NWFP Environmental Protection Agency

Environmental Assessment Checklists and Guidelines

Brick Kiln Units

No:	Version: **B**	Date: **21 May 2004**	Page **1** of **20**

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1. Introduction

More than 300 brick kilns are operating in and around Peshawar. Old rubber tyres, low-quality coal, wood and used oil are used in these kilns as fuel. Consumption of these fuels, combined with inefficient combustion process produces a large quantity of hazardous gaseous that is injurious to the health of the community living in the surroundings the kilns as well as the workers of the kiln.

1.1 Scope of Guidelines

These guidelines are applicable to the future developments of brick kiln units in the province of NWFP. It covers both the permanent and temporary brick kilns. The scope of these guidelines do not cover the social issue related to the use of bonded labor in the brick kilns.

1.2 How to use these Guidelines

The project proponent is obliged to use these guidelines. The project proponent has to fill in an environmental impact assessment form. The following steps are to be taken in this regard:

Step 1: Provide information on project [use **Section I**]

Step 2: Determine Applicability (*Are you sure that IEE or EIA is not required?*) [use **Section II**]

Step 3: Describe the physical, biological and social environment [use **Section III**]

Step 4: Assess potential impacts and applicable mitigation measures [use **Section IV**]

Step 5: Provide undertaking to the EPA on mitigation measures and compliance [use **Section V**]

Completed form is to be submitted to the NWFP Environmental Protection Agency for evaluation. NWFP EPA may request for additional information or decide to undertake visit to the proposed project site in order to assess the environmental impact of the proposed project.

1.3 Glossary

Act means the Pakistan Environmental Protection Act, 1997

Contamination introduction of impurities in the environment

Dust are fine powdery material such as dry earth or pollen that can be blown about in the air

Deforestation removal of trees

Environment means (a) air, water and land; (b) all layers of the atmosphere; (c) all organic and inorganic matter and living organisms; (d) the ecosystem and ecological relationships; (e) buildings, structures, roads, facilities and works; (f) all social and economic conditions affecting community life; and (g) the inter-relationships between any of the factors in sub-clause (a) to (f).

Environmental Assessment a technique and a process by which information about the environmental effects of a project is collected, both by the developer and from other sources, and taken into account by the planning authority in forming their judgments on whether the development should go ahead.

Flue Gas smoke or gas coming out of stack or chimney

Impact on Environment means any effect on land, water, air or any other component of the environment and including any effect on the social and cultural environment or on heritage resources.

Mitigation Measure means a measure for the control, reduction or elimination of an adverse impact of a development on the environment, including a restorative measure.

Pollution the presence in the environment or the introduction into it, of substances that have harmful or unpleasant effects

Particulate Matters any particles of dispersed matter, solid, liquid, that are larger than individual molecules

Regulations means the Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environment Impact Assessment Regulations, 2000

Soil Erosion physical removal of soil, either by wind or by running water

2. Industry Profile

There are two types of brick kilns units. The conventional type, the most common type in Pakistan, are those in which the brick kiln owners lease a piece of land for a limited period, usually not extending for more than few years, and establish a kiln on the land. The land is also the source of clay for the bricks. Once the lease period is over the land is returned to its owners. Bricks are also manufactured in more formal industrial units. These usually have gas-fired furnaces and use clay from various locations to produce harder and generally what is considered as better quality bricks. These guidelines are applicable to both types of brick kilns.

2.1 Description

The use of fired bricks goes back more than three thousand years, and bricks are still the preferred house construction material in most countries around the world. The brick kilns in Pakistan is a large user of energy and also employs a large number of workers, due to the labor intensive manual brick-making process. Suitable clays for manufacturing bricks exist almost everywhere, and the brick-making process can be done with simple manual methods. Brick kilns are generally found in clusters situated on the outskirts of main cities and towns.

Firing the bricks, also termed baking, gives them strength and turns the plastic clay irreversibly into a permanent hard material that can no longer be slaked in water. Originally, bricks were fired in clamps or scove kilns. These are not permanent structures, but simply a pile of green bricks covered with a sealing layer of mud, with the fuel placed under the bricks. Later, permanent kilns were used for firing bricks. Both types of kiln are loaded with green bricks, which are heated up to the desired temperature and then cooled again before the bricks can be drawn from the kiln. All the heat energy used for firing is lost during cooling, and such so-called periodic kilns waste energy.

In the late 1800’s a British engineer, W. Bull, designed an archless version of the continuous Hoffmann kiln, which is now called Bull' s trench kiln (BTK). This version and variations are widely used in Pakistan and in the rest of the subcontinent. Its greatest advantage is its low cost of construction and relative to the periodic kiln, a comparatively low energy consumption.

The kiln can be made circular or elliptical in shape. It is constructed on dry land, by digging a trench, 6–9 m wide, 2–2.5 m deep, and 100–150 m long. Gaps are left in the outer wall for easy assess to the trench during setting and drawing of bricks.

The green bricks to be fired are set in rows, two to three bricks wide, with holes in between that allow feeding of coal and a sufficient flow of air through the setting. A linking layer of bricks is made across the width of the kiln and half way up, to stabilize the setting. On top of the bricks, two layers of bricks, covered with ash or brick dust, seal the setting. A large piece of canvas, paper or metal sheet is placed vertically across the brick setting to block air from entering from the wrong side of the chimneys. Chimneys, 6–10 m high, made of sheet metal, are placed on top of the brick setting. The trench contains 200–300,000 bricks at a time.

The firing in a BTK is continuous, day and night. Green bricks are loaded and finished bricks are drawn all the time. The fuel saving is achieved by reusing part of the energy that is otherwise lost in periodic kilns. As shown in **Exhibit 1**, the air for combustion is drawn through the already fired but still hot bricks. The cooling bricks transfer their heat to the combustion air, pre-heating it before it enters the firing zone. After combustion, the hot exhaust gases pass through the yet unfired bricks on their way to the chimneys. This pre-heats the bricks, so less fuel is needed to bring the bricks to the maximum temperature. Once every 24 hours the chimneys are moved forward 5 to 7 m. Daily output is 15–25,000 bricks. In the dryer areas, a BTK with a fixed central chimney is now widely used. A large central flue channel is constructed in the center of the elliptical kiln, and through this, the exhaust gases flow to a brickwork chimney.

Normally, the firing crew consists of six men organized in two teams, who take turns stoking the kiln. The firemen stoke the fire through removable cast iron holes at the top of the brick setting. Ideally, stoking should be done 3–4 times per hour, but especially at night, the workers tend to stoke large amounts of fuel at long intervals, causing an increase in fuel consumption. The firing of the kiln demands great skill, which may take years to master well.

The fuel can be any combustible material or a combination of them; coal, lignite, peat, firewood, sawdust, agricultural waste, such as rice husk, brand or coffee shells. Natural gas or oil can also be used, but such fuel is normally too expensive. In Pakistan too the cheapest of fuels are used in the firing of the bricks. Coal, wood, waste oil, tyres, oily sludge etc all have been reportedly used.

In Pakistan kilns are established either on one’s own land or on land taken on lease. The land is supplied with water, usually from a tube well.

Operations begin with digging the earth. The clay is mixed with water to prepare a paste. *Katcha* (unbaked) bricks are prepared from this paste with the help of moulds. Contract laborers (which sometimes includes their families) carry out this work. This process is followed by baking, locally known as *jalai* (burning). The person involved is called the *jalaiwala*. The final process is called *nikas*, which means carrying the bricks out of the kilns for onward transportation to the markets.

2.2 Environmental Impacts

2.2.1 Inefficient Use of Fuel

Traditional brick production technology requires a great deal of fuel during firing. Inefficient production technologies and techniques and excessive fuel consumption are typical. Some are enumerated below:

- Improper kiln construction leads to excessive air leakage from the kiln system thus increasing the losses
- Small size chimney leads to excessive flue gas temperature to give effective draught.
- Heat loss from the side and top do not allow the attainment of full firing temperature and this leading to deterioration in quality of fired goods.
- Very high loss due to repeated heating of the kiln system because of high thermal mass

2.2.2 Resource Extraction and Depletion

Brick production can alter the landscape in ways that are harmful to the environment and may hamper future business plans. Production can deplete local sources of fuel wood; increase deforestation and associated environmental impacts (such as soil erosion), leaving less wood for future use. It can also create clay pits or 'borrow' areas, which, if improperly managed, can become safety hazards. They may also accumulate rainwater and become breeding grounds for mosquitoes. These effects, with associated soil erosion, may render land unusable for farming.

2.2.3 Inefficient Use of Non-Fuel Inputs

Improper brick formation and low-quality inputs result in a high number of bricks that crack or break during firing and must be discarded. This decreases output and increases waste disposal costs.

2.2.4 Dust

Dust, a byproduct of brick production, may cause serious health problems. Dust is most prevalent and dangerous when clay is extracted and finished bricks are transported following the firing process. Inhaling rock dust can lead to silicosis, a disease that affects lungs and breathing. Silicosis lowers the productivity of workers and can have long term and even fatal effects on the health of workers, owners and people who live close by (including the families of workers and owners).

2.2.5 Other Particulates

Adding pigment to bricks produces chemical wastes that could harm workers, pollute the air and contaminate water supplies. Enameling requires materials that contain metals, and improper handling or excessive contact can lead to metal poisoning, skin irritations or lung disease.

Major product of poor combustion and solid fuel use are particulates in the flue gas. Suspended particulate matter in the moving chimney type of kiln is between 500-2,000 mg/Nm^3, 100-500 mg/Nm^3 in a BTK with gravity settling chamber, and between 50 to 300 mg/Nm^3 in vertical shaft brick kilns. The National Environmental Quality Standards mentions 500 mg/Nm^3 as the limit for coal fired furnaces.

2.3 Mitigation Options

2.3.1 Inefficient Use of Fuel

- Use alternative fuel types. Organic Wastes such as rice husk or sugar bagasse can supplement scarce fuel sources, such as wood without sacrificing efficiency.
- Raise kiln temperature using improved firing techniques. Adding combustible material, such as sawdust or rice husk, around the bricks can increase temperature and lower traditional fuel needs.
- Include a properly designed chimney of minimum 120 feet height along with an integral gravitational settling chamber. Design flue ducts so as to provide the least amount of resistance to the flue gases.
- Maintain kiln structures and repair cracks or leaks. Even small leaks can substantially increase fuel costs over time. Monitor structure and machinery to identify potential leaks.

2.3.2 Resource Extraction and Depletion

- Consider planting fast-growing tree species that can be coppiced easily to maintain a source of fuel.
- Return land to usable state. Set topsoil aside before removing clay and replace it after production ends. If, the topsoil has been lost or dispersed, fill the borrow pit with soil to avoid creating pools of water that attract mosquitoes.

2.3.3 Inefficient Use of Non-Fuel Inputs

- If little or no machinery is used, consider low-cost technology improvements. Decrease losses during firing by improving brick preparation: use an extruder to process clay, or form bricks with manual presses.
- Improve input quality. Bricks that crack during firing may have too much organic material in them or too much topsoil mixed in with clay. Train workers in identification of clay, and monitor quality control regularly.
- Consolidate or remove brick once production ends. This waste may be scattered over a large area and impede future farming activities. Investigate possible uses of broken or burnt brick for construction and other processes.

2.3.4 Dust

- Provide workers with facemasks and instruct them to use masks in high-dust operations.
- Dampen bricks to keep dust down.

2.3.5 Other Particulates

- Improve storage practices. Close containers containing enameling material to prevent product loss through evaporation, spoilage or spills, and to minimize workers' exposure to fumes.
- Require workers to wear masks when they are using enameling chemicals.

- Ventilate kilns after firing. Dangerous gases and fumes escape during the firing process and can sicken workers removing bricks.
- Increase chimney heights to around 35 m.

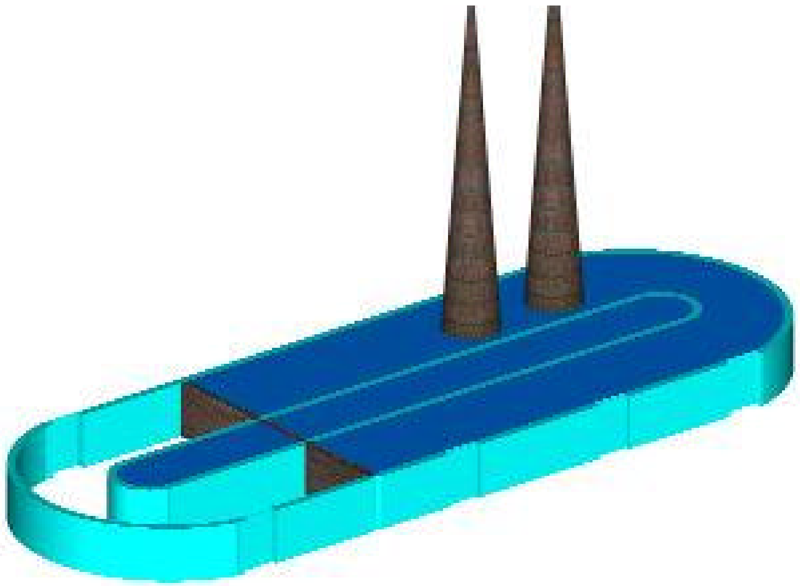

Exhibit 1: A Typical Bull' s Trench Kiln (BTK)

Environmental Assessment Checklist

Section I: Project Description

File No ______________________________ (To be filled by EPA)

Date ______________________________

General Information

1. Project Name or Title ______________________________
2. Project Proponent (Department or Organization) ______________________________
3. Address ______________________________
4. Telephone ______________________________
5. Fax ______________________________
6. E-mail ______________________________
7. Representative of the Proponent ______________________________
8. Designation ______________________________
9. Name of the person who conducted this assessment ______________________________
10. Designation ______________________________
11. Qualification ______________________________

Permanent Brick Kilns

Project Information

12. Project Location ______________________________
13. Cost of the Project ______________________________
14. Area of the proposed land for the project
    Total ______________________________ m^2
    Proposed covered ______________________________ m^2
    Open space ______________________________ m^2
15. List key equipment of the plant ______________________________
    ____
    ____
    ____

16. Brief Project Description ______________________________
____
____

Please attach a plot plan of the proposed project site showing the location of the key structures, access, utilities, units, etc.

17. Design production capacity of the unit ______________________________
18. Number and type of qualification of required staff to run the project? ________
____
19. What will be the expected water requirement for the project? __________ m^3/d
20. What is the proposed source of water? ______________________________
21. Where the wastewater from the unit be disposed? ______________________
22. Please describe any treatment system for the wastewater planned? _________
____
23. What is the height of the proposed stack? ____________________________ m
24. What will be the daily consumption of various fuel? ______________________
____
25. What will be the source of clay? ______________________________

Construction

26. Who owns the proposed land for the project? ______________________
27. What is the present use of the land? ______________________________
28. Are there any squatter settlements on the land? ______________________
    If yes, please specify
    Number of settlements ______________________________
    Will any compensation be paid to them? ______________________________
29. Are there any structures on the proposed site now? ☞ Yes ☞ No
30. If yes, will any structure be demolished? ☞ Yes ☞ No
31. If yes, where the demolition waste will be disposed? ______________________
32. Are there any trees on the proposed site? ☞ Yes ☞ No
33. Will any tree be removed? ☞ Yes ☞ No
    If yes, how many? ______________________________
34. Period of construction (start and end dates) ______________________________
35. What major construction equipment (dozer, grader, crane, etc.) will be used?
____
36. Is construction work during the night planned? ☞ Yes ☞ No

Temporary Brick Kilns

Project Information

37. Project Location ____
38. Brief Project Description ______________________________________
    ____
    ____

Please attach a plot plan of the proposed project site showing the location of the key structures, access, utilities, units, etc.

39. Design production capacity of the unit ___________________________
40. Number and type of qualification of required staff to run the project? ________
    ____
41. What will be the expected water requirement for the project? __________ m^3/d
42. What is the proposed source of water? ____________________________
43. Where the wastewater from the unit will be disposed? ________________
44. Please describe any treatment system planned for the wastewater? _________
    ____
45. What is the height of the proposed stack? __________________________ m
46. What will be the daily consumption of various fuel? ___________________
    ____
47. What will be the source of clay? ___________________________________
48. Who owns the proposed land for the project? _______________________
49. Total period of lease ____
50. Total area of the proposed land for the project ______________________ m^2
51. To what depth the clay will be removed? ___________________________ m
52. What is the present use of the land? _______________________________
53. Are there any structures on the proposed site now? ☞ Yes ☞ No
54. If yes, will any structure be demolished? ☞ Yes ☞ No
55. If yes, where the demolition waste will be disposed? __________________
56. Are there any trees on the proposed site? ☞ Yes ☞ No
57. Will any tree be removed? ☞ Yes ☞ No
    If yes, how many? ____
58. Period of operation (start and end dates) ___________________________
59. Is operations work during the night planned? ☞ Yes ☞ No

Section II: Screening

Is the proposed project located in an ecologically sensitive area?:

☞ Yes ☞ No

If the answer to the above questions is yes, then the project would require an initial environmental examination or an environment impact assessment. Refer to the Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environment Impact Assessment Regulations, 2000 for appropriate category.

Section III: Environmental Profile

1. Describe the terrain of the project area:
   - ☞ Flat or Level (Slope < 3%)
   - ☞☞ Level to moderately steep (Slope 3%-30%)
   - ☞☞ Moderately steep to mountainous (Slope > 30%)
2. Are there signs of soil erosion or landslide anywhere within 500 m of the proposed site?
   - ☞☞ Yes
   - ☞☞ No

   If yes, please describe (where, nature)________________________________

   ____
3. Is there any surface water body (river, canal, stream, lake, wetland) within 1,000 m of the proposed site?
   - ☞☞ Yes
   - ☞☞ No

   If yes, describe each water body:

Name (including type, ie, river, canal or stream)	**Dimensions**	**Status and Uses** (Is it polluted? Is domestic or other wastewater discharged to it? What are its uses, eg, agriculture, domestic, industrial, washing, fishery

4. Is there any groundwater well on the proposed site or within 500 m of the proposed site?

☞☞ Yes

☞☞ No

If yes, describe each well:

Type (Dug well, tube well, hand pump) **and Energy Source** (Electricity, diesel engine, animal driven, manual)	**Location** (Village, road, mohalla, etc. and distance from the site)	**Depth and Yield**	**Uses** (Drinking, agriculture, domestic, industrial, washing, livestock)

5. Based on the interview of the surrounding population or a wildlife expert, is any form of wildlife found on, or around the proposed site of the project?

☞☞ Yes

☞☞ No

If yes, please describe ____

____

6. Are there any existing trees or vegetation on the proposed site?

☞☞ Yes

☞☞ No

If yes, how many?____

7. Are there any reserved forest or protected area within 1,000 m of the proposed site?

☞☞ Yes

☞☞ No

If yes, please describe? ____

8. What is the present land use in the vicinity (roughly a radius of 500 m) of the proposed site?

	Residential (Thick, Moderate, Sparse)	**Commercial** (Office, Shops, Fuel Stations)	**Open Land** (Parks, Farmlands, unutilized plots, barren land	**Sensitive Receptors and Sites of Cultural Importance**	**Other**
Description					

(*Please attach a map of the proposed project site and indicate roughly the area that you have considered for this evaluation*)

9. For any agricultural farmland on the proposed site and a radius of 500 m around it, provide the following information:

   Main crop(s) and average yield ______________________________

   Source of irrigation water ______________________________

   Area affected by salinity or water logging ______________________________

10. Please describe all the sensitive receptors within 500 m of the proposed site:

Type (schools, colleges, hospitals, and clinics)	**Name**	**Size** (Number of students or number of beds)	**Location** (Village, road, mohalla, etc.)	**Distance from Site**

11. Roughly, how many houses are within a radius of 500 m of the proposed site?

    ____

12. What proportion of the houses in the area are *pukka, semi-pukka, and* kutcha?______________________________

13. How are the general hygienic conditions of the project area?

    ☞☞ Generally clean

    ☞☞ Fair

    ☞☞ Poor

14. Is there any bad odor in the project area?

    ☞☞ Yes

    ☞☞ No

    What is the source of the odor? ______________________________

15. What are the main sources of income of the surrounding community? ______

    ____

16. Is there any site of cultural importance (graveyard, shrine, mosque, archeological site) within 1,000 m of the proposed scheme?

    ☞☞ Yes

    ☞☞ No

    If yes, please describe? ______________________________

17. What other main sources of pollution exist within a radius of 500 m of the proposed site:

Name of the Source	**Type of Pollution** (Noise, air water)	**Location** (Village, road, mohalla, etc.)	**Distance from Site**

Section IV: Impact Assessment

Potential Negative Environmental Impacts	*Tick, if relevant*	*Mitigation Measures*	*Tick, if proposed*	*Monitoring*
Inefficient use of fuel	☞	Alternative fuel types such as organic wastes (rice husk or sugar bagasse) will be used.	☞	
		Kiln temperature will be raised by using improved firing techniques such as adding combustible material (e.g. rice husk or sawdust) around the bricks	☞	
		A properly designed chimney of minumum 120 feet height along with an integral gravitational settling chamber will be included. Flue ducts will be designed so as to provide the least amount of resistance to the flue gases	☞	
		Kiln structures will be maintained and cracks or leaks will be repaired.	☞	
		Kiln structures that requires less fuel such as Ventilated-shaft brick kilns (VSBKs) or bull trench kilns (BTKs) will be used.	☞	
		Filters will be installed in chimneys	☞	
Resource extraction and depletion	☞	Fast-growing tree species will be planted that can be coppiced easily, such as Leucaena or Albizia, to maintain a source of fuel	☞	

Continued…

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Potential Negative Environmental Impacts	*Tick, if relevant*	*Mitigation Measures*	*Tick, if proposed*	*Monitoring*
		Land will be returned to usable state by setting topsoil aside before removing clay and it will be replaced after production ends. If, the topsoil has been lost or dispersed, the borrow pit will be filled with soil to avoid creating pools of water that attract mosquitoes	☞	
Inefficient use of non fuel chemiclas	☞	Losses during firing will be decreased by improving brick preparation: using an extruder to process clay, or forming bricks with manual presses	☞	
		Input quality will be improved (Bricks that crack during firing may have too much organic material in them or too much topsoil mixed in with clay). Workers will be trained in identification of clay, and quality control will be monitored regularly.	☞	
		Brick waste will be collected and removed once production ends. Possible uses of broken or burnt brick for construction and other processes will be investigated.	☞	
Dust	☞	Workers will be provided with facemasks and they will be instructed to use masks in high-dust operations	☞	
		Bricks will be dumpen to keep dust down	☞	

Continued…

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Potential Negative Environmental Impacts	*Tick, if relevant*	*Mitigation Measures*	*Tick, if proposed*	*Monitoring*
Chemical pollution	☞	Storage practices will be improved such as containers containing enameling material will be closed to prevent product loss through evaporation, spoilage or spills, and to minimize workers' exposure to fumes	☞	
		Workers will be required to wear masks when they are using enameling chemicals	☞	
		Kilns will be ventilated after firing (Dangerous gases and fumes escape during the firing process and can sicken workers removing bricks)	☞	

Section V: Undertaking

I, ________________________________ (*full name and address*) as proponent for ________________________________ (*name, description and location of project*) do hereby solemnly affirm and declare:

1. The information on the proposed project and the environment provided in Forms I, II and III are correct to the best of my knowledge
2. I fully understand and accept the conditions contained in the Guidelines for ____ (*name, number and version of the guidelines*)
3. I undertake to design, construct and operate the project strictly in accordance with the project described in Form I, submitted with this undertaking.
4. I undertake to implement all mitigation measures and undertake monitoring stated in Form IV, submitted with this undertaking.

Date _______

Signature _____________________

Name _____________________

Designation _____________________

(with official stamp/seal)

Witnesses:

	Signature	Name	Address
1	_____________	_________________	_______________________
2	_____________	_________________	_______________________