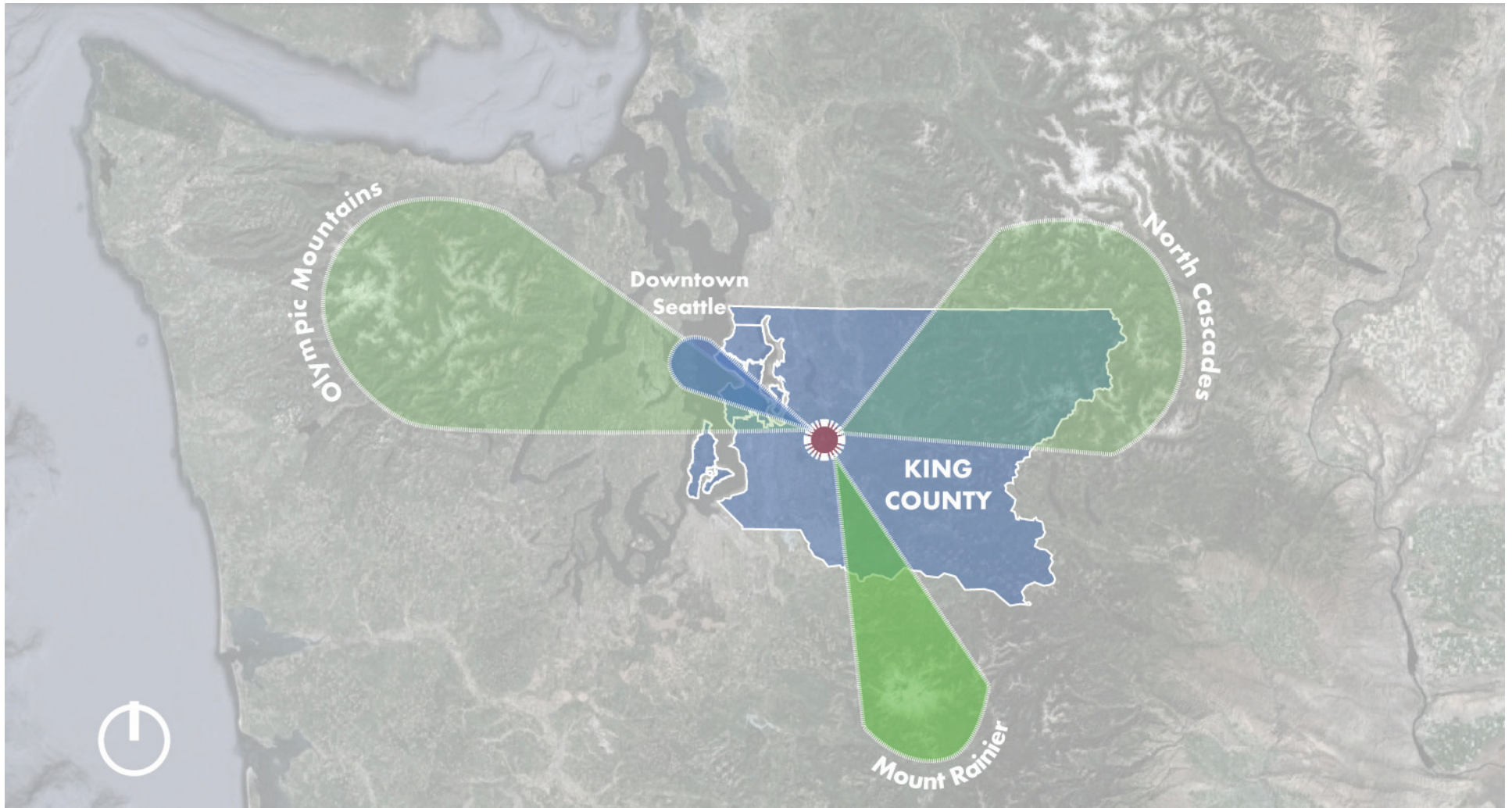


Fig. 4.4 Evolution of the CHRL as described by the layering of Active Zones from historical aerial photographs.

Currently, the highest elevation at the Cedar Hills regional landfill is somewhere around 750 feet above sea level, with a maximum allowable height of between 780-800 feet.³⁶ Approximately 200 feet of contemporary midden are waiting to be mined underneath the surface formed by the cosmetic veil of stabilization grasses planted in three to five feet of soil over a foot or two of gravel, rubber membrane and geo-textile fabric. The deep invisible section presents the opportunity for a phased design approach to mining the site. Understanding the evolution of the landfill over time informs an approach to mining it (fig. 4.4). The densities revealed in the overlaying the outlines of past active zones show where the opportunities for the richest depth of history and therefor cultural understanding.



Cradled on the north by mountains and hills to the east and west, the natural setting of the landfill provides a stunning view of Mt. Rainier to the south, and downtown Seattle and the Olympics to the west, providing a compelling juxtaposition to the mound of garbage that dominates the site (fig. 4.5). The site's relative proximity to the cultural and institutional hub of Seattle provides compelling reasons for researchers in the still-emerging field of landfill archeology as well as artists to come participate in the experience of excavating culture from the fifty-year-old landfill. Additionally, the adjacency to regional and international transportation infrastructure and local population centers argues the potential influential

Fig. 4.5 *Regional Situation and Viewsheds*



Fig. 4.6 Proximity of the Cedar Hills Regional Landfill to population centers and primary transportation infrastructure.

conscious impact an interpretive, dynamic landfill mining operation open to the public could have at a community and cultural level (fig. 4.6).

The rural setting in the Issaquah foothills amongst a collection of protected parks and other public lands, the Cedar Hills Regional Landfill is situated to act as a vital connection and corridor between areas to the north and east, and those to the southwest along the Cedar River (fig.4.7). The site already serves as a

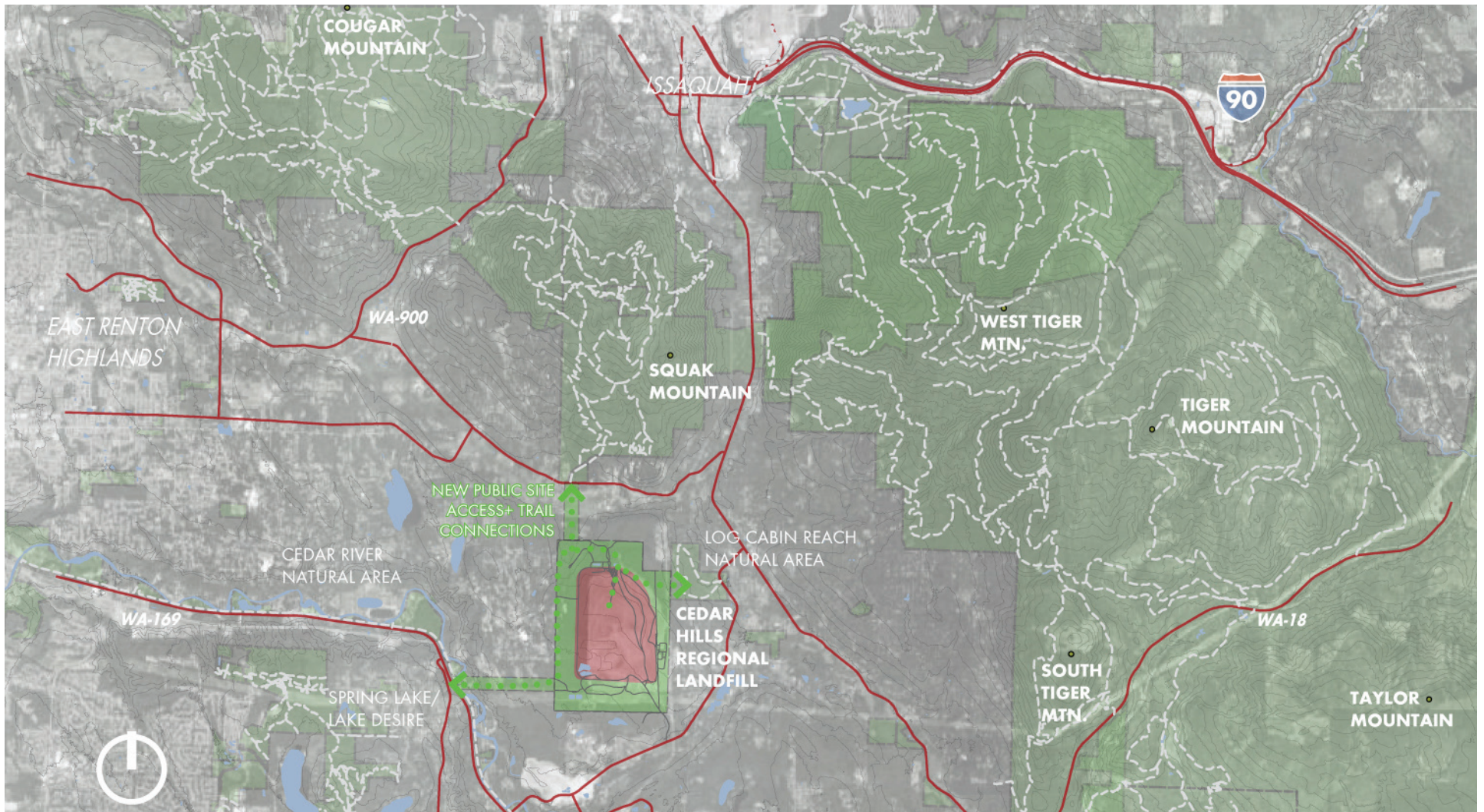
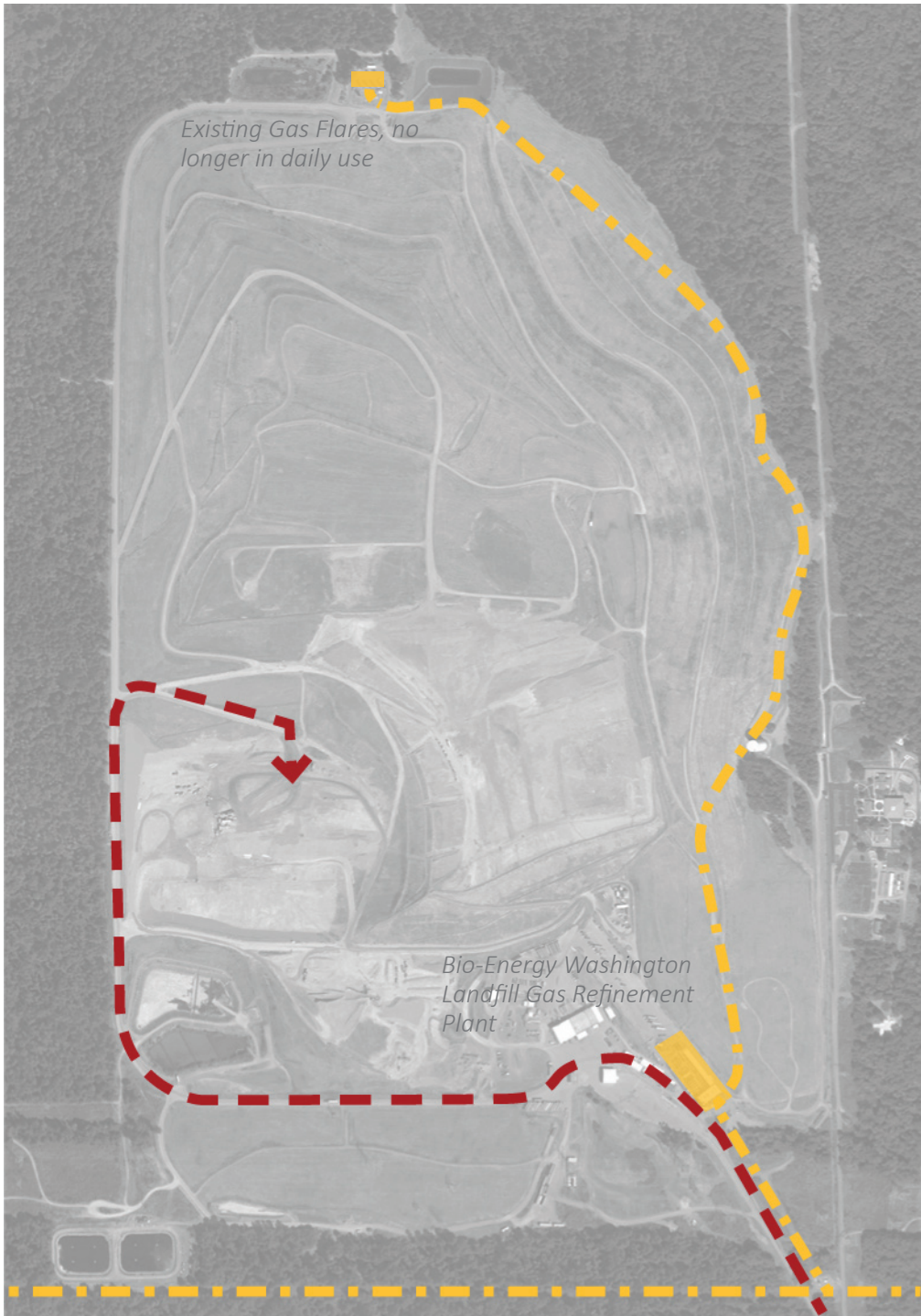


Fig. 4.7 Cedar Hills Regional Landfill as a vital connector between Public Lands Connections

wildlife corridor and sanctuary, with species including bald eagles, deer, field mice, and rabbits along with other mammals and birds occupying the site. This can be contributed to the ecotone, or transitional edge between dense forested buffer zone surrounding and the monotonous prairie-like grassland disguising the landfill proper. These many reasons provide strength to the argument of re-framing the landfill as a unique typology of public land which should be experienced by the public that helped to co-create it.



new waste delivery

waste-to-energy plants & flares

gas pipeline

Fig. 4.8 Existing Site Flows: Materials + Energy

An Existing waste-to-energy facility run by Bio Energy Washington (BEW), a subsidiary of the Mid-Atlantic-based parent company, INGENCO, processes and refines the landfill gas evacuated from the midden of the Cedar Hills landfill. Currently, all of the landfill gas is extracted via an intricate network of pipes and associated engineering, where nearly all of the landfill gas is converted to useful fuel operating on a year-round basis. A majority will be refined to pipeline gas standards and delivered to a major natural gas pipeline just barely outside the south property boundaries of the landfill (fig. 4.8). The opportunity to be able to tap into some of this existing energy producing infrastructure is a strong argument for expanded production implementing other waste-to-energy technologies such as plasma gasification, where the SynGas produced from this process requires similar refinement processes. The addition of an industrial waste process producing local energy would add jobs helping to create a sense of community pride and appreciation for the landfill as a socio-economic resource.

The existing BEW plant is just east of the Cedar Hill Regional Landfill's scalehouse and office, which together form the extent of potential current public interaction, although a guided tour will be provided upon request. Beyond this relatively non-existent publically accessible area are the operations and maintenance facilities, which are comprised of several pre-engineered metal buildings and other modular office structures. Large portions of well graded paved areas exist between the main entry and these facility buildings. This thesis incorporates this currently active area on the site to display the cultural actions of that time. The proposed intervention will drastically modify the existing site flows and therefore disengages with all of the existing built infrastructure at the south of the site, deciding to instead engage with the abstract cylindrical volumes of the existing landfill gas flares at the north (fig. 4.9). These artifacts of the history of human manipulation of the site speak of the evolution of the site through their varied paint schemes and levels of rust. Their simple, but repeated forms provide a precedent for creating a vertical rhythm through elements of energy generation and more generally, any new built intervention on site.



Fig. 4.9 Existing Gas Flares at North end of site.

PROGRAM

Inspired by the notion that architectural design and sequence can foster experiential relationships between landfill and the public visitor, this thesis proposes a dynamic landfill mining operation which is programmatically inter-related and physically connected to a facility housing materials recovery operations and a plasma gasification technology waste-to-energy plant. Exposing the public to the various methods of sorting and analyzing of our garbage, and subsequent resource extraction, people can begin to have a different understanding of their waste. Landfill mining produces excavated waste that is documented by landfill archaeologists. These scientists and their associated territory become the mediators between the raw, open mining and the utilitarian architectural intervention. New waste will no longer be landfilled, but instead dumped and sorted in the facility alongside the mined waste not recuperated as cultural artifacts. What is non-recoverable from this combined waste stream will be transformed into clean energy that will power the facility and produce varying quantities of excess energy that can be refined into pipeline quality methane or turned into electricity and absorbed into the grid (fig. 4.10). The vitreous slag by-product of the plasma gasification system is utilized as aggregate in gabion cages, which will be used as a rainscreen cladding for the building and also as movable dynamic retainment structures within the landfill mining operation. This provides an additional layer of on-site resource use or re-use, expressing the dynamic processes occurring within the site as a tangible, understandable material language. This thesis proposes a transparent public structure that promotes the visual and physical interaction between the community, their waste stream, and the sciences and conservation practices bringing them closer to that waste. While expressing the inviting public engagement of the building, the transparency of the structure also echoes the newfound visibility of the landfill due to the excavation efforts.

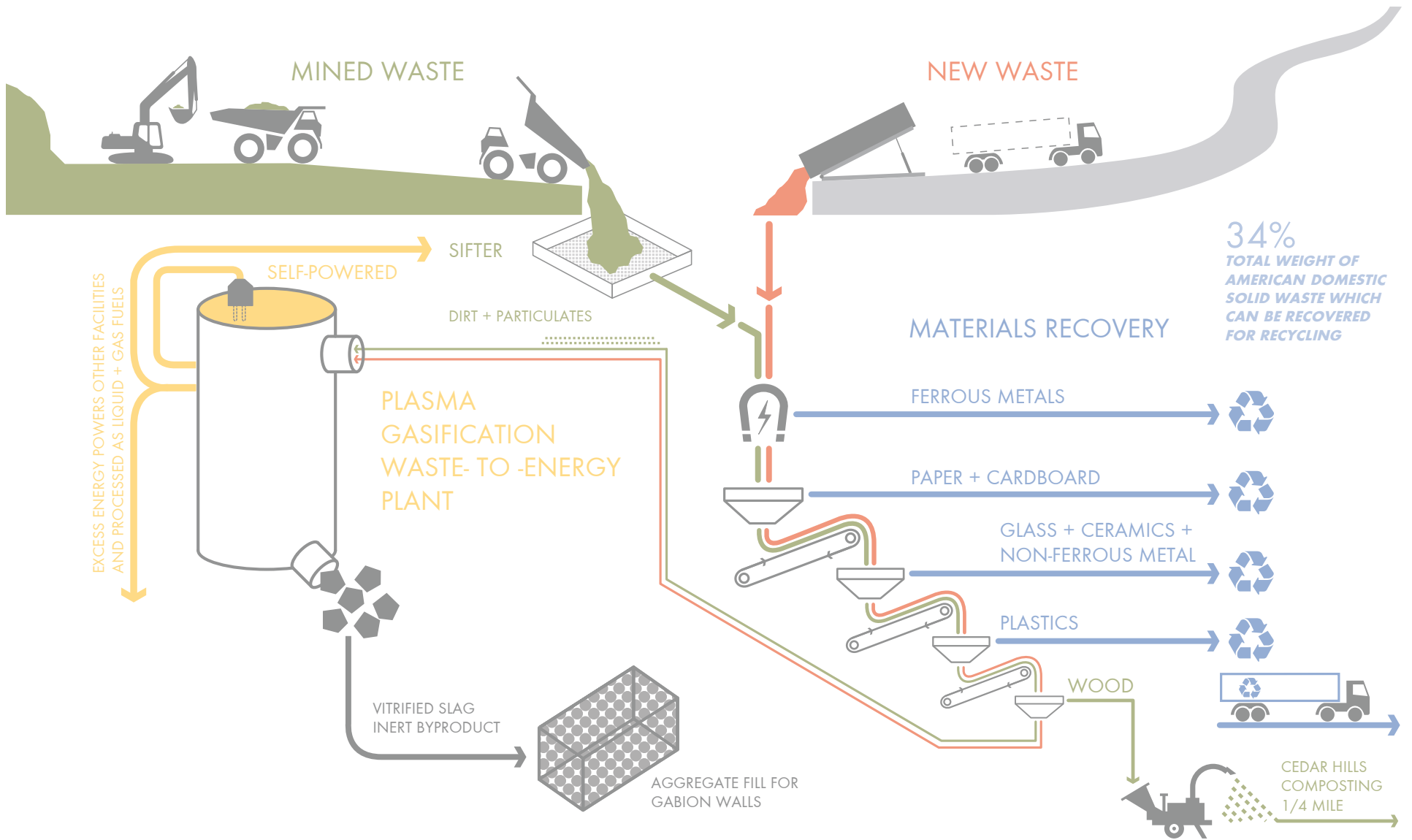


Fig. 4.10 Program Diagram describing Mined + New waste interaction, sorting for recoverable materials and transformation into energy and inert byproducts.

CHAPTER 5: FINDINGS

Beginning with the new site flows proposed by this thesis (fig. 5.1), there will, at the least, be more action and excitement on site, and hopefully at best, the interaction of public visitors with this waste landscape enticing personal interpretations of their connection to and contribution to the creation of that unique public land that is the landfill.

The public visitor will approach the new site and architectural intervention via the forested buffer zone. As one crosses the threshold of the ecotone between forest and prairie-like landfill zone, the new facility for dynamic landfill mining will come into view beyond the existing gas flare towers as a crisp, translucent volume rooted to the site in with its relatively dark and dense, yet porous base of gabion walls. The volume of the building is long and slender, reflecting how the processes informing the major components of the program, and therefore the building design, are generally complex in description but fairly linear in their execution. Where the mining operation engages with the structure, the primary volume opens to receive the mine, allowing this void to be read from a distance.

The mining process evolves simultaneously as the building is erected, the two blending together at times to blur the boundaries between the act of excavation and that of construction. The tectonic expression of the building is inseparable from the soldier pile and lagging excavation technique employed to “embed” the building into the hill of midden and create the spine, or consistent datum, of the mine. The rhythm established by the piles begins to set up a structural grid, and the fairly straightforward shed roof structures of the facility begin to take shape (fig. 5.5 - 5.11).



- new waste delivery
- waste-to-energy plants & flares
- gas pipeline
- dynamic landfill mining facility
- active strip mine
- mined waste influx
- Recyclables export
- public visitor paths

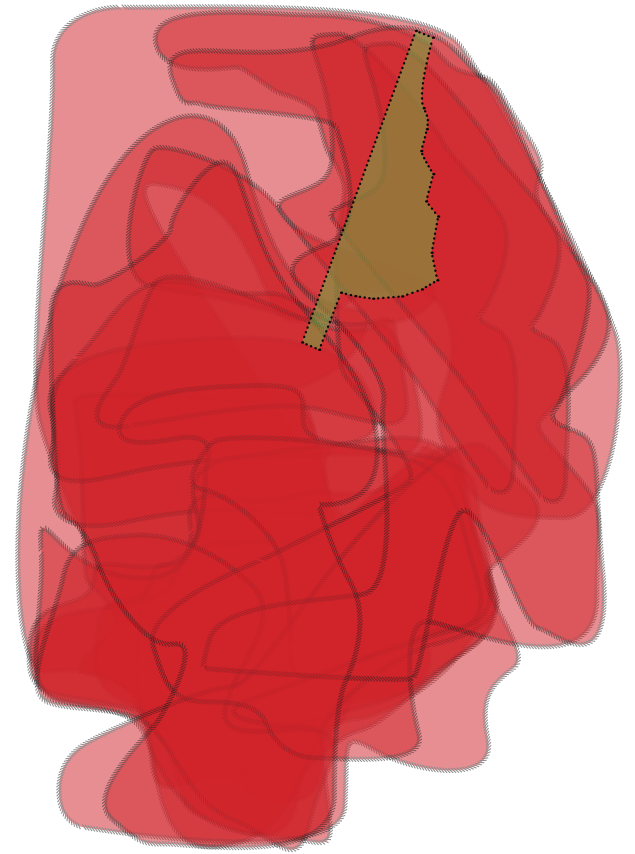


Fig. 5.1 (Left) New Site Flows: Materials in/out, Energy, Landfill Mining and the Public Visitor

Fig. 5.2 (Above) Historical Density overlays of active zones showing mining intervention



Fig. 5.3 (Above) Site Plan: trail approach, car/bus parking, waste delivery & recycling export trucks.



Fig. 5.4 (Right) Site Plan showing public vehicle and trail approaching site through forested buffer.

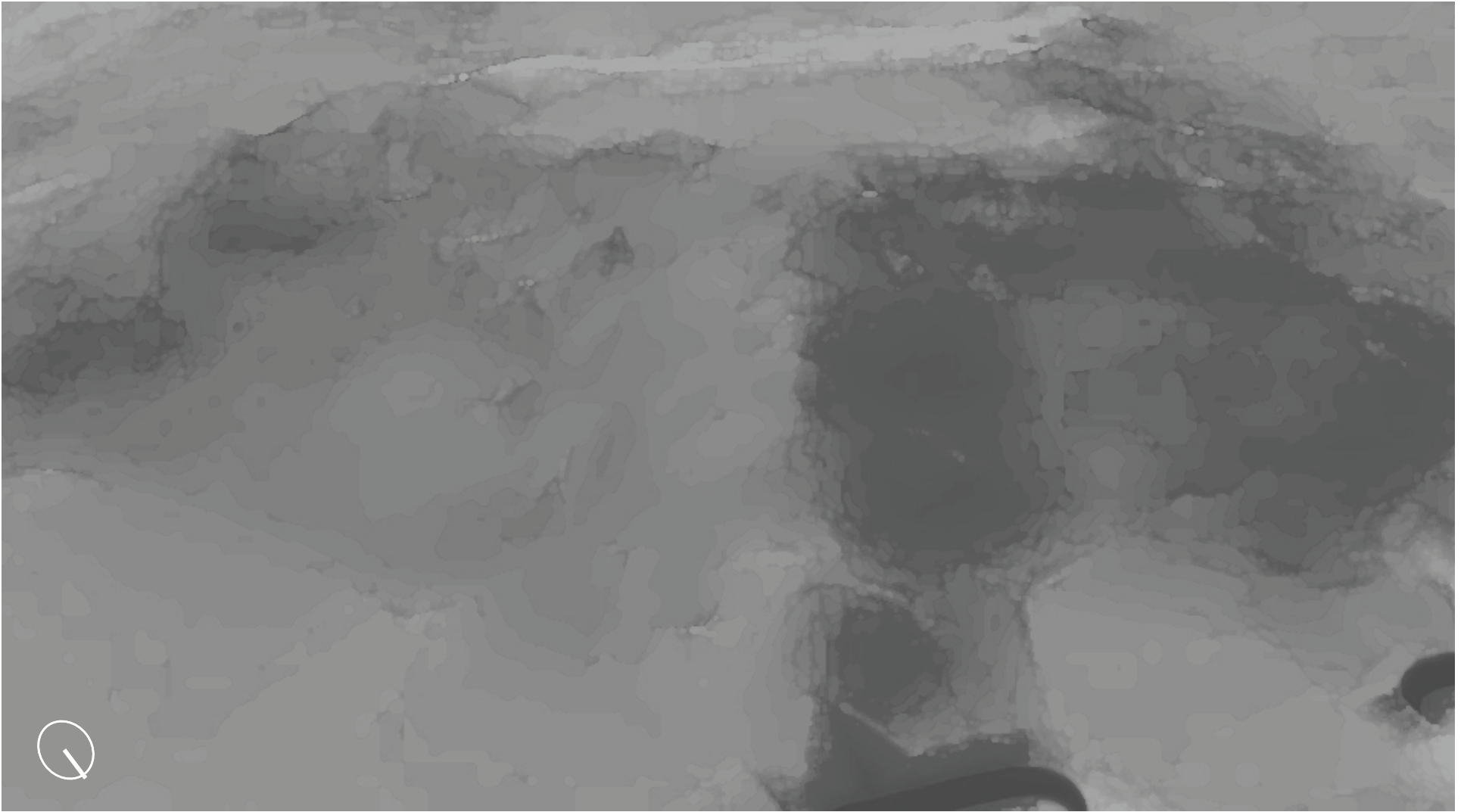


Fig. 5.5 *EXISTING: Aerial axonometric view*

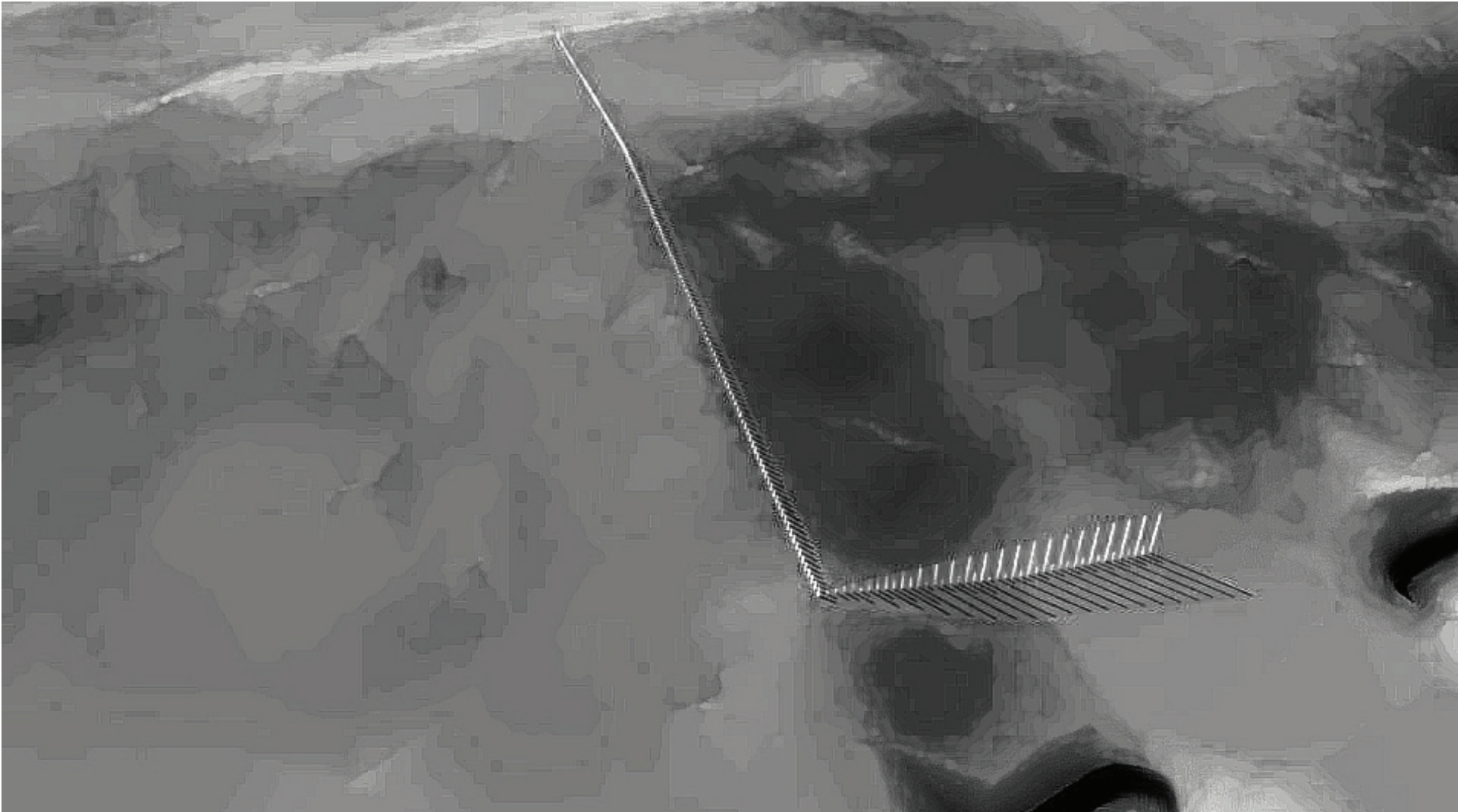


Figure 5.6 PHASE 1:

- *Soldier piles define extent of mine*
- *building spine + ridgeline to peak*
- *public experience + watershed*

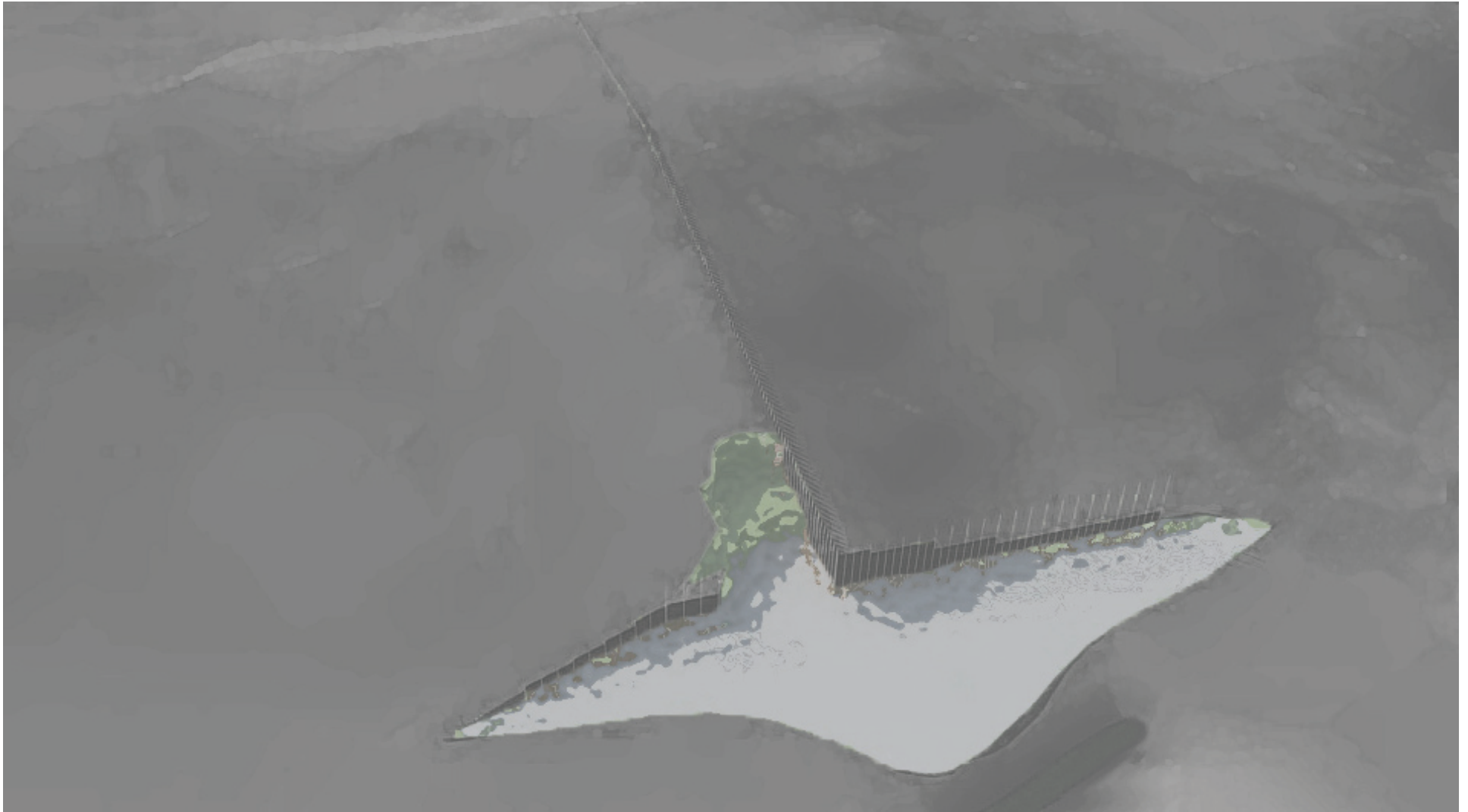


Fig. 5.7 phase 2:

- *dynamic landfill mining begins*
- *building pad graded + gravel base*
- *lagging installed for retention*

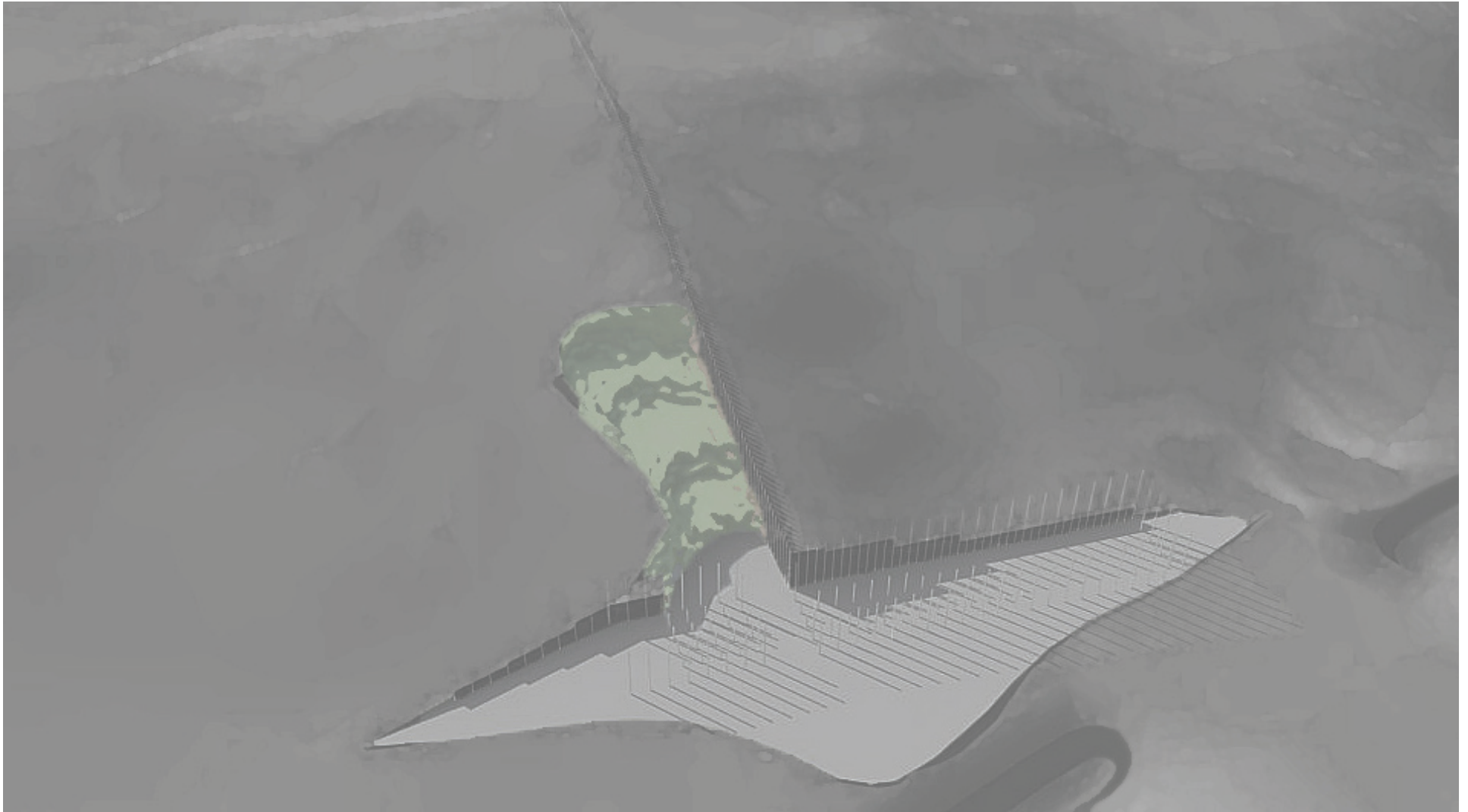


Fig. 5.8 PHASE 3:

- landfill mining reaches 3 strata
- remaining structural piles installed
- lagging continues into shore mining operations

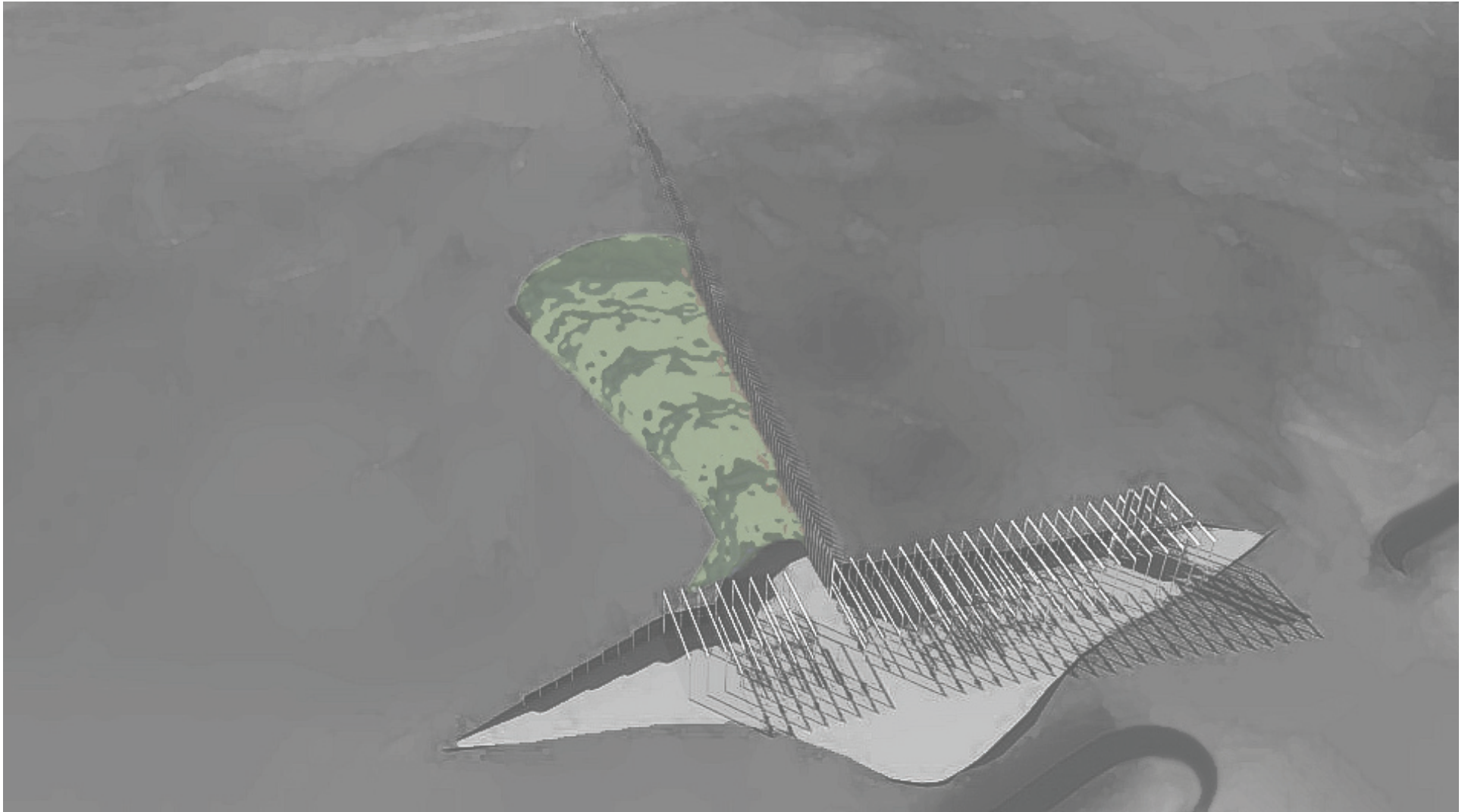


Fig. 5.9 PHASE 4:

- *landfill mining reaches 5 strata*
- *remaining vertical structure*
- *plasma gasification units*
- *queen post roof structure*
- *seismic + lateral bracing*



Fig. 5.10 PHASE 5:

- landfill mining reaches 9 strata
- plasma gasification technology
- waste-to-energy process begins
- Floor slabs- on grade + pre-cast
- standing seam galvalume roof

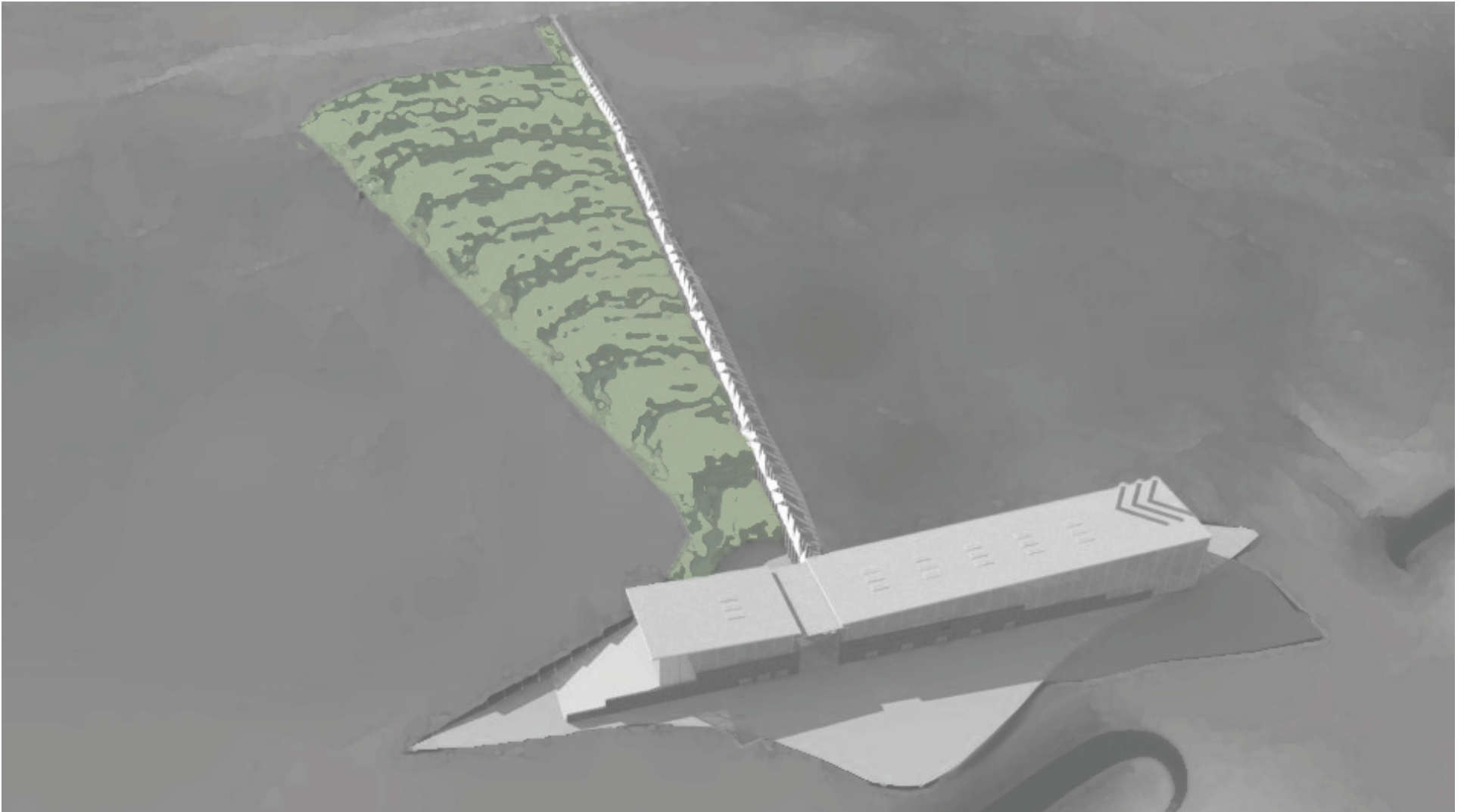


Fig. 5.11 PHASE 6:

- landfill mining reaches peak | 11 strata
- public path steel trusses + fabric sails
- gabion walls grow as slag produced
- polycarbonate glazed exterior +
- central skylights | daylighting
- materials recovery facility (MRF) operational
- new waste transitions+ landfill-ing officially ends

Fig. 5.12 (Opp.) Site Section with Diagrammatic Site plan showing scale of mining and building interventions relative to entire site scale.



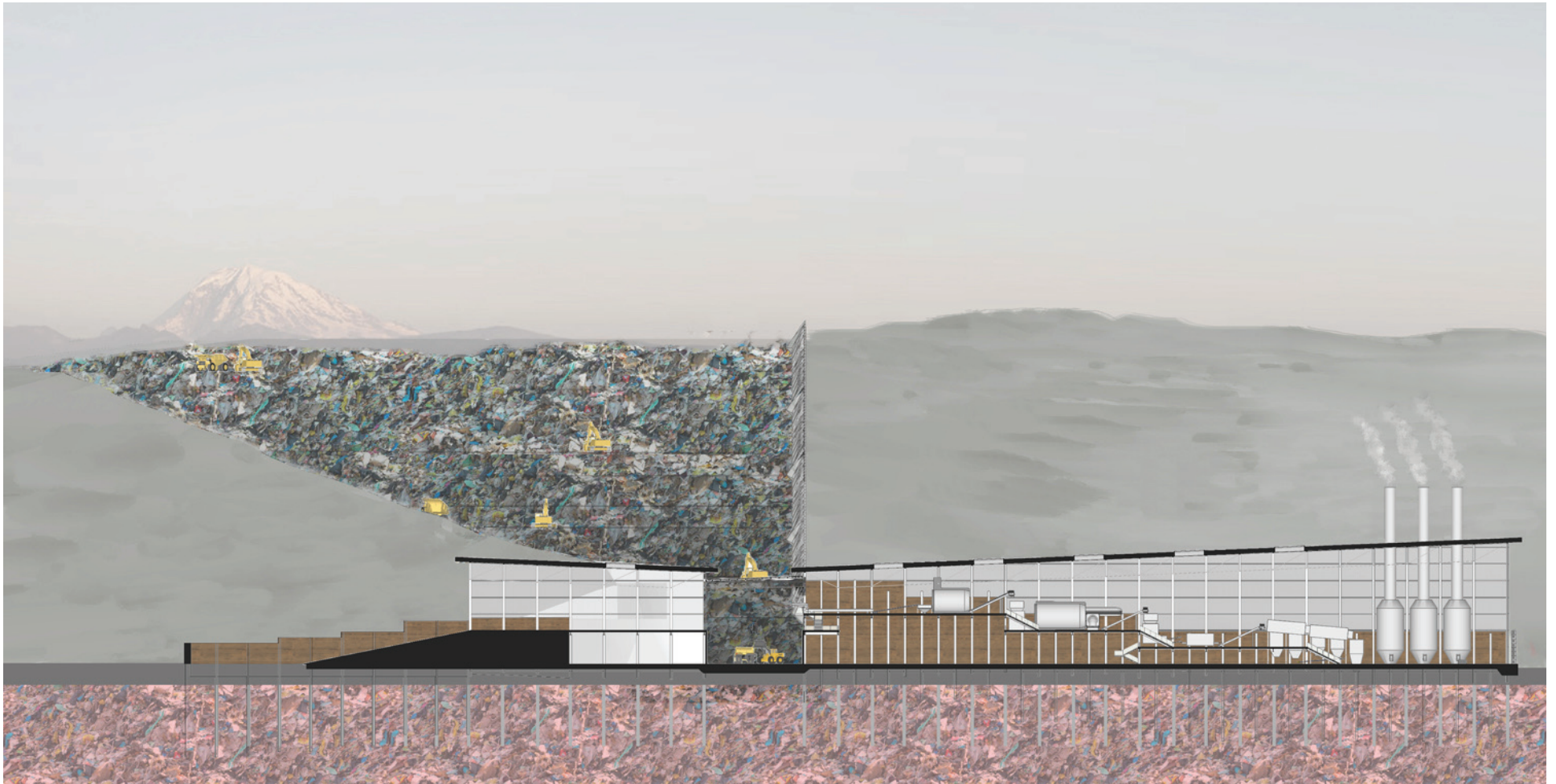


Fig. 5.13 Building Section highlighting opening in massing with landfill mining operation beyond.

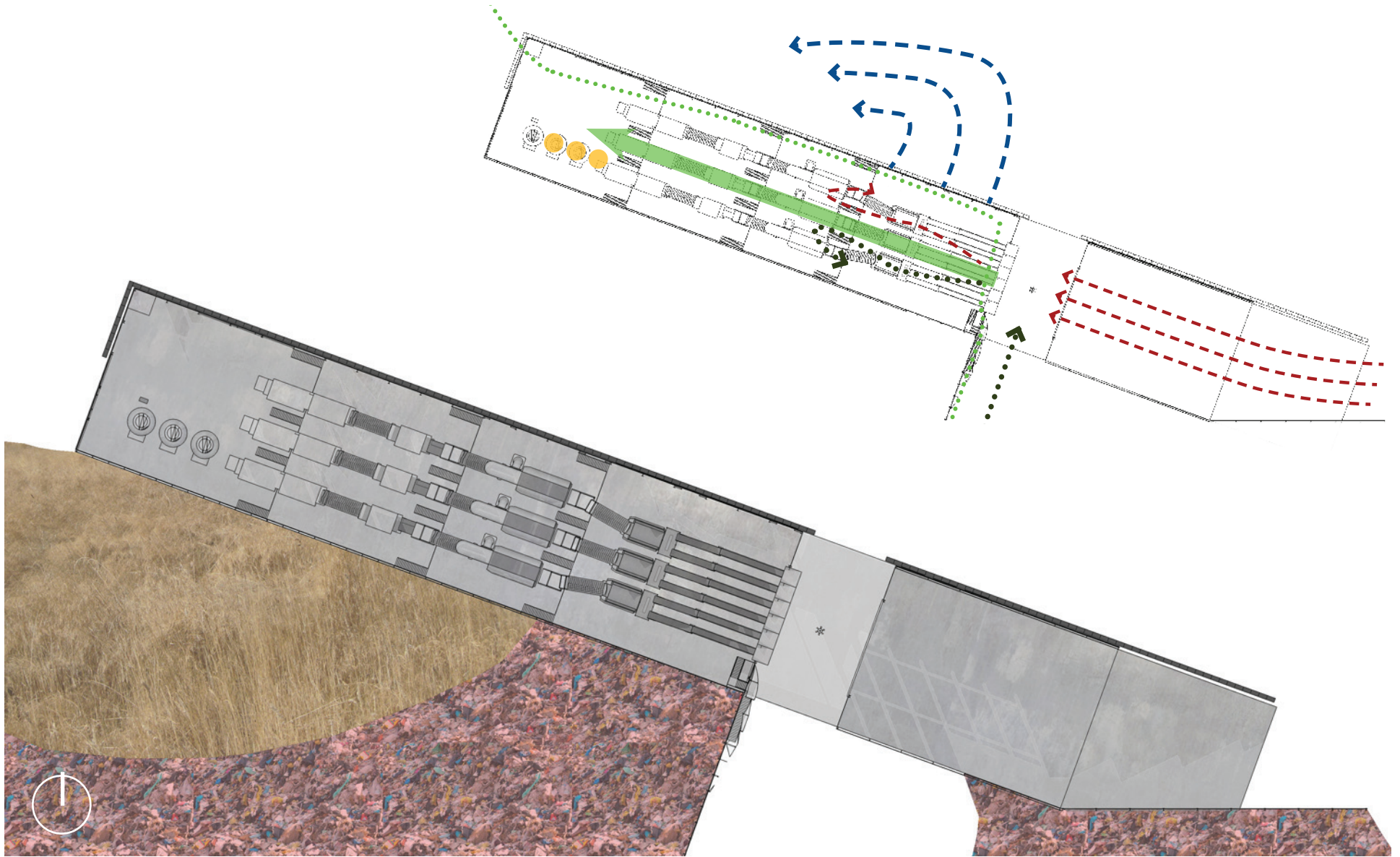


Fig. 5.14 (Above) Floor Plan showing internal sorting equipment and building/retainment structures holding back landfill mass.

Fig. 5.15 (Top) Building Plan Diagram showing public visitor and material flows

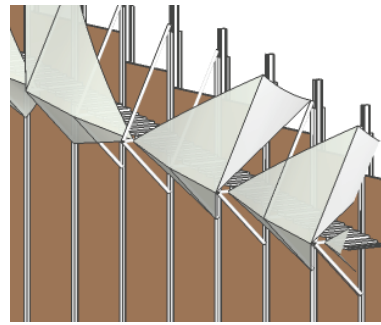
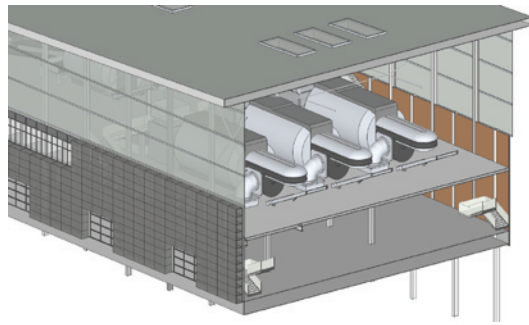
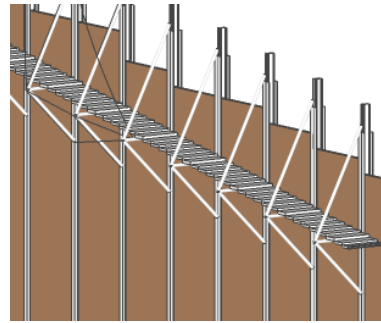
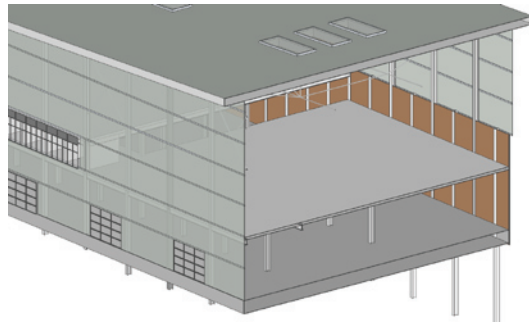
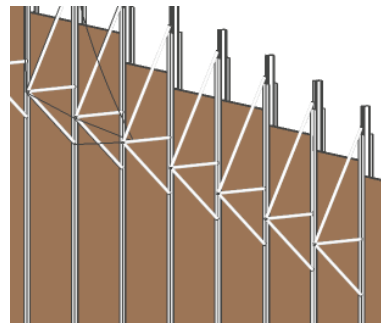
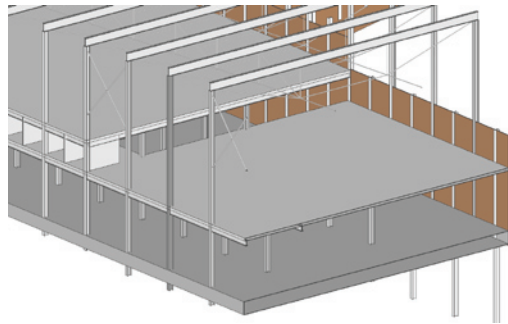
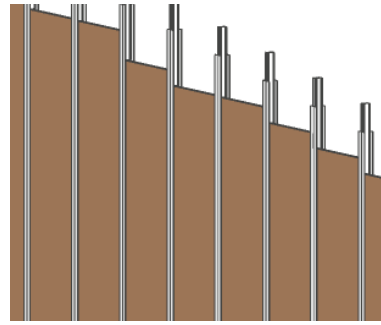
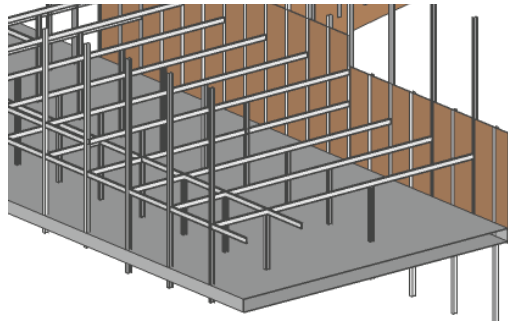


Fig. 5.16 Tectonic section axons of both the building and path through the mine. Evolution and relationship between structures for retainment (excavation related) and construction of the facility.

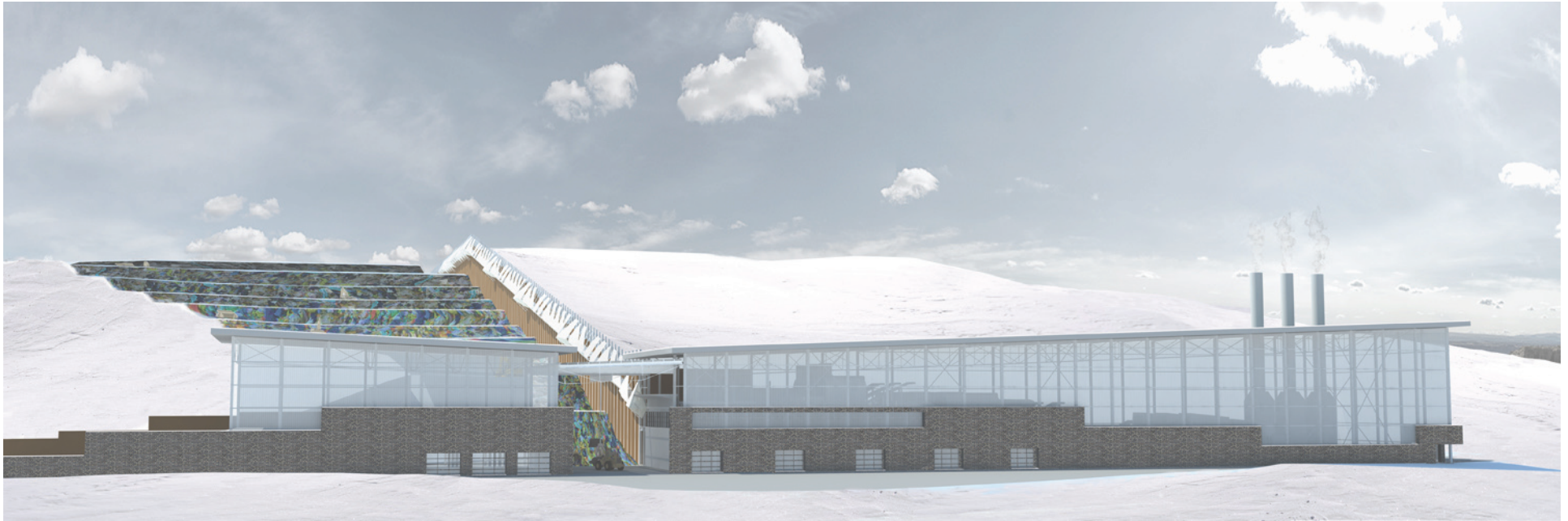


Fig. 5.17 North Elevation of Dynamic Waste Harvesting facility after a snow, showing landfill mining operation in full effect beyond. Note the dynamic rhythm of sails wrapping the public path as it climbs up the wall of the mine.

This series shows the tectonic progression of both the building and the suspended path. Both start out as the simple yet rhythmic excavation system of soldier piles and lagging.

The building grows by installing the remaining pile columns on a structural grid based on a unit set by the standard lengths of wood lagging. Beams are installed to brace and align the columns. Precast hollow-core plank slabs are installed for the upper floors, roof queen-post trusses are installed, as is lateral bracing to the steel frame. Purlins are installed over the columns and sheathed with polycarbonate glazing panels; storefront glazing, exterior soffits, standing seam metal roofing and skylights installed. Finally, waste sorting equipment is installed along with interior vertical circulation and guardrails; gabions begin to populate the facade after plasma gasifiers have created ample aggregate slag.

The path happens in a similar evolution, but with a simpler palette, and more delicate forms. The first act of construction following the excavation system is to install vertical plate extensions which bolt to the web of the soldier pile. Next simple steel tube truss members are suspended from these uprights and the bottom brace struts are welded to the wide flanges exposed on the surface of the retaining wall. Precast concrete stair elements are installed to connect and span between the flat post of the steel trusses and provide lateral bracing for the system. To provide directed and changing views, as well as shade and accentuate rhythm, translucent fabric is stretched over these triangular forms and creates a dynamic experience for visitors walking up and through the path as well as registering the ridge line from afar.

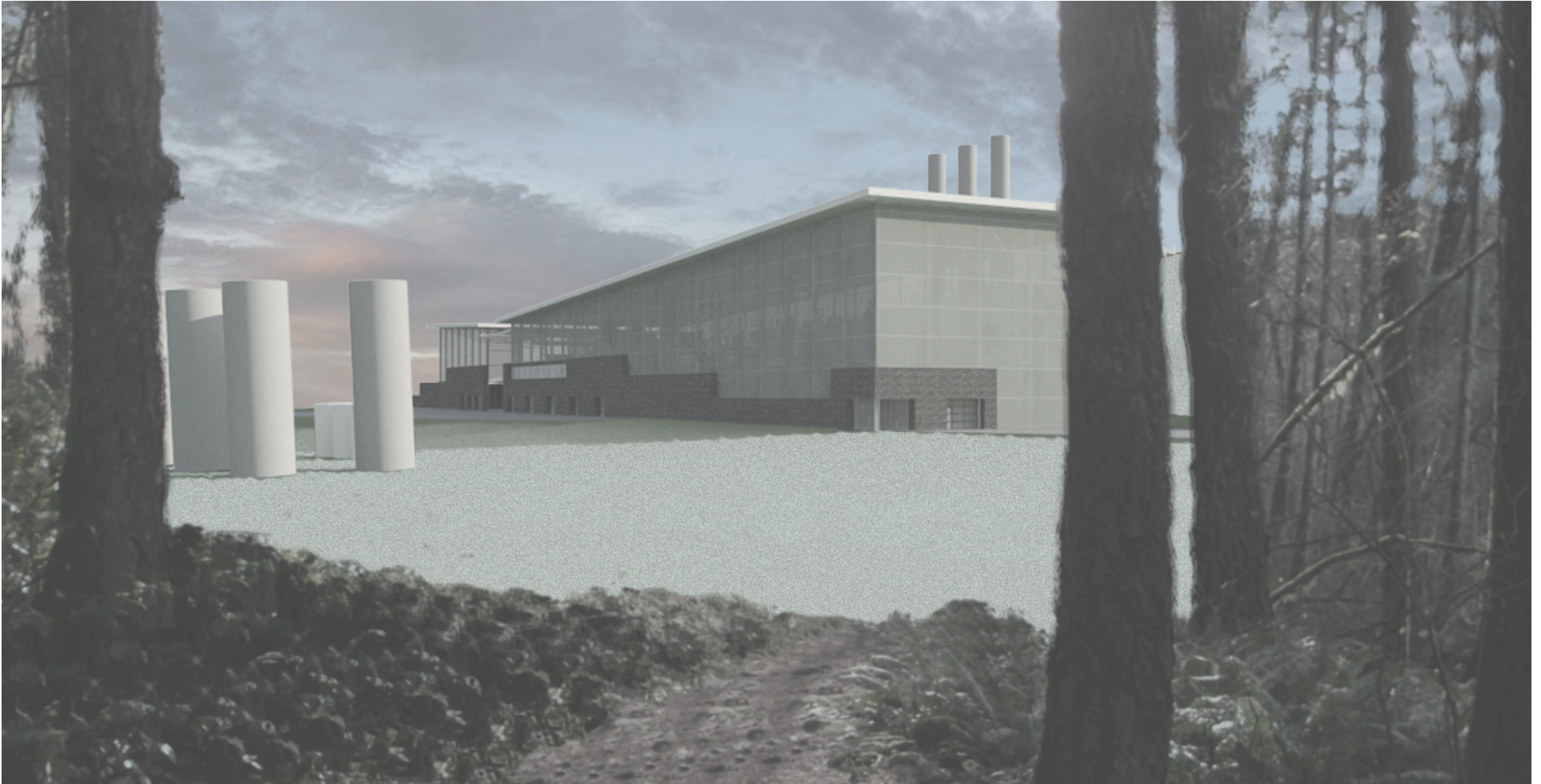


Fig. 5.18 *Emerging from the forested buffer zone through the ecotone and into the waste landscape*

This series of vignettes describes the procession of the public visitor to the site. People would experience the dynamic waste harvesting and landfill mining operations in the opposite direction of the waste, beginning where the waste essentially ends, or is transformed into energy and usable aggregate for the gabions. As the public ventures further into the facility, and eventually the landfill mine, their understanding of how waste is being handled, processed and commodified into resources begins to shift their perceptions of the value of the landfill and their connection, as a consumer in our society, to this unique public land.

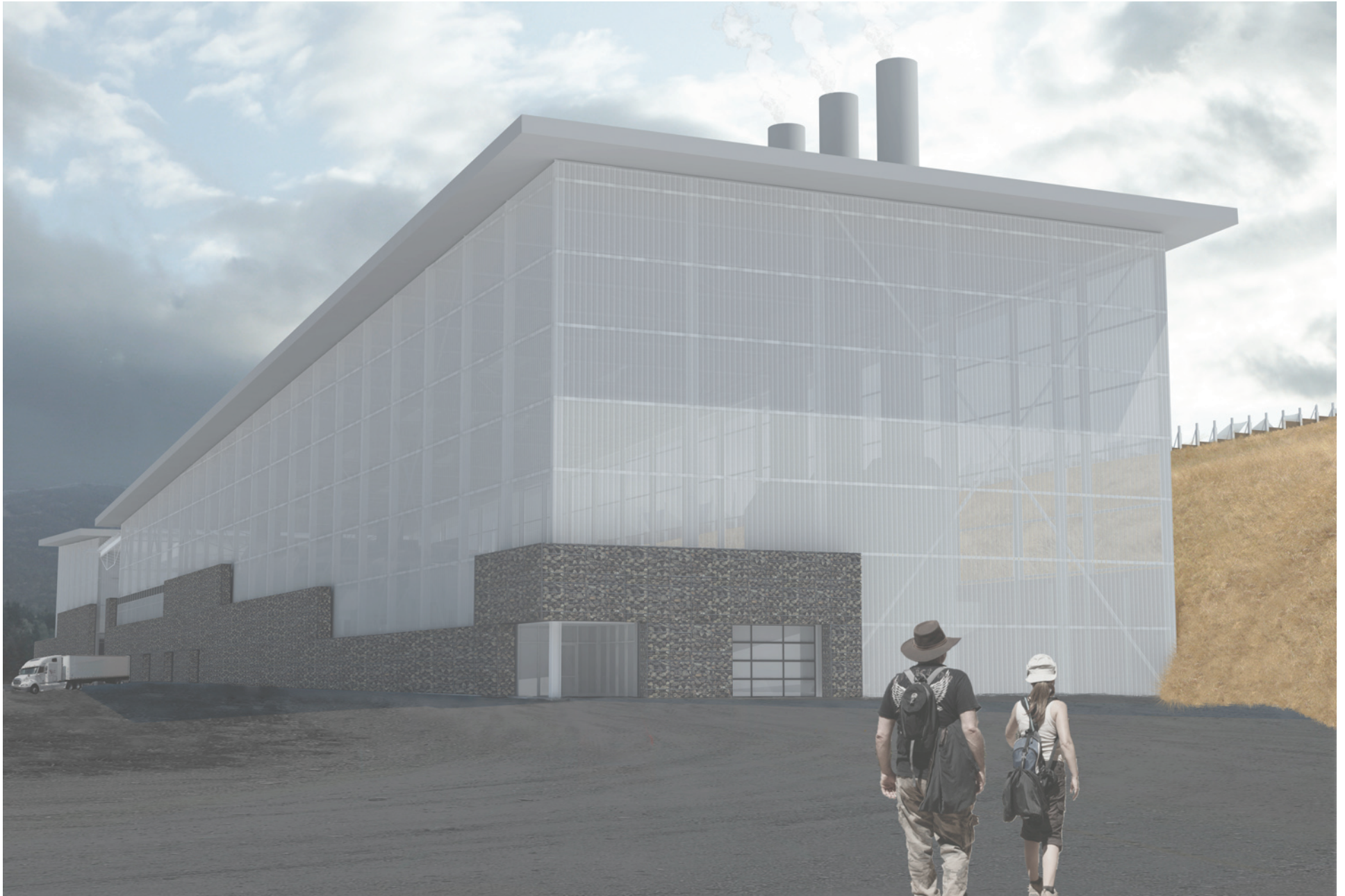


Fig. 5.19 *Approaching the public entry to the facility.*

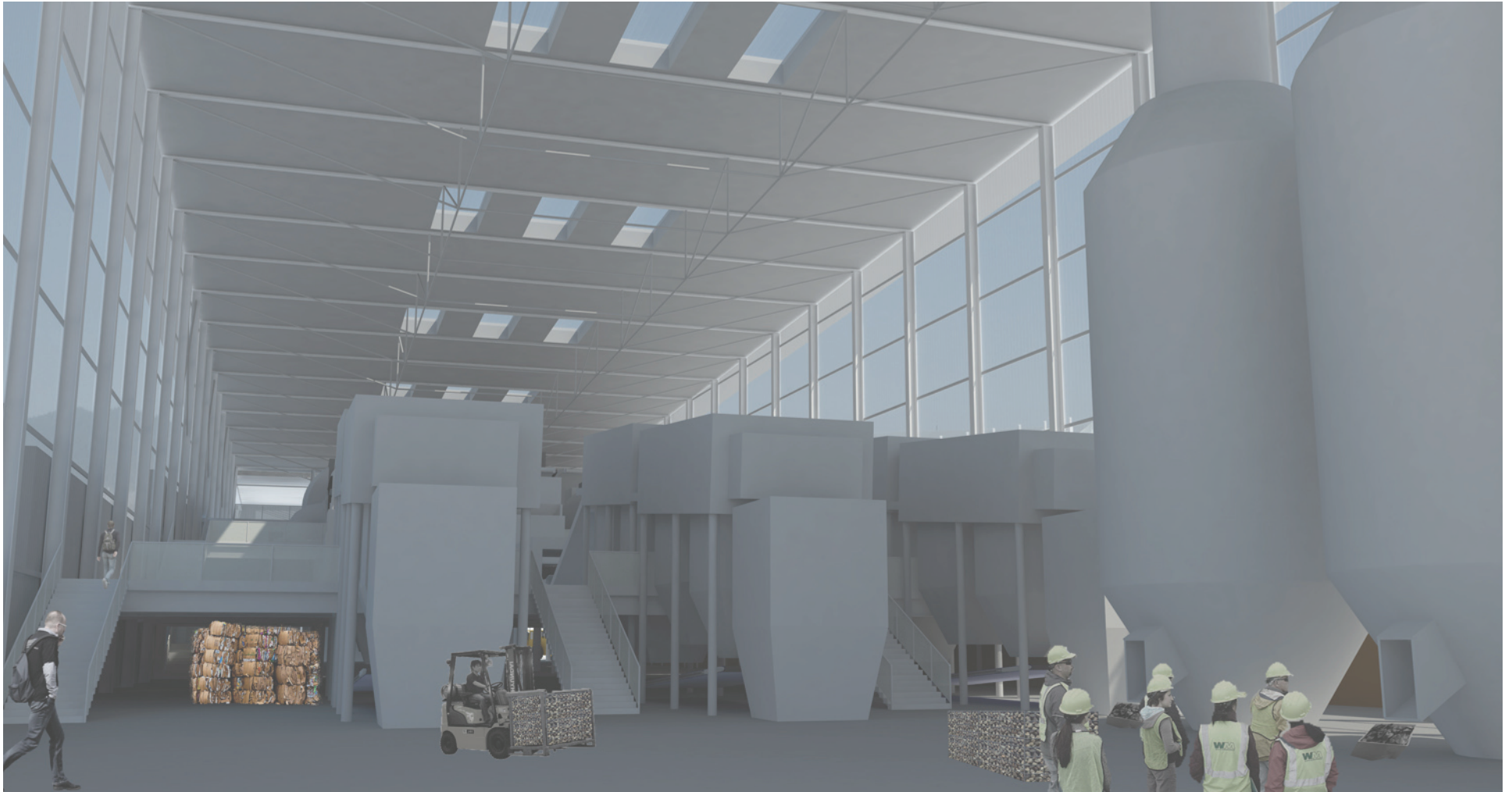


Fig. 5.20 Plasma gasification waste-to-energy units dominate the space upon entry, making their daily quota of vitreous slag that will fill the gabions being fashioned adjacently. The forklift is delivering some freshly finished gabions for the facade and mining retainment. Baled recyclables wait for delivery underneath the second level deck.



Fig. 5.21 *The public visitor's awareness of the manner in which waste is being treated as a resource grows as they are exposed to the sorting equipment and facility personnel.*

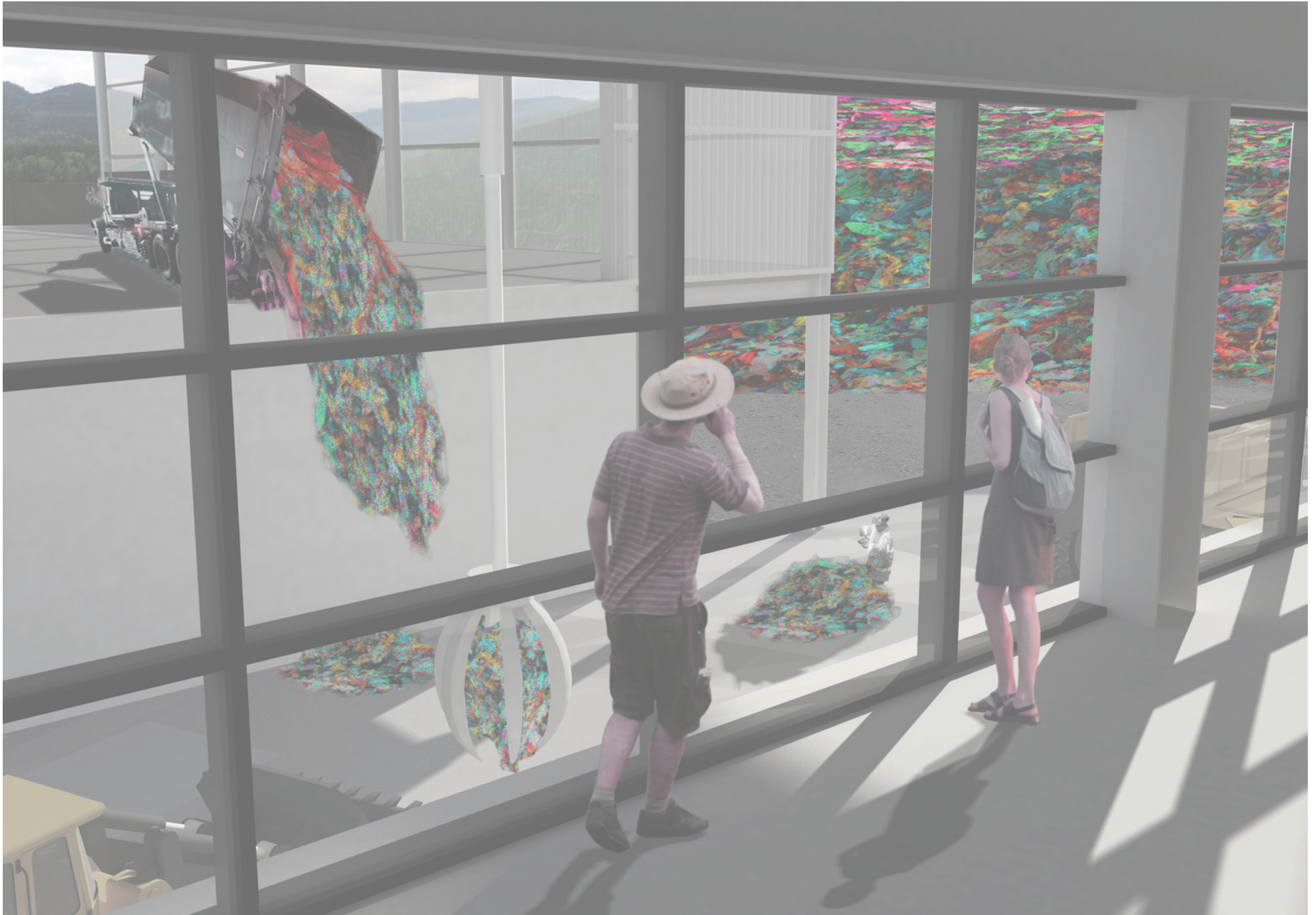


Fig. 5.22 View down into the tipping floor, where new and mined waste comes together.

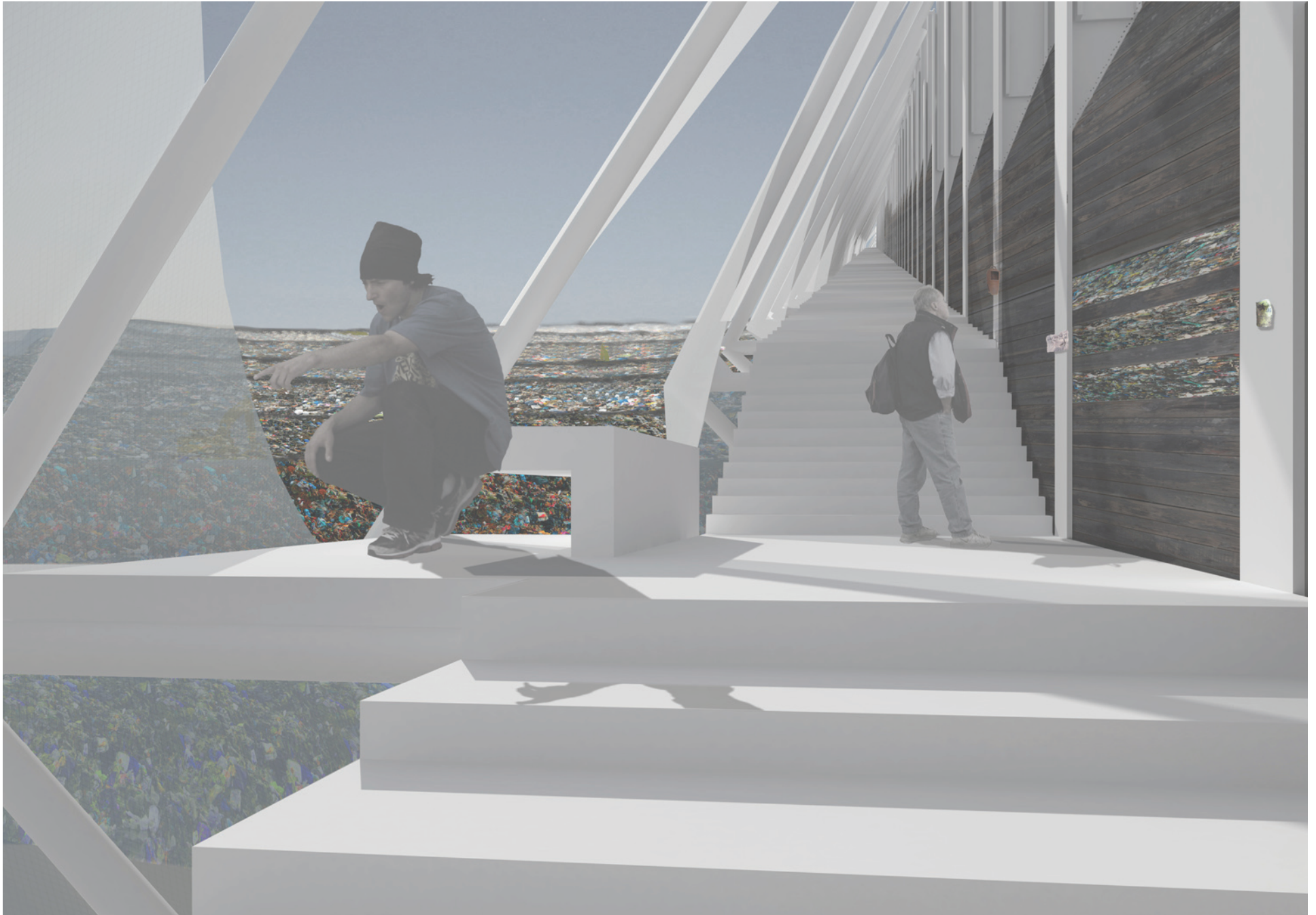


Fig. 5.23 View up to the path with glass lagging "windows" into strata of mine.



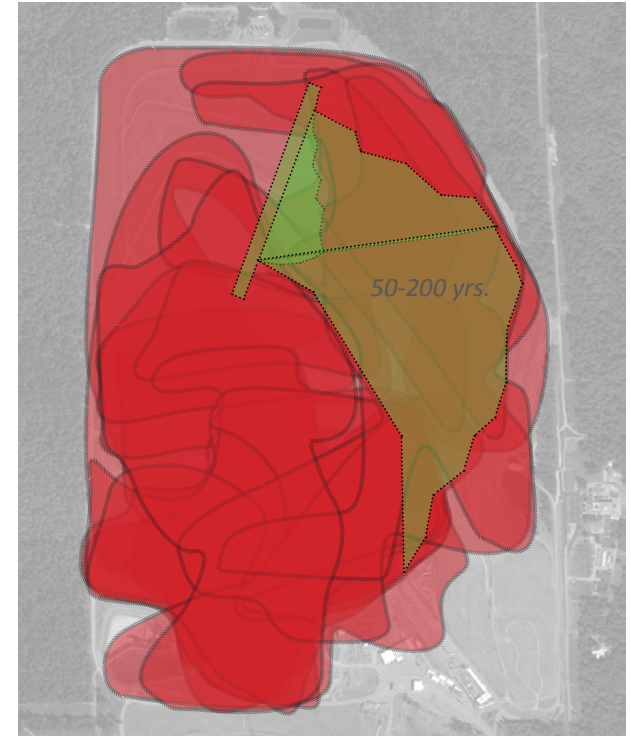
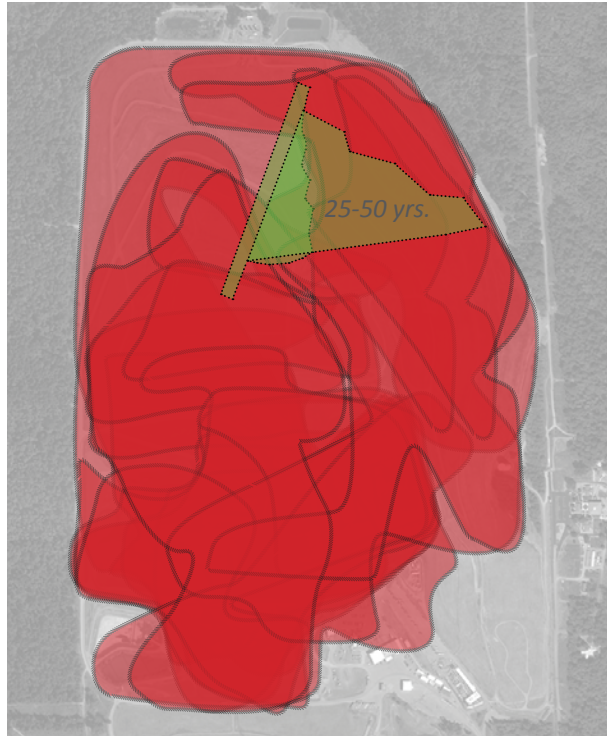
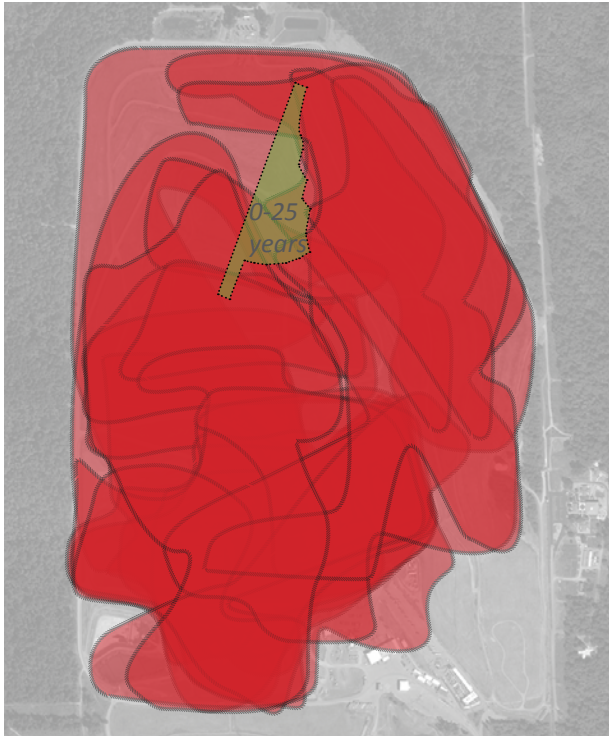
Fig. 5.24 View into the mine looking back at the facility and the forested, mountainous backdrop. Cultural artifacts begin to populate the soldier piles



Fig. 5.25 Framed view of Mt. Rainier at peak of landfill. The height of the landfill has blocked this view up until this point of the visitor's journey.



Fig. 5.26 *From deep inside the mine doing the most exciting and pungent work. Public path above registers datum with a dynamic rhythm.*



The landfill will continue to be mined into the foreseeable future. All of the the previous images show the mining operation after a year or two have passed. With the uncertainties of future waste production, which could potentially increase due to population gains, or decrease in response to reduced packaging, consumerist lifestyles, or advances in recycling and composting operations in King County, the ratio of mined to new waste processing will likely vary throughout the life of the facility. Waste mining and the associated science of landfill archaeology will continue to uncover patterns of our past consumption habits for possibly hundreds of years into the future (fig 5.25). As more efficient waste management practices emerge and the technologies employed in this structure come to an end of their useful lives, recoverable materials can harvested from the structure, machinery and fixtures, for recycling or reused elsewhere, and the remaining portions of the structure can decay gracefully and honorably, the same as the other infrastructure on site, as a testament to the intentions and best practices of the era in which it was designed and built.

Fig. 5.27 Site diagrams showing how the future evolution of mining operations on the site follow the ridgeline down to the south to define front and rear watersheds as well as capitalizing on the overlaps of layered active zones in those areas.

CHAPTER 6: CONCLUSIONS

This thesis is about connecting people to the end point of their solid waste stream, the landfill, and architecture's role in experiencing the hidden value and danger entombed in the landfill to allow the public to contemplate their relation to the site's existence. In approaching a site typology that is typically concealed from the public eye and mind, and therefore, the public realm, this thesis aims to shift this perception to re-connect the public to a landscape/landform that has been collectively created by the public. Mining the landfill offers a site approach that reveals its cultural depth and material value. Architecture is often used to bestow value on buildings and public spaces. This can be conventionally seen in churches, government buildings, museums, schools, houses, parks and plazas. The idea of the landfill as a public space contrasts these typologies sharply. It is a place that is hidden in plain sight, its value ignored, and even despised by those who might be "unfortunate" enough to live close to one of these sites. The landfill is certainly not valueless, though its value is hard for people to appreciate, because of the stigma that is attached to these sites in our culture. The Cedar Hills Regional Landfill is a central piece of infrastructure in King County whose value has been, at the very least, underappreciated, and more likely, neglected and shunned. This thesis attempts to use architecture as a catalyst for discovering the hidden value in these landscapes of waste.

Mining the landfill was chosen as a site approach to expose and reveal the internal processes of the landfill, informed by the work of The Garbage Project and landfill archaeologists. Intentionally seen as a way to engage all the senses of the public visitor, mining allows a tangible understanding of the complexities created by burying our solid waste. It also represents an opposing force to land-filling, excavation. In order to create an integrated connection between this mining process and the architectural

intervention, this thesis began to explore how to situate the structure down within the void of the mining operation itself. This relationship between building and mine led to an exploration of methods of commercial excavation, and an approach to implementing a system of soldier piles and lagging was chosen. Given that the building program is primarily utilitarian in nature, and the excavation system's materials and scale are expressed a dynamic, yet straight forward process, the building tectonically and programmatically joins the mining processes with those of landfill archaeology, materials recovery and waste-to-energy. The soldier piles that support the mining operations simultaneously serve as vertical structure for the facility and set up the proportions expressed in the architecture. The building's form splits into two volumes separated by a void, the threshold into the mine, the mouth of the animal, the space of waste acceptance, the tipping floor. The linear path of the public visitor follows the rhythm of the building set up by the soldier piles, and rotates at the corner of the tipping floor, which is also the moment where the building structure turns to become the same system of excavation. Except now this structure provides the spine for the linear path to climb up through the mining operation, suspended from the piles in a dynamic expression of fabric sail covered trusses which registers the original height of the ridgeline which set the datum for mining.

The further integration of program requirements and tectonics came from the production of an obsidian-like inert, vitreous slag which is the solid byproduct of the plasma gasification technology waste-to-energy process. With the intention of finding an on-site use for the material, an approach was chosen that could be expressed through the architecture and the mining operation. Utilizing the slag as aggregate to fill gabion cages, these are used in a dynamic façade system, which is stacked up and disassembled as gabion units are produced and as needed as structures for retainment within the mine itself. That this particular byproduct of the recovery process turned into tectonic a material expression is seen as a very exciting potential of this thesis.

The chosen vehicle for the exploration of this thesis proved to be more program heavy than originally intended from the beginning phases of research. The struggle to relate the cultural value and the economic, material and energy value lead to some interesting research and design solutions, specifically those of excavation techniques. This was an unexpected trajectory that added to the credibility and depth of the design intervention. This was part of a more general pattern in the thesis process, where the programmatic requirements and their relation to the architecture began to take precedent over the larger site response. As a result, the process evoked from the title of this thesis, "Mining the Midden", is more ambiguous in its formal qualities, and more abstracted in its representations for reasons which include the reality that there are few precedents, of which most are poorly documented or so contemporary that published information and photo-documentation is scarce. In the end, this thesis' proposal to connect people to society's collective waste burial sites and allow opportunities for engagement, interpretation and reflection has explored an approach that looks at the landfill in a progressive way and elevates the methods in which society thinks about and deals with the solid waste stream which we all helped and continue to help to create.

ENDNOTES

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- 2 Rathje, WL and Cullen Murphy, *Rubbish!: The Archaeology of Garbage* (Tuscon: The University of Arizona Press, 2001), 24.
- 3 Matthew R. Lane, "A conversation with William Rathje", from *Anthropology Now*, Vol. 3, No. 1 (April 2011), 79. Published by: Paradigm Publishers
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- 5 Lane, 83.
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