

ANNEX T-3

TEMPLATE: FUMIGATION MANAGEMENT PLAN (FMP) FOR PHOSPHINE FUMIGATION OF FOOD COMMODITIES IN SHEETED STACKS

About FMPs. Fumigation Management Plans (FMPs) are widely recognized fumigation good practice, and are mandatory in the US. They are written documents that provide specific logistical, performance and contact information to better assure that fumigation follows systemic planning and execution for efficacy and safety.

FMP Requirements for USAID Partners. As described in Annex T-1, fumigation compliance requires USAID partners to complete a Fumigation Management Plan (FMP) for EACH fumigation event, and to keep these FMPs on file for 2 years. Compliance further requires that the plan and the fumigation event itself substantively confirm with the FMP template that follows. **In areas where Partners make substantial changes to the FMP template provided herein, they must submit the proposed changes to USAID for approval.**

Modifying this template. USAID partners must review this FMP template for compliance with local requirements and adjust accordingly. Other adjustments to local circumstances and capabilities are possible. *However*, any substantive changes must be requested in the Food Assistance Program's PERSUAP (the template for which is provided as Annex T-2 to this PEA) or subsequently in writing to the Food Assistance Program's AOR, who will forward for clearance to the DCHA Bureau Environmental Officer.

Purposes of this FMP template. This FMP template is NOT:

- A substitute for training in phosphine fumigation.
- A how-to manual for phosphine fumigation.
- Applicable without significant modifications to the fumigation of whole structures, containers, or vehicles.

This FMP template IS intended to very substantially reduce the effort required by USAID partners to develop a compliant FMP, and to conduct compliant (and therefore safer and more effective) fumigation of food commodities in sheeted stacks.

More specifically, this FMP template is a succinct summary of acceptable technical practice for phosphine fumigation of USAID-funded Food Commodities in sheeted stacks in a form that: (1) guides a trained fumigator to produce safe and efficacious results, (2) allows a USAID partner to better oversee their fumigation services provider; and (3) supports fumigation compliance reporting required by Food Aid Program PERSUAPs.

This template FMP embodies the acceptable technical practices for fumigation set out in annex T-7.

Key sources:

van Someran Graver, J. E. 2004. *Guide to Fumigation Under Gas-Proof Sheets*. Food and Agriculture Organization of the United Nations. Produced by the Australian Centre for International Agricultural Research, Canberra, Australia. Available at

http://www.fao.org/inpho_archive/content/documents/vlibrary/ad416e/FAOHomeIndex.htm (on-line e-book; includes accompanying videos) and

<http://http://aciarc.gov.au/files/node/543/FAO%20full%20text.pdf> (print-ready PDF).

“Standard Operating Procedure for Contractors Undertaking Phosphine Fumigation and Insecticide Spraying in WFP Stores” (Nov 2003 revision). World Food Program. Available at:
http://documents.wfp.org/stellent/groups/public/documents/manual_guide_proced/wfp254885.pdf.

“North Dakota Fumigation Management Plan Intermediate to Large Operations” North Dakota State University Department of Agriculture. Available at
<http://www.ag.ndsu.nodak.edu/aginfo/pesticide/pdf/fum/FMP%20int-lg.pdf>

Proper Disposal of Animal Carcasses in Michigan: An Industry Guide to the Bodies of Dead Animals Act. Michigan Department of Agriculture, Lansing, Michigan. Available at
http://www.michigan.gov/documents/MDA_BODA_80099_7.pdf.

Rodent Control: How to Use Rodent Traps and Bait Stations. Public Health Seattle & King County. Environmental Health Services, Seattle, Washington. Available at :
www.kingcounty.gov/healthservices/health/ehs/~/.RatTraps.ashx.

Dead Animal Disposal. Indiana State Board of Animal Health. Available at
<http://www.in.gov/boah/2369.htm>.



USAID Food Assistance Program Name:

PHOSPHINE FUMIGATION MANAGEMENT PLAN (FMP) (SHEETED STACKS ONLY)

**THIS FMP TEMPLATE PROVIDES A STEP BY STEP PROCESS TO
ENSURE SAFE AND EFFECTIVE FUMIGATION AND TRAIN
FUMIGATION PERSONNEL**

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COMMODITY AND OWNERSHIP

PLANNED FUMIGATION DATES:

A. OVERALL PROGRAM & CONTACT INFORMATION

Lead Awardee	
Program Name	
Fumigation Compliance Lead	
Compliance Lead Contact Information	

ATTENTION:
To ensure full safety and efficacy, completion of this FMP is mandatory for each fumigation event.*

***Some information may remain the same across fumigation events.**

B. FACILITY INFORMATION

Name of Facility	
Location	
Responsible Manager (Name, Organization & Title)	
Contact Information	

C. FUMIGATOR INFORMATION

Lead Fumigator	
Organization	
Contact Information	
Certification # & Expiry Date (if any)	

D. COMMODITY TO BE FUMIGATED

Commodity(ies) & Amount in tons (est) (e.g. maize 200mt)	
Owner of	

E. FUMIGANT PRODUCT INFO & DOSAGE

E1. Fumigant (product name/description)	
E2. Ambient Temp (Expected indoor temp range)	
E3. Quantity Req'd	

D. COMMODITY TO BE FUMIGATED

commodity	
How commodity is packaged	
# of stacks & size (e.g., 4 stacks 3m X 2m X 2m)	
Last fumigation	Enter date if known. Otherwise, enter "unknown"
Condition	Moldy? Visibly infested?
Moisture %	
Purpose of Fumigation	

E. FUMIGANT PRODUCT INFO & DOSAGE

E4. Required time @ concentration* (e.g. 7 days @ 200ppm)	
E5. Planned downtime* (Days + hours, includes aeration.)	

***REQUIRED:**
DOCUMENT CALCULATIONS E3, E4 & E5 IN ANNEX #A. NOTE THAT EFFECTIVE PHOSPHINE FUMIGATION TYPICALLY REQUIRES 7-10 DAYS. .

EMERGENCY PLANNING AND SAFETY**F. CONTACT INFORMATION: MEDICAL FACILITY, EMERGENCY RESPONSE AUTHORITIES**

	LOCATION	TELEPHONE
Police		
Fire Service		
Clinic/Hospital		
Other Local Authority (specify Port Authority, District Council, Chieftaincy, etc.)		
Pesticide Regulatory Authority		
Chief of Party (or commodity point of contact)		

GI. ADVANCE NOTIFICATION PLAN FOR ABUTTERS

Specify the procedures for notifying those living and working within 100m of the facility. The fumigation team needs to alert relevant entities, particularly households, about fumigation activities.

G2. ADVANCE NOTIFICATION PLAN FOR LOCAL AUTHORITIES

Specify the procedure for notifying local authorities, as required or agreed with these authorities.

H. EMERGENCY RESPONSE PLAN

Describe the procedure to be followed if phosphine concentrations exceed (1) 0.3ppm (or local TLV, if more stringent), or (2) 1 ppm (or local STEL, if more stringent) (TLV= threshold limit value; STEL = short term exposure limit. See PEA Annex T-9).

I. FUMIGATION PLAN & EXCLUSION ZONE

REQUIRED ACTION:	Y	N	CONFIRMING INITIALS
11. Obtain plot or make scale sketch map of facility and surroundings. (note grid paper is provided as final page of this template)			
12. Mark locations of stacks to be fumigated.			
13. On plot, mark exclusion zone that maintains at least a 6M perimeter from stacks to be fumigated, and which INCLUDES buildings or rooms with walls common to the room in which the stack is being fumigated. An exception must be requested if the exclusion zone cannot be maintained.			
14. Determine if a watchman or watchmen will be required to maintain the			

exclusion zone. If yes, inform the facility manager immediately.			
15. On plot, mark shut-off points for electricity, water, gas, if any.			
16. On plot mark doors/gates to be secured to enforce exclusion zone and locations of warning signs to be posted.			
17. On plot, mark locations of hazard monitoring (at least 3 locations just outside exclusion zone, where gas is mostly likely to accumulate).			
18. On plot, mark locations of phosphine trays and monitoring lines.			
19. Attach plot to this Fumigation Management Plan as Annex #F			

J. COMMUNICATION AND TRAINING

REQUIRED ACTIONS	Y	N	CONFIRMING INITIALS
J1. Fumigation team reviews product label , MSDS, and applicator/product manual. Lead applicator provides detailed verbal briefing if required.			
J2. Lead applicator briefs the team regarding the symptoms of phosphine poisoning and first aid. (See Fumigation PEA Annex T-10)			
J3. Lead applicator briefs the team regarding the planned fumigation process with reference to the site plot (I10) WITH FACILITY MANAGER PRESENT			
J4. Lead applicator briefs the team & facility manager on EMERGENCY RESPONSE PLAN (H1) & roles and responsibilities for implementing the plan are agreed.			
J5. All employees engaged in fumigation instructed on the use, impact, and mitigation measures of phosphine fumigation.			

EQUIPMENT AND SUPPLIES

K. NUMBER OF SHEETS, SAND SNAKES AND TRAYS REQUIRED

REQUIRED ACTION:	QUANTITY REQUIRED
K1. Determine number of fumigation sheets required (note that joining sheets requires a <u>1(one) meter</u> overlap, tightly rolled & then clipped or weighted. If clips are used, they must be applied every 20cm.) <i>(Indicate number & size of sheets, standard 18meterX12meter sheets preferred)</i>	

K2. Determine length of sand snakes required (double rows must be used) (<i>in meters</i>)	
K3. Determine number of phosphine tablet trays required	

L. CONDITION, QUANTITY & ADEQUACY OF EQUIPMENT & SUPPLIES

FUMIGATION MAY NOT PROCEED UNLESS ALL ANSWERS ARE “YES”

CONFIRM THAT:	Y	N	CONFIRMING INITIALS
L1. Required quantity of sheets (K1) meeting specifications (M1) are available			
L2. Required length of sand snakes (K2) are available			
L3. Required number of tablet trays (K3) are available			
L4. Respiratory equipment and protective gear meeting specifications (M2) are available FOR THE FULL TEAM and all personnel can achieve a complete face seal. No one enters the fumigation area without protective gear.			
L5. (1) <u>Dry, clean cotton gloves</u> in good condition; (2) rubber boots; (3) liquid-tight coveralls are available FOR THE FULL TEAM			
L6. Detection (monitoring) equipment meeting specifications (M3) is available to monitor HAZARD			
L7. Detection (monitoring) equipment meeting specifications (M3) is available to monitor EFFICACY			
L8. Warning signs (placards) IN APPROPRIATE LANGUAGES and WITH APPROPRIATE PICTOGRAMS and compliant with host country regulations (if any) are available in quantity required by plot (I6)			
L9. Required quantity of fumigant (E3) is available			

M. SPECIFICATIONS FOR SHEETS, RESPIRATORY & DETECTION EQUIPMENT

M1. FUMIGATION SHEETS	M2. RESPIRATORY PROTECTION
<p>Sheets must be:</p> <ul style="list-style-type: none"> resistant to ultraviolet light tear-resistant along BOTH length and width of material impermeable to phosphine (gas loss must be less than 1 mg/day/m²) in good condition with ALL holes and 	<p>Properly maintained canister-type full facemask respirator. The canister must (1) be rated to protect against phosphine, (2) not expired, (3) not damaged, and (4) canisters previously used must not be opened more than 6 months ago & not have exceeded their rated time-in-use.</p> <p>OR</p> <p>Properly maintained self-contained breathing apparatus.(SCBA)</p> <p>Other varieties of respiratory protection may be acceptable, see</p>

<p>tears mended with material-specific adhesive and patch.</p> <ul style="list-style-type: none"> light enough to carry (200-250g/m²) a full standard-size (18mX12m) sheet <p>250-micron (0.25mm) thickness PVC sheet, PVC on a nylon or terylene scrim, or multi-layer thin-film laminates are all acceptable.</p> <p>Thin coatings on widely woven materials and annealed polypropylene sheets NOT acceptable.</p>	<p>PEA Annex T-9.NOTE. <u>Canister/cartridge type respirators are NOT adequate to enter a fumigation enclosure (e.g. go into a sheeted container)</u></p>
M3. MONITORING EQUIPMENT	
<p>All equipment must be properly calibrated and maintained. Detector tubes, if used, must NOT be expired. Efficacy monitoring equipment must be able to read in the 200-500ppm + range. Hazard monitoring equipment must be able to accurately read in over the 0.3-3ppm + range.</p> <p>See PEA Annex T-9 for more information</p>	

N. RESPIRATORY AND DETECTION EQUIPMENT			
Required Action: Complete log of all Respiratory and Detection Equipment.			
DESCRIPTION <i>e.g., Canister Respirator</i>	MANUF & MODEL #	MANUF DATE (IF KNOWN)	SERIAL NUMBER

**Note: advance notice of 24 or more hours may be required by country laws or regulations.*

APPLICATION AND MONITORING

O. SUITABILITY OF FACILITY, STACKS AND TEAM FOR FUMIGATION			
BY FOLLOWING THESE STEPS, MANADATORY FUMIGATION WILL BE SAFE AND EFFECTIVE. FUMIGATION MAY NOT PROCEED UNLESS ALL CRITERIA ARE MET.			
MANDATORY STEPS. CONFIRM THAT:	CRITERION IS. . .		CONFIRMING INITIALS
	MET	NOT MET	
O1. Commodities being fumigated are not required for use before the end of the planned down time (E5) + 1 day			

O2. Expected temperature during the fumigation period will be 15°C or above.			
O3. Stacks are NOT built around pillars or against walls, and that there is sufficient clearance (1m) around each stack to effectively sheet and seal.			
O4. Surface issues: EITHER (1) the floor under <u>and for 1 (one) meter around stack</u> is crack-free concrete OR (2) the stack is placed on top of intact fumigation tarps. (If multiple tarps are used, they must be joined by tightly rolling a 1m overlap & weighting or clipping the join).			
O5. The marked exclusion zone (see I3) can be maintained for the duration of the fumigation (7-10 days or more). (Exclusion = no people EXCEPT for fumigation personnel with proper breathing equipment in this zone.)			
O6. A <u>trained</u> 2-person (or larger) team is available for application of fumigant and aeration and the team holds any required country licenses.			
O7. If watchmen are required to maintain the exclusion zone, they will be available over the entirety of the fumigation period, including aeration time.			
O8. The warehouse contains only the commodity to be fumigated.			

P. WARNING SIGNAGE AND SECURITY

REQUIRED ACTIONS	Y	N	CONFIRMING INITIALS
P1. <u>Notify Abutters</u> per Notification Plan (G1). In particular, ensure that nearby residents have been informed of activity,			
P2. <u>Notify Workers</u> and any others with customary access to the exclusion zone. Brief on emergency response plan (H1)			
P3. If applicable, execute Local Authorities Notification Plan (G2)*			
P4. Post <u>warning signage</u> at all points indicated by fumigation plot (I6)			
P5. Assure that doors are ready to be locked. (Locks and keys available)			
P6. Assure that watchmen are on-site, if required to maintain the exclusion zone.			

Q. PLACING SHEETING AND COVERING STACKS

REQUIRED ACTIONS IN EXACTLY THIS ORDER	Y	N	CONFIRMING INITIALS
Q1. <u>Position sheets.</u> Carry, do not drag the sheets into position			
Q2. <u>Cover stacks.</u> Unfold the sheets towards the stack. Place the sheet over the stack and position with 1 (one) meter of sheet lying on the ground. Unroll the sheet to cover the entire stack. If more than one sheet is used, join the sheets. Joins require a 1(one) m overlap, tightly rolled, and then clipped every 20cm or weighted.			

Q3. <u>Set sand snakes.</u> Smooth out any wrinkles and folds in sheets, and then place two rows of sand snakes on the sheets along the sides of the stack. Ensure that a good seal is achieved along the whole length and take special care at the corners.			
Q4. <u>Place monitoring lines.</u> Place two monitoring lines from the top and one from the bottom of each stack for efficacy monitoring. Cut small holes to insert tubes and seal holes in gas sheets with tape. Gas monitoring lines should extend outside of the exclusion area. Place duct tape over the free tube ends, except when measuring gas concentrations. Tubes MAY NOT be located near placement positions for phosphine tablets.			

R. APPLYING FUMIGANT

ATTENTION: PHOSPHINE GAS BEGINS FORMING AS SOON AS THE AIR-TIGHT PACKAGING OF PHOSPHIDE PELLETS/TABLETS IS OPENED. IT IS A DEADLY POISON. IT IS FLAMMABLE. CONTACT OF PHOSPHIDE WITH WATER WILL CAUSE FIRE OR EXPLOSION. SMELL IS NOT A RELIABLE INDICATOR OF DANGER.

REQUIRED ACTIONS IN EXACTLY THIS ORDER	Y	N	CONFIRMING INITIALS
R1. Watchmen go on duty (if required to maintain the exclusion zone) & remain OUTSIDE the zone until aeration is complete (W9)			
R2. Verify ONLY personnel involved in fumigation are in the exclusion zone			
R3. Turn off electric lights & any sources of sparks			
R4. Ensure that all fumigation personnel are wearing PPE, <u>including respirators</u> , as per L4 & L5			
R5. Lay out the trays for aluminum phosphide tablets/pellets around the stack. Remove the sand snakes that hold down the sheets next to the trays.			
R6. Distribute UNOPENED tablets/sachets next to the trays			
R7. Position tablets/pellets in a single layer on each tray. To avoid fire risk, do not pile tablets or pellets. Slide trays under the sheets and replace the sand snakes. To minimize worker exposure to gas being released, placement of trays should be completed within 15 minutes. Work from the back of the stack towards the exit doors. Pellets may NOT touch bagged commodities.			
R8. Assure all opened tablets/pellets are used			
R9. Leave the warehouse and lock ALL doors			

S. MONITOR GAS CONCENTRATIONS FOR EFFICACY AND HAZARD & LOG RESULTS

REQUIRED ACTIONS	Y	N	CONFIRMING INITIALS
S1. <u>Hazard Monitoring</u> . 1 hour, 2 hours, 4 hours & 24 hours after applying fumigant, and every 24 hours thereafter, monitor for hazard at all points designated on the fumigation plot (I7). Record results on attached log (#D).			
S2. <u>Hazard Monitoring Response</u> . If concentrations exceed 0.3ppm (or the local TLV,* if more stringent), assure that individuals move through the area only in passing. If concentrations exceed 1.0ppm (or the local STEL, if more stringent) evacuate the area. NOTE ANY SUCH ACTIONS IN EXCEPTIONS LOG (#C).			
S3. <u>Efficacy Monitoring</u> : Monitor EACH monitoring line 24 hours after fumigation application; every 24 hours thereafter. Monitor within stacks to confirm it was an effective fumigation application. Record results in attached logsheet (#E). NOTE ANY EXCEPTIONS IN LOG.			
S4. <u>Efficacy Monitoring Response</u> . If concentration does not reach or falls below 200ppm before additional fumigant may be added <u>IF SCBA apparatus are used</u> . NOTE ANY SUCH ACTIONS IN EXCEPTIONS LOG (#C).			

*threshold limit value. **short-term exposure limit see PEA Annex T-9.

T. CERTIFY FUMIGATION COMPLETE OR ABORTED

REQUIRED: CERTIFY WHICH OF THE FOLLOWING APPLIES.	✓	REQ'D TIME @ CONCENTRATION e.g. 200 ppm @ 7 days
T1. Efficacy monitoring results show that the required phosphine gas concentration was sustained over the required period in each stack		(Copy from E4)
T2. Efficacy monitoring results show that the required concentration was NOT sustained over the required period in one or more stacks.		

U. AERATE

REQUIRED ACTIONS IN EXACTLY THIS ORDER	Y	N	CONFIRMING INITIALS
U1. Fumigation team puts on respirators and other PPE per L4 and L5 before entering exclusion zone.			
U2. Open all doors and ventilators. Turn on fans, if any.			
U3. Remove sand snakes from the corners of up to 2 stacks so that sheet covering each can be lifted. (If the stacks are large relative to the			

size of the room, ONLY 1 stack can be opened at a time.)			
U4. Pull the free corner of each sheet up to the top of the stack with a rope. Team leaves exclusion zone immediately.			
U5. Allow gas to leave stack and warehouse for a half-day to 1 day			
U6. Repeat U1, U4 & U5 until remaining stacks are opened			
U7. Repeat U1. Then completely remove all sheets covering stacks.			
U8. Monitor inside warehouse and directly next to stack until phosphine gas concentration is less than 0.3 ppm (or local TLV value, if more stringent.)			
U9. ONLY AFTER CONCENTRATION IS LESS than 0.3 ppm (or local TLV value, if more stringent), lead fumigator informs facility manager that the area is safe to enter.			

DISPOSAL AND CLEANUP

V. ALUMINUM PHOSPHIDE RESIDUE REMOVAL & DISPOSAL

ATTENTION: Residues contain 3-5% unreacted materials and are hazardous to breathe and touch!

ATTENTION: NEVER DISPOSE OF UNUSED TABLETS/PELLETS WITH THESE METHODS. NEVER PLACE UNUSED PELLETS/TABLETS IN A DRUM WITH OR WITHOUT DETERGENT AS A FIRE OR EXPLOSION MAY OCCUR.

REQUIRED ACTIONS	Y	N	CONFIRMING INITIALS
V1. Personnel involved put on respirators and other PPE per L4 & L5.			
V2. Collect residue from trays in bucket or drum. Do <u>not</u> allow any residue to touch food commodity			
V3. Remove residue to a safe outdoor area			
V4. Remove warning signs & stand down watchmen			
V5. Standing upwind to avoid any evolved phosphine, mix residue slowly into soapy water, assuring the residue is fully reacted.			
V6. After any reaction is complete, dispose of mixture in a 0.5m deep disposal pit, at least 100m away from warehouse structures. Fill in hole.			

W. CLEAN-UP

ATTENTION: Dead animals should be considered a biohazard & must be disposed as soon as possible after aeration is complete

REQUIRED ACTIONS	Y	N	CONFIRMING INITIALS
W1. Crush empty phosphide tablet/pellets containers and dispose per host country requirements. If none, bury.			
W2. Inspect entire warehouse with flashlight, including under pallets and under-roof area for dead rodents and birds			

W3. Collect all dead animals wearing disposable gloves (if available). If not available, pick up with shovel or inside-out plastic bag.			
W4. Dispose of carcasses by (1) burying, wrapped in newspaper or plastic bag 0.6-1.2m deep and at least 60m from any shallow well or surface water; OR (2) burning, where it will not cause a public nuisance and in accordance with local laws; or (3) otherwise in accordance with local laws.			
W5. Wash hands thoroughly with soap.			

ANNEXED LOGS AND DOCUMENTATION

#A. DOCUMENTATION OF DOSAGE CALCULATION

Document the calculations/information used to determine the quantity of fumigant required and the “time @ concentration” efficacy threshold (e.g. 200 ppm @ 7 days)

General recommendation is 3 ALP tablets/metric ton but will vary with commodity, temperature & moisture content. 6 tablets/metric ton may be needed for highly sorptive commodities such as paddy rice, brown rice & pulses. Consult product label.

#B. FUMIGATION TIME LOG

#B1. Planned down time (days + hrs) (from H5)

#B2. Fumigant Applied (Date & Time)

#B3. Efficacy Reached (Day & Time that H4 is achieved)

#B4. Aeration Start (Date & Time)

#B5. All-Clear Given (see V9) (Date & Time)

#C. ISSUES, INCIDENTS AND EXCEPTIONS LOG

Log here any issues, incidents or exceptions that arise during the fumigation, including but not limited to phosphine concentrations > TLV outside the exclusion zone, violations of the exclusion zone, known or suspected problems with PPE discovered after the initial inspection, members of the fumigation team who become ill, addition of fumigant to reach or sustain required concentrations, etc.

#D. PHOSPHINE CONCENTRATION LOG: HAZARD MONITORING

Per S1, log phosphine gas concentrations taken at designated locations outside the exclusion area, in ppm.

LOCATION*	MONITORING TIME (TIME 0 = APPLICATION OF FUMIGANT)												
	1 hr	2 hr	4 hr	24 hr	1 day	2 days	3 days	4 days	5 days	6 days	7 days	8 days	9 days
A													
B													
C													

*As designated on plot map, Annex #F. Add locations as needed.

#E. PHOSPHINE CONCENTRATION LOG: EFFICACY MONITORING

Per S3, log phosphine gas concentrations taken from monitoring lines, in ppm.

MONITORING LINE*	MONITORING TIME (TIME 0 = APPLICATION OF FUMIGANT)												
	24 hrs	2 days	3 days	4 days	5 days	6 days	7 days	8 days	9 days	10 days			
1													
2													
3													
4													

*As designated on plot map, Annex #F. Add lines as needed.

#F. SCALE MAP/PLOT OF FACILITY AND SURROUNDINGS, SHOWING EXCLUSION ZONE

(use this grid for a sketch map, if a more formal site map is not available. See section I for requirements)

