

## ASSESSING COMMUNITY PERCEPTION OF POST-MINE BROWNFIELD'S EFFECT ON THE SOCIAL ENVIRONMENT AND VISUAL QUALITY OF URBAN LANDSCAPES IN KISUMU CITY, KENYA

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**Abstract:** *Brownfields (degraded landscapes) are considered as problem spaces, barriers and obstacles that do not fit well within the landscapes they are found within. Crime and other social evils besides hazards are usually associated with their abandoned, disused and derelict nature. They are not aesthetically appealing to residents of the neighborhoods in addition to occupying large areas that would be used more productively. While there is need to rehabilitate Kisumu's brownfields into more productive urban land uses, public perception of the social effects and visual quality of these sites is not clearly known. In accordance, this study postulates that rehabilitation of post-mine brownfields lies in understanding the social effects and visual quality they pose within the neighborhoods they are found in and which should not be neglected in the wake of spreading urban development to these areas. The purpose of this paper is to fill a gap in terms of assessing the public perception of the social effects and visual quality of post-mine brownfields within the urban landscapes. Case study research was carried with the unit of analysis being the brownfield sites and households living within a 500-metre radius of each brownfield site. A total of 96 participants selected randomly were involved in the survey within four brownfield neighborhoods that were purposively selected in the study due to long history of quarrying thus resulting into post-mine brownfields. The survey used questionnaires administered randomly and the findings were analyzed using percentages and presented in tables and figures. On site observation within the four sites was also carried through photography. The study found out that the post-mine brownfields affected the visual quality of the immediate areas due to waterlogging, visible rugged landscape, untamed vegetation and dumping of wastes. The findings revealed that the four post-mine sites had very high levels of unpleasantness that affected the aesthetic value of the immediate surroundings. The study recommends that the negative spatial attributes of the sites such as untamed vegetation, dumping of wastes should be addressed to avoid possible hideouts for crime and other social evils that they pose as threats to the surrounding community. Planning for long term solution through rehabilitation re-uses that are productive and beneficial should be undertaken through holistic stakeholder engagement.*

**Keywords:** *Community perception, Degraded landscapes, Post-mine brownfields, Social environment, Visual quality, Urban landscapes, Spatial planning, Kisumu City Kenya,*



## INTRODUCTION

Quarries and areas of surface mining within various parts of cities that remain untreated after closure of active mining result into diverse problems. They produce extensive damages to land and create diverse safety and environmental impacts (Milgrom 2008; Lin et al., 2005). According to Martinat et al. (2016) brownfields sites and their neighborhoods are greatly influenced by the neglected, abandoned, disused and devastated state that they present. These sites interfere with the functioning of the wider urban structure to the local levels where they are sited. The sites present problems of anti-social behavior in addition to other economic and environmental problems that they cause to the local neighboring residents to wider population at city level. The other social problems of brownfield sites are psychological in nature in terms of social stigma and fear that is connected with their neglected nature. All these negative attributes from the abandoned state negatively impact on the residents within such neighborhoods (Martinat et al., 2016). Abandoned sites of quarries, according to Buckley & Mason (2012), attract a host of harmful and unhealthy land uses. These sites are commonly targeted for illegal dumping of wastes. Neglected quarry sites often become hang-out sites of local gangs, fuelling various forms of crime. Siebielec (2012), points out frequent social problems as migrations, job loss, concentration of problematic inhabitants, vandalism and crime risk, movement of labor to be associated with such sites.

According to Tsolaki-Fiaka et al. (2018) the complete lack of security within abandoned quarry lands resulted in illegal dumping that affected the visual quality and this could result in social stigma for such areas. In addition, these unused quarry lands endanger the lives of the inhabitants due to lack of quarry fencing. The aesthetic alteration of the landform and change of geomorphological characteristics due to previous resource exploitation caused visible scars in such landscapes. On site observations by these authors revealed visual pollution due to illegal dumping of urban wastes, deteriorated landscape aesthetics, alteration of landscape landforms and the resultant reduction in land value (Tsolaki-Fiaka et al., 2018). According to Redondo-Vega et al., (2017); Legwaila et al., 2015; Nita (2012) abandoned quarry lands have visual impacts that may extend over large landscape areas that are noticeable as scars with colour contrasts. This affects the aesthetic appeal of the landscape and thus the scenic quality of the areas is reduced. Nita (2012) stresses the dissonance created in the visual and aesthetic values between the surrounding landscape and the abandoned quarry lands. Baczynska et al. (2018) considered the issue of landscape attractiveness of abandoned quarries in terms of uniqueness, differentiation and curiosity they evoked among local and foreign viewers who visited them. They established that even in their abandoned state quarries can be considered as: very attractive, attractive, slightly attractive and unattractive based on their visible landscape forms (Baczynska et al., 2018).

Open pit/surface mining of various resources such as stones extensively changes the landscape and can result in severe visual impacts of the affected landscapes. According to Simpson (1979), the physical change and contrast between the mine and its surroundings resulting from mining operation vary over time and that the visual impact of change is dependent upon the viewer's perception of the modified landscape. There is great need to give a consideration to the visual impacts within and around the post-mine brownfields (Baczynska et al. 2018; Tsolaki-Fiaka et al. 2018; Legwaila et al., 2015; Simpson 1979). Simpson (1979), states that a person's

perception of a mine is intertwined with the perception of the entire surrounding landscape and will be affected by distance from the mine, orientation of the mine, the viewing location and conditions of the areas surrounding the mine. Krause (2001), states that landscape is perceived as a visual resource. The holistic image of a landscape comprises not only its spatial and structural aspects but also the formal visual and cultural aesthetic expression of the landscape. The aesthetic value of landscape is one of the most threatened attributes of the human environment. This threat is particularly dramatic in post-mining landscapes. Legwaila et al., (2015); Sklenicka & Kasparova (2008), state that the key aesthetic problem of post-mining areas is the negative visual impact of the mining sites on the surrounding landscape. This means that the aesthetic value of the adjacent landscape is degraded mainly by the negative visual impact of the unreclaimed sites. The negative visual impact of the mining sites unavoidably lowers the aesthetic value of the landscape and its surroundings. So, post-mining landscape planning and rehabilitation activities should strictly consider the previous aesthetic characteristics of the land and their future development within an interdisciplinary approach.

Loures et al. (2015) assert that brownfields constitute environmentally impaired resources that need to be reintegrated into surrounding land uses of the community and as such be brought back to beneficial uses (Loures et al., 2015). According to Concerted Action on Brownfield and Economic Regeneration Network (CABERNET, 2012); Loures and Panagopoulos (2007) post-industrial landscapes that include post-mine brownfields play an important role in the development of a city both in terms of economy and environment. The presence of several derelict landscapes coupled with decreased new lands for urban development and concern for protection of the environment brings reclamation of derelict landscapes to the attention of several professionals. Their reclamation brings to an end the several problems they pose to the environment that includes ecological, social and visual quality problems as well. Kryzstofik et al. (2020); Martinat et al. (2016), Legwaila et al., 2015; Loures and Panagopoulos (2007) support the importance placed on the need to plan for rehabilitation of post-mine brownfields. These authors posit that making decisions on recent spatial development are particularly visible in large cities especially with regard to post-mining areas with focus being on their rehabilitation. Martinat et al. (2016) posit that a significant element of consideration of recent urban development and changes is the need to consider the significance presented by brownfield sites within a given city (Martinat et al., 2016). A study by Martinat et al. (2016), found out that awareness about brownfields problems was quite limited among the local population. Loures & Panagopoulos (2007) posit that landscapes from past industrial activities should be viewed as a resource and a great opportunity to recover them through reclamation into new landscapes that offer multi-functions. The authors in this paper posit that the fact that post-mine brownfields are considered as barriers and obstacles should not shroud the very potential they present that is not yet realized in their various locations through rehabilitation.

We postulate that effective reuse of post-mine brownfields through rehabilitation starts with assessing the various problems they pose as concerns within the various local jurisdictions they are sited within through community perception. At the time of the study there was little known existing body of knowledge about the various post-mine sites in terms of their spatial attributes,

effects on the environment and possible reuse options through rehabilitation to reintegrate them back into existing land uses in a compatible manner. This study sought to assess the community perception regarding the social effects and visual quality of the four post-mine sites on the urban landscapes within their neighborhoods. This was in terms of crimes and other social evils and the visual quality as perceived by the residents within the neighborhoods. This study postulates that understanding the social effects and visual quality of the post-mine brownfields is an important step in planning for their rehabilitation in an attempt to reintegrate them back into the planned urban landscape that then mitigates the problems they pose due to their neglected and abandoned state. Therefore, the current study intended to assess community perception of post-mine brownfield's effect on the social environment and visual quality of urban landscapes in Kisumu city, Kenya.

## METHODOLOGY

The study was conducted in Kisumu City, Kenya. The study's geographical scope was limited to four post-mine sites within the four sub-locations of Nyawita, Migosi, Wathorego and Kanyawegi. The four sub-locations were selected purposively because of the long history of stone mining within them. By the time of the study, these sites had remained in abandoned, disused state due to closure of quarrying activities within them several years back. The brownfields studied were once the sites of stone mining that was converted into ballast and other concrete products.

Migosi Sub-location is within Kondele Location of Kisumu Central Constituency/Sub-County and was as a result of Municipal site and service scheme At the time of the study, Government of Kenya's Kenya National Bureau of Statistics GOK, KNBS (2009), census report revealed that it is densely populated at 4795 households within an area of 1.9 square kilometers and total population of 19,826 people. Nyawita Sub-location is found within Kondele Location of Kisumu Central Constituency/Sub-County. According Kisumu Integrated Sustainable Urban Development plan ISUD, (2013), Nyawita falls under the large belt of unplanned settlements and has informal housing mostly consisting of non-approved developments. At the time of the study, it was densely populated with 4099 households within an area of 1.3 square kilometers. According to GOK, KNBS (2009) at the time of the study it had a total population of 14,747 people.

Wathorego is within Kajulu West Location of Kisumu East Constituency/Sub-County. GOK, KNBS (2009) census report at the time of the study showed that it had a total population of 11,823 people, 2849 households within a total area of 9.0 square kilometers. Main economic activities include agriculture and quarrying for sand and stones. Quarrying for stones is carried out by companies that crush the stones into ballast and other products that they further use to process concrete products like building blocks, road kerbs and paving slabs (Kisumu ISUD, 2013). Kanyawegi Sub-location is within Kisumu South West Location of Kisumu West Constituency/Sub-County. Land use designated for the area is peri-urban farmland i.e. agricultural use and land tenure is mostly private freehold (Kisumu ISUD, 2013). At the time of the study, it

had a total population of 6,529 people. It was sparsely populated at 1454 households within an area of 17.4 square kilometers (GOK, KNBS, 2009). The main economic activities are agriculture, quarrying and various forms of businesses such as retail trading. The total population within the four Sub-locations according to GOK, KNBS (2009) at the time of study between October 2017 and March 2018 was 52,925 people and 13,197 households. However, from the reconnaissance carried out not all the population and households were aware of the post-mine brownfield within the sub-location.

Reconnaissance study was conducted between 2016 and 2017 to identify and locate the post-mine brownfields within the study area of Migosi, Nyawita, Wathorego and Kanyawegi sub-locations. The reconnaissance was carried out by interviewing the area sub-chiefs who are well versed with the location, number and landowners of the brownfields within their areas of jurisdiction. The study was carried out between October 2017 and March 2018 for data collection and analysis. All the four brownfields under study were identified and selected for study using purposive sampling method due to their large sizes. Each brownfield became a sample site due the fact that they were existing sites of former stone mining areas and that they no longer had mining activities ongoing. Other studies on brownfields have defined a brownfield neighborhood as a 500 meter (0.3 mile) circular radius around a brownfield (Pearsall, 2010; Fisher (2011). Essoka (2010), considered a slightly larger radius of 0.5 mile to allow for more general understanding of socio-economic character of areas adjacent to brownfields. This study was based on households that are living within the 500 metres from the boundary of the brownfield within each of the four sub-locations. According to GOK, KNBS (2009), the four sub locations where the four post mine sites are found have a total of 13,127 households. A total of 3300 households constituting a quarter number for all the households within the four sites was used to calculate the total sample size for all the four sites. Sample size calculation was according to Mugenda & Mugenda (2003) for population less than 10,000.

Selecting the households for each brownfield site was based on the sampling frame above with a total of 96 households for all the four sites. The number of households that constituted the sample for each sub location was therefore Migosi 35 households, Nyawita 30, Wathorego 21 and Kanyawegi 10 households Random sampling was used to collect data from the households from the boundary of each site and in the subsequent radii within the 500 metres boundary. Data was collected from the willing respondents within each diameter of the concentric rings around each site with each first household being selected randomly and others within the ring picked randomly at various ends all-round the diameter. Proportional stratified sampling technique was used to calculate the number of households to form the sub samples to be included in the survey within each of the four sub locations of the study area. The primary data was collected through questionnaire, observation guide and photography. The respondents were asked their perception on various effects of the post-mine sites within their neighborhoods. On site observation was carried at random times of the day for each of the four sites under study. Observation and digital photography helped the researcher to cross check some of the responses from the respondents done through questionnaire. Quantitative data was analyzed using descriptive statistics including percentages. Analyzed data has been presented using texts, tables and figures.

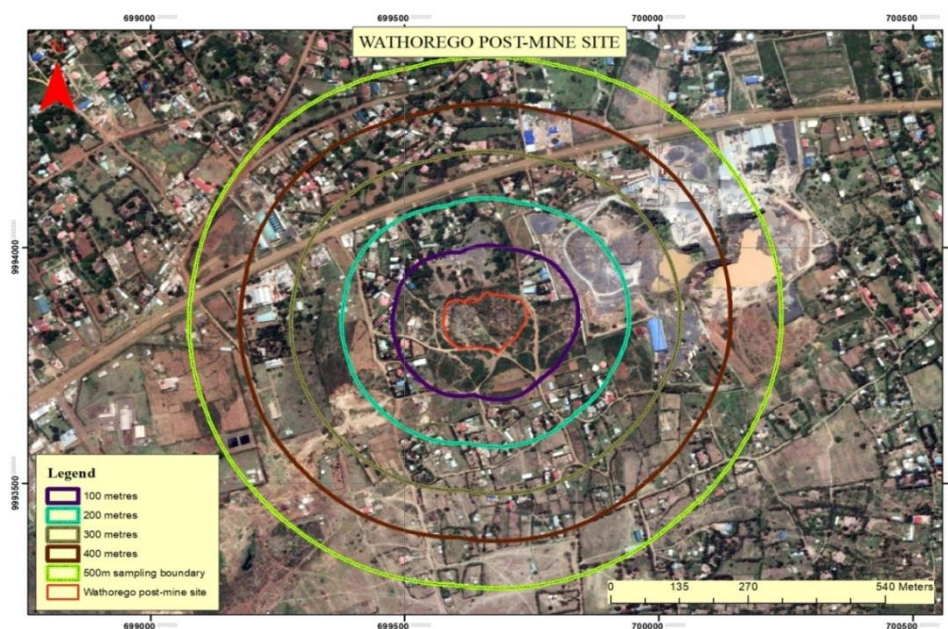


Figure 1: Satellite aerial image showing the sampling radius intervals and the 500 metres sampling boundary around the Wathorego post-mine site.

Source: Satellite aerial image (2018).

## RESULTS

### Demographic Characteristics of the Respondents

Respondents within the four sub-locations of the study area comprised 41% female and 59% male. The age distribution of the respondents showed that 46% were aged between years 18 and 30, 30% aged 31 to 40years, 15% were aged between 41 and 55while 9% were aged over 55years. Most respondents therefore were between ages 18 and 30. The age distribution is skewed to older age groups implying that most of the participants were mature persons. They were therefore, expected to respond adequately to the study questions that were about the effects of the post-mine brownfields within their neighborhoods at the time of the study. Marital status of the respondents was that 64% were married 34% single. Educational attainment of the respondents indicated that 22% had attained primary education, 43% secondary education and 35% had tertiary education and above. The implication of these findings to the study is that 78% of the respondents were educated beyond primary school, hence expected to understand and objectively respond to questions regarding the post-mine brownfields within their neighborhoods.

How long the respondents had lived within the area of study around the brownfield was also analyzed. Those who had stayed for less than two years constituted 14%, two to five years of stay was 33% while the majority at 53% had stayed for more than five years. The length of residence results indicates that majority of the respondents had lived in their various post-mine

neighborhoods for a period that would ensure they were aware of the existence of the brownfields and their effects on the neighborhoods.

### Perceived Social Effects and Visual Quality

The survey sought the community perception on the social effects that was studied in terms of crime other forms of evil within the immediate surroundings. Visual pleasantness or not constituted the survey findings on visual quality of the immediate surroundings where the post-mine brownfields were sited. The following Table 1 summarizes the social effects and effect on the visual quality across the four sites under study.

Table 1  
*Social effects of the post-mine brownfields on environment*

	Nyawita post-mine site		Migosi post-mine site		Wathorego post-mine site		Kanyawegi post-mine site	
	Agreed	Disagreed	Agreed	Disagreed	Agreed	Disagreed	Agreed	Disagreed
<b>Crime &amp; other Social evil</b>	82%	18%	86%	14%	94%	6%	100%	0%
<b>Effect on visual quality</b>	90%	10%	76%	24%	90%	10%	100%	0%

### Public Perception on Crime and Other Forms of Evil

Nyawita post-mine brownfield according to 82% of the respondents as indicated in Table 1 above is perceived as a threat in terms of crime/insecurity as a hiding ground for thieves and other forms of evil, while 18% did not consider it a security threat. Its abandoned nature at 18% was attributed to the security threat, 14% attributed to the untamed vegetation that is wildly growing within the entire post-mine and 68% was attributed to the hideouts that exist within the post-mine due to the deep depths at several points. The majority therefore attributed the deep depth that creates possible hideouts within the post-mine to the security threat. Those who didn't consider it a security threat attributed clear views into the post-mine at 86% while some attributed the distance from their residence to the post-mine at 14%.

Twenty six percent of Migosi respondents attributed its abandoned nature to be a security threat. Untamed vegetation that is wildly growing within the entire post-mine was attributed to a security threat by 29% and 45% attributed the hideouts that exist within the post-mine due to the deep depths at several points. The majority therefore attributed the deep depth that creates possible hideouts within the post-mine to the security threat. Those who didn't consider it a security threat attributed clear views into the post-mine at 62% while some attributed the distance from their residence to the post-mine at 38%. Twenty percent of Kanyawegi respondents attributed its abandoned nature to be a security threat while 80% attributed the security threat to the hideouts

that exist within the post-mine due to the deep depths at several points. The majority therefore attributed the deep depth that creates possible hideouts within the post-mine to the security threat. On-site observation and site analysis at the time of the study showed that few residential houses were found close to the abandoned quarry boundaries hence no dumping of wastes was evident.

Wathorego's post-mine had its abandoned nature attributed to be a security threat by 9%, 34% attributed the untamed vegetation that is wildly growing within the entire post-mine and 57% was attributed to the hideouts that exist within the post-mine due to the deep depths at several points. The majority therefore attributed the deep depth that creates possible hideouts within the post-mine to the security threat. Those who didn't consider it a security threat attributed the far distance from their residence to the post-mine at on-site observation and site analysis showed that the area immediately around the quarry boundaries has few upcoming developments but they were few and at least 50 to 80 metres distance from the abandoned quarry.

### Public perception on visual quality/aesthetics

The aspects that affected the visual quality/aesthetics for the four post-mine brownfield sites was considered in terms of water logging, visible rugged landscape, untamed vegetation and dumping of wastes. Figure 2 below summarizes the results.

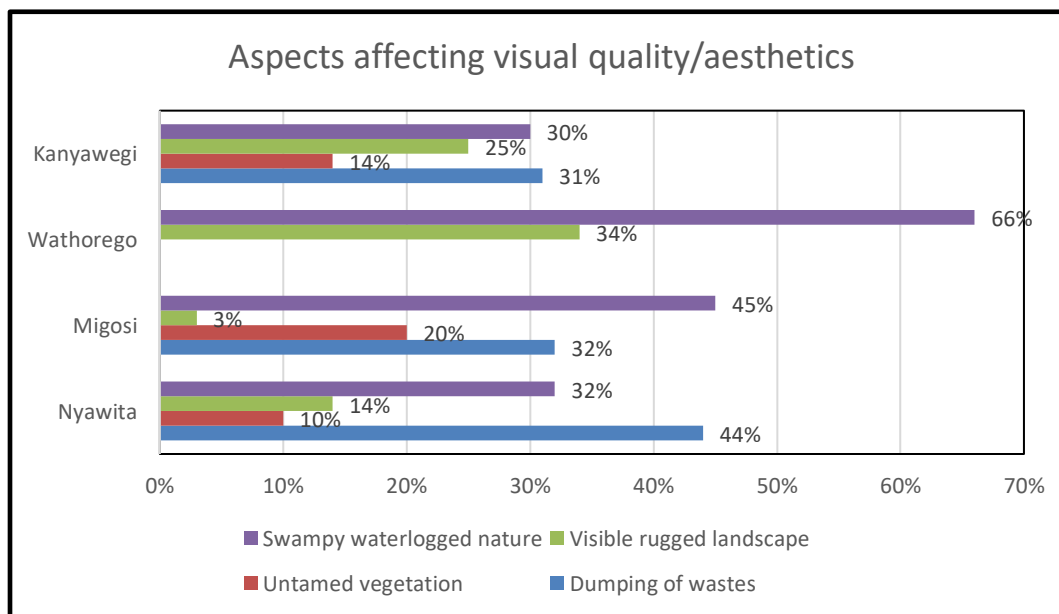


Figure 2 Aspects affecting visual quality/aesthetics within the four post-mines.

Visual quality for the Nyawita post-mine was considered in terms of views on the physical appearance/state of the quarry. Visible aspects included the dumping of wastes at various ends, untamed vegetation within the post-mine, visible rugged landscape appearance exposed by the deep depths, swampy waterlogged nature that was evident at the shallow entry point of the post-mine as documented from the on-site observation and site analysis. As indicated in Figure 3 above,



dumping of wastes was considered by 44% of the respondents to be affecting the visual quality and aesthetic value of the immediate surroundings, while untamed vegetation was considered by 10%, visible rugged landscape by 14% and the swampy water logged nature was considered by 32% by the respondents. The 10% of the respondents who did not consider the visual quality of the post-mine to be affecting the aesthetic value in a negative way attributed this to minimal dumping of wastes by 60%, few untamed vegetation by 20% and minimal rugged landscape by 20%. None of the respondents considered the water logging to be minimal and this supported the on-site observation and site analysis that had been carried out that revealed the water logging that was evident within the shallow entry point into the post-mine. The dry parts of the quarry during the observation and site analysis also showed signs of being water logged in times of heavy rains.



Plate 1: Swampy waterlogged area next to the Nyawita brownfield entry point.



Plate 2: Dumping of household wastes on the northern side of the Nyawita brownfield.

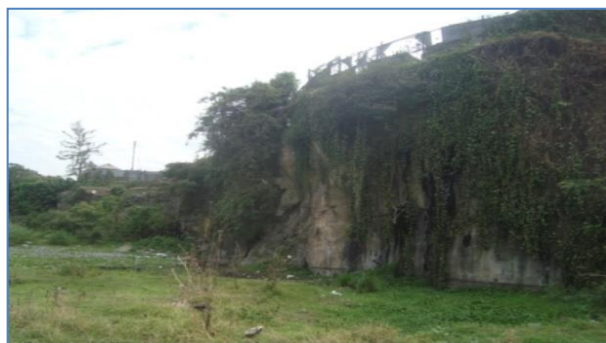


Plate 3: Quarry depth at one end & creeping vine vegetation on the rugged quarry wall at Nyawita post-mine site.



Plate 4: Untamed vegetation along the quarry wall on the southern border.

Visible aspects affecting visual quality at Migosi included the dumping of wastes at various ends, untamed vegetation within and around the post-mine, visible rugged landscape appearance at some points, swampy waterlogged nature that was evident on the entire post-mine as documented from the on-site observation and site analysis. Dumping of wastes was considered by 32% of the respondents while untamed vegetation was considered by 20%, visible rugged landscape by 3%

and the swampy water logged nature was considered by 45% of the respondents. None of the respondents considered the water logging to be minimal and this supported the on-site observation and site analysis that had been carried out that revealed the entire Migosi post-mine to be completely subdued in stagnant water without any outlet at any end to release the surface run off that collected within the post-mine.

Visible aspects at Wathorego included the dumping of wastes at various ends, untamed vegetation within and around the post-mine, visible rugged landscape appearance at some points, swampy waterlogged nature that was evident on the entire post-mine as documented from the on-site observation and site analysis. Dumping of wastes was considered by 32% of the respondents to be affecting the visual quality and aesthetic value of the immediate surroundings, while untamed vegetation was considered at 20%, visible rugged landscape by 3% and the swampy water logged nature was considered by 45% of the respondents.



Plate 5: Rugged quarry walls at the deep end of Wathorego brownfield.  
Source: Author (2017)



Plate 6: Water logging within the deepest end of Wathorego brownfield.  
Source: Author (2017)

Visible aspects affecting visual quality at Kanyawegi included the untamed vegetation within and around the post-mine, visible rugged landscape appearance at most points, swampy waterlogged nature that was evident on one end of the post-mine as documented from the on-site observation. Visible rugged landscape was considered by 34% while the swampy water logged nature was considered by 66% of the respondents. The four post-mine sites have an effect on the visual quality of the immediate surrounding and this was rated in terms of how unpleasant it was to the eye.

The visual quality of each post-mine brownfield has an effect on the aesthetic value of the immediate surrounding and this was of concern. The aspects used to rate visual quality included the aspects on Figure 2 above (swampy waterlogged nature, visible rugged landscape, untamed vegetation and dumping of wastes). The views of the respondents were as follows (Table 2):

Table 2  
*Rating for visual unpleasantness for the four post-mines*

Visual quality	Points/ Percentage	Migosi	Nyawita	Wathorego	Kanyawegi	Average across the sites
No unpleasantness	0	5%	6%	10%	0%	5.25%
Very low unpleasantness	1-20	7%	0%	0%	0%	1.75%
Low unpleasantness	21-40	9%	2%	19%	0%	7.5%
Medium unpleasantness	41-60	17%	42%	16%	20%	23.75%
High unpleasantness	61-80	26%	24%	16%	33%	24.75%
Very high unpleasantness	81-100	36%	26%	39%	47%	37%
<b>Total</b>		<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	

The unpleasantness was ranked from lowest indicating no unpleasantness to the highest indicating very high unpleasantness. From the Table 2 above, very high unpleasantness was selected by majority of the respondents across all the four post-mine sites. More than 60% of the respondents across the four post-mine sites rated the visual unpleasantness to be high to very high with ranges between 61-80 and 81-100 respectively. This confirms the findings of the on-site observation during the site visits that revealed this through the waterlogged nature, visible rugged landscapes, untamed vegetation and uncontrolled dumping of wastes. Very few respondents across the four sites felt that there was no unpleasantness as a result of the four post-mine sites at the time of the study. This finding can be attributed to the respondents who lived far away from the post-mine boundaries who were not aware of any dumping and other negative attributes of the sites that those who interacted closely with the sites were well aware of.

## DISCUSSION

The study sought to assess the effects of the post-mine brownfields in terms of social effects and effects on the visual quality. Social effect was studied in terms of community perception of crime and other social evils. The four sites had varying depths from 3 metres to 15 metres that posed great risk and danger of presenting possible hideouts for crime and other social evils. According to Buckley & Mason (2012) studies have long linked high crime rates to areas that have visible physical deterioration. Other authors ( Tsolaki-Fiaka et al., 2018; Baczynska et al 2018; Redondo-Vega et al. 2017; Martinat et al (2016); Legwaila et al., 2015; Nita, 2012) stressed the problems attributed to disused, abandoned state of the quarry lands that they presented to the neighborhoods within which they are located. The post-mine brownfields in this Kisumu case study were

overgrown with untended vegetation and filled with trash from illegal dumping. At the time of the study, there were concerns by the County Government of Kisumu on the need for sustainable mining and as well as rehabilitation of abandoned quarry lands. At the time of the study all the four post-mine sites exhibited abandoned, disused, neglected nature that posed security threat to the immediate residents and the neighborhood at large. The four post-mine brownfields in this study had overgrown untamed vegetation, with wastes from illegal uncontrolled dumping.

Visual analysis for this study was based on the spatial attributes of the quarry and its impact on the immediate surroundings. The spatial attributes and that of immediate surrounding were analyzed in terms of presence/extent of dumping of wastes, untamed vegetation, visible rugged landscape and swampy water logged nature. The relative distance of the respondents' residence to the post-mine was considered. The relative distance from the boundary of the sites revealed varying responses from the residents. Simpson (1979) posit that public attitude about abandoned mines is influenced or should be influenced by the visibility of the mines. According to Legwaila et al. (2015) aspects of landform that impact on landscape quality in abandoned mine lands include rock exposure, soils and terrain (slope and elevation) while properties of visual quality is in terms of colour, line, texture, form and scale. These authors stress the fact that the main components of quarry landform present safety and visual quality challenges. They cause contrast in form and colour between the quarry landform and the nearby undisturbed landscapes (Legwaila et al., 2015). Migosi and Nyawita post-mines have been surrounded by residential houses and the only open areas around the quarry pits are the undeveloped plots but the respondents were aware of its presence and felt it had negative visual impact on aesthetic value of the immediate surroundings. Kanyawegi post-mine was screened by vegetation and by the high topography of the quarried area. Wathorego post-mine was screened by vegetation on one end that is on the high topography while the other sides were exposed to nearby access roads and were not screened off with vegetation. Majority of the respondents in all the post-mines despite the relative distance from their residence to the abandoned quarries had a feeling that the visual impact negatively affected the aesthetic value of the immediate surroundings.

Baczynska et al. (2018), state that areas of abandoned quarries are an important element of the environment in terms of both their regional and national meaning. Excavated holes left after exploitation of solid rock minerals are characterized by many features resulting into various landscapes. These authors suggest that the main indicator of a quarries' attractiveness is their uniqueness, aesthetic appeal, interest, and the curiosity they raise among the viewers. This leads to classification based on attractiveness in terms of: very attractive, attractive, slightly attractive, and unattractive quarries. These authors established that unattractive quarry landscapes showed little vertical differences, had bad preservation state and had no contrast to the surrounding areas that ensured they remained hardly visible (Baczynska et al., 2018).

Findings for this paper revealed that all the four post-mines were characterized by high exposed, rugged stone walls and untamed vegetation that provided excellent hiding areas both during the day and night hence posing a security threat within their neighborhoods. Majority of the respondents across the four sites rated the visual quality they presented at the time of the study to

be highly unpleasant based on the negative spatial attributes the exhibited. The four abandoned quarries in this study had changes in their landform, texture and this created a contrast between the quarry pit and their surroundings leading to major visual impacts. This confirms the earlier findings by Tsolaki-Fiaka et al., (2018); Legwaila et al., (2015); Sklenicka and Kasparova (2008) on the negative visual impact of post-mine sites on the surrounding landscape that unavoidably lowers the aesthetic value of the landscape and its surroundings. The negative aesthetic value associated with these sites further leads to social stigma for such areas (Martinat et al., 2016).

Based on the findings of this study, the authors propose the holistic long term planning for rehabilitation of the existing post-mine brownfields. The authors argue that continued presence of post-mine brownfields without planning for their reuse into beneficial land uses through rehabilitation means the physical and social problems they pose will continue to be felt within their localities. If their present state is not addressed, then the risk of hazards due to accidents, safety threats due to crime, social evils and problems like illegal dumping that impact negatively on the environment will continue to be felt within the neighborhoods they are located in. CABERNET (2012); Koudela et al. (2004) state that post-mine brownfields reduce an area's intensity for beneficial and productive land uses. This negatively impact on the local neighborhood and the urban economy at large. The notion that these sites in their abandoned state are scars on the face of cities, are liabilities that degrade the value of the surrounding land and are barriers to local development (CABERNET, 2005) should be reversed and mitigated through rehabilitation that allows for appropriate reuse land use options. Rehabilitation to eliminate their negative effects so as to achieve social acceptance, environmental sensitivity, and economic gain should be prioritized. If not done, environmental stigma associated with these sites continues and the urban landscape in general suffers.

## CONCLUSION

The study has drawn conclusion that different residents within the post-mine boundaries had different perception regarding the social effects and effect on visual quality that they posed within the neighborhoods. Those farther away from the post-mine sites but within the study radius did not feel the sites were a security threat that aided in committing crime and other social evils unlike those who lived closest and had regular interaction with the abandoned and neglected spaces. The negative attributes that can aid in committing various social evils should be addressed through long term planning for reuse through rehabilitation. The brownfield land owners should address short term problems caused by untamed vegetation to eliminate possible hideouts that aid in committing various crimes and other social evils within the neighborhoods. Planning for long term reuse through beneficial and productive land uses would overcome the current negative attributes such as abandoned nature, untamed vegetation and deep depths that the survey findings revealed posed security threats and were contributing to negative visual quality within the neighborhoods.

All the negative spatial attributes like water logging, deep depths, and untamed vegetation for the four post-mine sites should be addressed to convert them into positive attributes that are beneficial for the preferred reuse options when planning for rehabilitation. Addressing these negative spatial attributes leads to elimination of the negative effects they pose within these neighborhoods. The

study recommends that all the four abandoned post-mine sites should have their untamed vegetation managed to avoid possible hideouts that may be security threats. Water logging prevalent in all of the should be addressed by planning for proper storm water management within and around them for the preferred reuse option to be successful and to reverse and eliminate the current problems associated with this negative attribute.

Visual unpleasantness across the four post-mine sites that was supported by majority of the respondents should be addressed. Those who lived closest to the post-mine sites felt the negative attributes more than those who lived farther away and were not aware of such acts as uncontrolled use of the sites to dump wastes. Addressing long term solution to these problem spaces that are currently considered obstacles and barriers to neighborhood development will also address the problem of negative visual quality. Integrating new re-use land uses that are compatible with the existing residential land use will ensure productive and beneficial uses that are visually pleasant to the residents within the neighborhood. There is need for the regional authorities like County Government of Kisumu to have an elaborate database of the various post-mine brownfields within their jurisdiction to aid in planning the rehabilitation into beneficial uses.

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