ACT 381 & GRANT/LOAN WORK PLAN ELIGIBLE ACTIVITY GUIDANCE

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In order to gain approval for eligible activities by the Michigan Department of Environment, Great Lakes and Energy (EGLE), at a minimum, the work plan must:

- Demonstrate that the activities are eligible and an explanation of why;
- Describe how activities will be protective of public health, safety, and welfare, and the environment; and
- Detail how activities are cost effective and will be implemented or accomplished including methods, drawings, quantities, unit costs, etc. Additional information necessary may include, but is not limited to, the nature and extent of contamination, the location, depth, volume, disposal locations, how cost estimates were determined, and rationale that the lowest cost alternative method is used or was considered.

For additional guidance, the document below contains a list of typical eligible activities and the level of detail the Department is looking for in a work plan. If this is a grant/loan work plan, "Tasks" should be in line with the broad tasks presented in Appendix A of the grant/loan agreement, followed by individual eligible activities/sub-activities.

For the purpose of this work plan, "Tasks", "Activities", and "Sub-Activities" are defined as follows:

- Tasks: are the broad category tasks as provided in Appendix A of the grant/loan *agreement*
- Activities: are high level category activities (e.g., Phase I Environmental Site Assessment [ESA], Phase II ESA, contaminated soil management, vapor mitigation system [VMS], etc.) that may or may not have more detailed components or sub-activities, as defined below
- Sub-Activities: are the detailed components of an activity (e.g., drilling, ground penetrating radar [GPR], laboratory analytical, field work, reporting, transportation, disposal, waste characterization, oversight, project management, contractor procurement, design, installation, performance monitoring, etc.)

Example:

Assessment (Task)
Phase I ESA (Activity)
Phase II ESA (Activity) Drilling (Sub-Activity) GPR (Sub-Activity) Laboratory Analytical (Sub-Activity) Field Work (Sub-Activity) Reporting (Sub-Activity)
Baseline Environmental Assessment (Activity)

ELIGIBLE ACTIVITIES

General Notes:

- *With all items provided below, this is not a comprehensive list but rather a tool to help understand the level of detail the Department is looking for in a work plan in accordance with state brownfield statutes and policies. Please use your professional judgement, and include, modify, add or delete information as appropriate to your project and eligible activities.*
- *The level of detail below for Assessment and Investigation activities is only required for a Grant/Loan Work Plan and not for Act 381.*

- *In accordance with state brownfield statutes and policies brownfield redevelopment grants used solely for assessment purposes must:*
    - *Identify future potential limitations on the use of the property based on the environmental conditions identified in the assessment; and*
    - *Include an estimate of due care and/or response activity costs based on the environmental conditions identified in the assessment.*
- *If this work plan includes costs for soft costs (e.g., contractor procurement, engineering, design, legal services, oversight, project management, reporting) or temporary costs (e.g., staking, land control, soil erosion and sedimentation control, construction access roads, truck washes, traffic control, facility, utilities, etc.) in association with an eligible activity please provide the following with each associated activity below:*
    - *A detailed scope of work, breakdown of costs provided in Table 1, and locations of activities/sub-activities on Figures; and*
    - *Justification of why the activity/sub-activity is associated with an eligible activity and not a normal cost of development and a demonstration that only the additional incremental cost associated with the eligible activity beyond the cost associated with the normal cost of development is included.*

Phase I ESA

If this work plan includes costs for a Phase I ESA, at a minimum this section should provide the following:

- Reason, scope of work, and referenced standards for the Phase I ESA

Asbestos and Hazardous Materials Survey

If this work plan includes costs for an Asbestos and Hazardous Materials Survey, at a minimum this section should provide the following:

- The standards and regulations that survey will be based on
- A general or detailed scope of work of the survey depending on what is known
- Estimated number and type of samples planned to be collected (e.g. potential asbestos containing materials [PACM], waste characterization, lead based paint [LBP], etc.), if known
- If sampling is planned, please refer to the “Phase II ESA/Subsurface or Other Investigation guidance below

Phase II ESA/Subsurface or Other Investigation

If this work plan includes costs for a Phase II ESA/subsurface investigation or other investigation, at a minimum this section should read like a sampling and analysis plan (SAP) and provide the following:

- Purpose for conducting the Phase II ESA/subsurface investigation/supplemental subsurface investigation (e.g., due diligence, characterization, due care investigation, etc.)
- The standards, if any, the investigation is based on
- A detailed scope of work of what the investigation will entail (e.g., ground penetrating radar, test pits, hand auger borings, geo-probe borings, hollow-stem auger borings, wells to be installed, soil vapor points to be installed, media to be sampled and analyzed, field and lab quality assurance/quality control [QA/QC], waste characterization, methodologies, reports prepared)
- Number of samples
- Sample locations provided on an attached Figure
- Laboratory analytical planned for samples collected
- Data quality objectives (DQO) (e.g., decision units, methodology, etc.) if incremental sampling is proposed (*Please note additional information may be necessary)*

Baseline Environmental Assessment

If this work plan includes costs for a Baseline Environmental Assessment (BEA), at a minimum this section should provide the following:

- Narrative of the scope of work

Plan for Compliance with Section 20107a and/or 21304c

If this work plan includes costs for preparing a Plan for compliance with Section 20107a and/or 21304c, at a minimum this section should provide the following:

- Narrative for scope of work

Lead, Asbestos, Mold Abatement and Demolition (Note: these activities would need to be considered a response activity under Act 381)

If this work plan includes costs for lead, asbestos, mold abatement or demolition, at a minimum this section should provide the following:

- A detailed scope of work for each activity/sub-activity associated with lead, asbestos, mold abatement or demolition (e.g., removal of ACM, removal or encapsulation of lead paint, removal of mold, site demolition, building demolition, interior and/or partial demolition, etc.)
- If this lead, mold, or asbestos abatement is considered an imminent and significant threat to human health, justification that it is
- If this demolition activity is considered a response activity under a grant/loan, justification that the demolition is necessary due to contamination, to access contamination, or to protect public health, safety, and welfare and the environment
- If this demolition activity is not considered a response activity under a grant/loan, justification that the combined costs of activities including disposal of solid waste, lead, asbestos, or mold abatement, and demolition that is not related to contamination, removal and disposal of contaminated lake or river sediments are less than the cost of eligible environmental activities
- A breakdown of costs for each activity/sub-activity provided in Table 1
- Locations of activities provided on attached Figures

Transportation and Disposal of Contaminated Material

If this work plan includes costs for transportation and disposal of contaminated material (e.g., soil, urban fill, etc.), at a minimum this section should provide the following:

- A detailed scope of work for each activity/sub-activity associated with transportation and disposal of contaminated material (e.g., transportation, disposal, waste characterization, etc.)
- A breakdown of costs for each activity/sub-activity provided in Table 1 including unit costs per ton or yard, etc.
- Locations of activities provided on an attached Figure
- Justification that the material being transported and disposed of is contaminated
- Justification of why the activity/sub-activity is associated with due care and not a normal cost of development
- Maps provided as figures with descriptions of where the contaminated material will be removed from
- Estimated quantities of material to be removed
- Estimated dimensions of material to be removed

Contaminated Source Soil Removal

If this work plan includes costs for contaminated source soil removal, at a minimum this section should provide the following:

- A detailed scope of work for each activity/sub-activity associated with contaminated source soil removal (e.g., excavation, transportation, disposal, waste characterization, backfill, compaction, surveying and staking, etc.)
- A breakdown of costs for each activity/sub-activity provided in Table 1
- Justification that the material being transported and disposed of is a source area of contamination

- Justification of why the activity/sub-activity is a response activity and not a normal cost of development
- Maps provided as figures with descriptions of where the contaminated material will be removed from
- Estimated quantities of material to be removed
- Estimated dimensions of material to be removed

On-Site Soil Management

If this work plan includes costs for on-site soil management (e.g., relocation, berming, fill, cover, etc.) at a minimum this section should provide the following:

- A detailed scope of work for each activity/sub-activity associated with on-site soil management
- A breakdown of costs for each activity/sub-activity provided in Table 1
- Locations of activities provided on attached Figures
- Justification that the soil being managed on site is contaminated
- Justification of why the activity/sub-activity is associated with due care and not a normal cost of development (i.e., land balancing, etc.) or a demonstration that only the additional incremental cost beyond the cost associated with the normal cost of development is included

Container Removal

If this work plan includes costs for container (e.g., hazardous materials, drums, hoists, hoist tanks, above ground storage tanks, etc.) removal, at a minimum this section should provide the following:

- A detailed scope of work including, but not limited to, containers to be removed, quantities, waste characterization necessary, methodologies, etc.
- A breakdown of costs for each activity/sub-activity provided in Table 1
- Locations of activities provided on attached Figures

Dewatering

If this work plan includes costs for dewatering, at a minimum this section should provide the following:

- A detailed scope of work for each activity/sub-activity associated with dewatering (e.g., pumping (n*ote: pumping is generally considered a normal cost of development)*, treatment, transportation, and/or disposal of contaminated groundwater, etc.)
- A breakdown of costs for each activity/sub-activity provided in Table 1
- Locations of activities provided on attached Figures
- Justification that the groundwater is contaminated or that dewatering is limited to runoff or rain event dewatering on contaminated land
- Justification of why the activity/sub-activity is associated with due care and not a normal cost of development
- A cost-benefit analysis that demonstrates how the proposed cost is the least cost alternative for dewatering (e.g. frac tank/trucking and disposal, National Pollutant Discharge Elimination System [NPDES] permit and discharge, groundwater discharge [permit or via Part 22 District approval], or discharge to a local sanitary system, etc.)

Vapor Mitigation System

A work plan including a VMS must be approved by the vapor intrusion (VI) specialist or VI technical and program support (TAPS) team within EGLE. Depending on response times of the developer's design team, this approval could take an <u>average</u> of 60 days from receipt of a complete plan. It is recommended to consult with your brownfield coordinator and technical project manager early when a VMS is proposed. Please refer to the following checklists attached:

- Checklist for Developing a Conceptual Site Model (CSM)

- Checklist for Reviewing the Design of a Passive Mitigation System
- Checklist for Reviewing the Design of an Active Mitigation System

Note: It would help your review to include the appropriate checklist(s) along with associated page numbers and/or references with your submittal

Some commonly missed items include:

- Data to identify site contaminants in <u>all</u> media and their potential migration pathway
- Data sufficient to support mitigation choice
- Written description of each component and activity/sub-activity associated with the VMS
- Building layout
- Engineered VMS design and figures with locations of VMS components including, but not limited to, barrier, ventilation configuration, calculations demonstrating flow, radius of influence, and air quality exemptions, installation verification, testing, and quality assurance/quality control, signage, and performance monitoring components
- VMS technical specifications including demonstration that the barrier or system is protective of the contaminants on the property
- Installation report to demonstrate as built system
- Performance monitoring plan
- Operations and maintenance plan
- A breakdown of costs for each component and/or activity/sub-activity provided in Table 1

Direct Contact Barrier

If this work plan includes costs for a direct contact barrier, at a minimum this section should provide the following:

- A detailed scope of work for the direct contact barrier (e.g., thickness, material, specifications, justification that the barrier is protective of the contaminants on site, etc.)
- Justification that the barrier is warranted (e.g., contaminated soil near the surface is contaminated above direct contact criteria over the entire area of the proposed barrier, etc.)
- A breakdown of costs for each activity/sub-activity provided in Table 1
- Locations of activities provided on attached Figures

Infiltration Prevention and Diversion Barriers

If this work plan includes costs for infiltration prevention and/or diversion barriers, at a minimum this section should provide the following:

- A detailed scope of work for the barrier (e.g. thickness, material, specifications, justification that the barrier is protective of the contaminants on site, etc.)
- Justification that contamination is present to warrant this engineering control
- A breakdown of costs for each activity/sub-activity provided in Table 1
- Locations of activities provided on attached Figures

Underground Storage Tank Removal and/or Closure

If this work plan includes costs for underground storage tank (UST) removal and/or closure, at a minimum this section should provide the following:

- A detailed scope of work for each activity/sub-activity (e.g., investigation, GPR, UST removal, contaminated soil removal, waste characterization, backfill and compaction, verification sampling, reporting, etc.)
- A breakdown of costs for each activity/sub-activity provided in Table 1
- Locations of activities provided on attached Figures

Specialized Foundations

If this work plan includes costs for specialized foundations, at a minimum this section should provide the following:

- A detailed scope of work for each component of the specialized foundations
- A breakdown of costs for each component provided in Table 1
- A cost-benefit analysis by a licensed professional engineer (P.E.) that demonstrates that the additional incremental cost of the specialized foundation is less expensive than the trucking and disposal costs of the soil that would be excavated for a typical foundation
- A demonstration that only the additional incremental cost of the specialized foundation beyond the cost of the standard foundation is included
- Locations of activities provided on attached Figures
- *Note: If the local unit of government/developer requesting EGLE funding prefers the higher cost option, state funds can still be approved for the equivalent of the lowest cost option*

Dust Control

If this work plan includes costs for dust control (i.e., actions necessary to prevent or reduce the surface and air transport of dust during demolition and construction), at a minimum this section should provide the following:

- A detailed scope of work for each activity/sub-activity (e.g., spraying, misting or hosing down a demolition or construction area with water to minimize on-and off-site dust that may impact air quality, minimizing soil disturbance, applying cover surface roughening, etc.)
- A breakdown of costs for each activity/sub-activity provided in Table 1
- Locations of activities provided on attached Figures

Industrial Cleaning

If this work plan includes costs for industrial cleaning (i.e., cleaning walls, floors, pits, or drains to allow new tenants to reuse an existing structure, install equipment, or complete interior renovations), at a minimum this section should provide the following:

- A detailed scope of work for each activity/sub-activity (e.g., wall cleaning, floor cleaning, pit cleaning, drain cleaning, etc.)
- A breakdown of costs for each activity/sub-activity provided in Table 1
- Locations of activities provided on attached Figures

Sheeting and Shoring Necessary for the Removal of Contaminated Materials at Projects Requiring a Permit Under Part 301, 303, or 325 of the Public Act 451, The Natural Resources and Environmental Protection Act, as amended (NREPA)

If this work plan includes costs for sheeting and shoring (i.e., bracing, sheeting, or shoring necessary prior to excavation of contaminated material to protect life, the land, or the integrity of the excavation) for the removal of contaminated materials at projects requiring a permit under Part 301, 303, or 325 of NREPA, at a minimum this section should provide the following:

- A detailed scope of work for each activity/sub-activity
- A breakdown of costs for each activity/sub-activity provided in Table 1
- Locations of activities provided on attached Figures

Disposal of Solid Waste

If this work plan includes costs for disposal of solid waste (e.g., used tires, old appliances and furniture, used car batteries, etc.), at a minimum this section should provide the following:

- A detailed scope of work for each activity/sub-activity associated with the disposal of solid waste (e.g., removal, transportation, disposal, etc.)
- Justification that the combined costs of activities including disposal of solid waste, lead, asbestos, or mold abatement, and demolition that is not related to contamination, removal and disposal of contaminated lake or river sediments are less than the cost of eligible environmental activities
- A breakdown of costs for each activity/sub-activity provided in Table 1
- Locations of activities provided on attached Figures

Removal and Disposal of Lake or River Sediments

If this work plan includes costs for removal and disposal of lake or river sediments, at a minimum this section should provide the following:

- A detailed scope of work for each activity/sub-activity associated with removal and disposal of lake or river sediments from a navigable waterway (e.g., dredging, testing, transportation, disposal, upland disposal or cover, provided that on-site disposal does not result in contaminated land, etc.)
- A breakdown of costs for each activity/sub-activity provided in Table 1
- Locations of activities provided on attached Figures
- Justification that the combined costs of activities including disposal of solid waste, lead, asbestos, or mold abatement, and demolition that is not related to contamination, removal and disposal of contaminated lake or river sediments are less than the cost of eligible environmental activities
- Justification that the one of the following scenario requirements is met:
  - Dredging is tied to an economic development project with a committed developer, and the upland parcel(s) is contaminated; or
  - The sediment is contaminated and would create or exacerbate contaminated land if deposited on the upland parcel(s)

Third-Party Environmental Oversight Professional

Example Language: Grant/Loan third-party environmental oversight language (e.g., Third-party environmental oversight is included in this work plan not to exceed the lesser of 5% of the total award amount spent or the amount included in Appendix A of the agreement, as amended.)

Grant and/or Loan Administration

Example Language: Grant/Loan administration language (e.g., Grant/Loan administration is included in this work plan not to exceed the lesser of 3% of the total award amount spent or the amount included in Appendix A of the agreement, as amended.)

Contingency

If contingency was included in the grant/loan award, please use something similar to this Grant/Loan contingency language (e.g., Contingency is included in this work plan not to exceed the lesser of 15% of the total of eligible activities or the amount included in Appendix A of the agreement, as amended. The contingency will only be used for unanticipated conditions that may be encountered during the performance of eligible activities. Further, the contingency will not be utilized without first consulting (verbal or written) with EGLE before activities are conducted and subsequently followed up with a written request and approval by EGLE.)

Contingency under Act 381 is allowed up to 15% of the activity/sub-activity costs that have yet to occur.

Table 1: Example Activity Costs and Schedule Table

Work Plan Activity Costs and Schedule					
Eligible Activities **(Main categories should follow Tasks in Appendix A or Principle Department Specific Activities; individual activities/subactivities should be included to fit your specific project and desired outcome)**	**Quantity**	**Unit**	**Unit Cost**	**Cost**	**Estimated Completion Quarter / Completion Season/Year**
Task # TaskName/PrincipleDepartmentSpecificActivity					
Activity/DepartmentSpecificActivity				$ -	
SubActivity/SubActivity (if relevant)				$ -	
Example: Task 1 Assessment and Investigation				$ -	
Phase I Environmental Site Assessment (ESA)				$ -	
Phase II ESA				$ -	
Drilling				$ -	
Laboratory Analytical				$ -	
Field				$ -	
Report				$ -	
BEA				$ -	
Example: Task 2 Due Care				$ -	
Vapor Mitigation System (VMS)				$ -	
Design				$ -	
Contractor Procurement				$ -	
Installation				$ -	
Installation Report				$ -	
Performance/Monitoring				$ -	
Oversight				$ -	
Project Management				$ -	
Contaminated Soil Management				$ -	
Waste Characterization				$ -	
Contractor Procurement				$ -	
Transportation				$ -	
Disposal				$ -	
Oversight				$ -	
Project Management				$ -	
EGLE Eligible Activities Total Costs				**$ -**	

Attachment A: Appendix C.2 Checklist for Developing a Conceptual Site Model

APPENDIX C.2

Developing a Conceptual Site Model

Developing a conceptual site model (CSM) is an important first step for assessing contaminated sites and the potential for vapor intrusion. Briefly, a CSM is a picture and narrative of the site contamination: how it got there, whether or not it is migrating or degrading, its distribution across the site, who might be exposed to it, and what risk-reduction strategies are most feasible. A CSM development actually begins during the Phase I Environmental Site Assessment with collection and evaluation of site history and reconnaissance information.

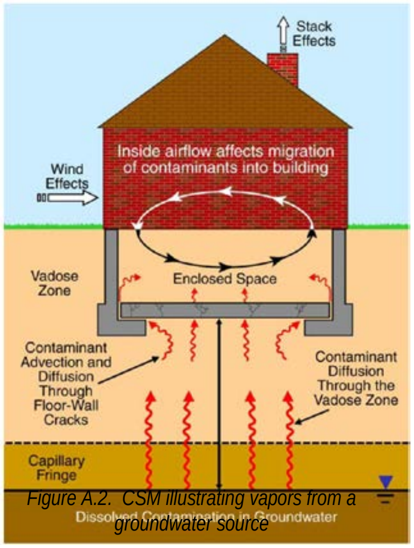

Figure A.2. CSM illustrating vapors from a groundwater source

During subsequent site characterization activities, the CSM can be augmented and refined, as necessary, with site-specific information on source areas, contaminant properties, stratigraphy, hydrogeology, exposure pathways, and potential receptors. Building and refining a thorough CSM may involve a combination of techniques and tools to understand the subsurface, but specifically, investigations for vapor intrusion often include collecting samples of soil, groundwater, soil vapor, and/or indoor air. Investigators may use sampling in combination with predictive models. Constructing a CSM for vapor intrusion requires the integration of important site characteristics to assist in understanding and evaluating the potential impacts that vapor intrusion risks pose to potential receptors.

The purpose for developing a CSM for the vapor intrusion pathway is to assemble a three-dimensional concept of the site that is as comprehensive as possible. This is based on reliable data describing the sources of the contamination, the release/transport mechanisms, the possible subsurface migration routes, the potential receptors, as well as historical uses of the site, cleanup concerns expressed by the community, and future land use plans. All the important features relevant to characterization of a site should be included in a CSM, and any irrelevant ones excluded.

Contents of the Conceptual Site Model

The CSM should present both a narrative and a visual representation of the actual or predicted relationships between the contaminants at the site and receptors (building occupants), as well as reflect any relevant background levels. A basic example of a visual representation is included as Figure A.2.

The CSM should also contain a narrative description that clearly distinguishes what aspects are known or determined and what assumptions have been made in its development. The CSM should also identify conditions that may result in alternate approaches. The CSM provides a conceptual understanding of the potential for exposure to compounds of concern at a site. It is an essential tool to aid management decisions associated with the site and serves as a valuable communication tool both internally with the site team and externally with the community. The CSM is a dynamic tool to be updated as new information becomes available after each stage of investigation. Below is a CSM checklist to assist in the review of this component of the vapor intrusion assessment.

APPENDIX C.2
Checklist for Developing a Conceptual Site Model

The information included in this checklist may be useful for evaluating a site-specific conceptual migration model and ensuring that the model contains the necessary elements. A blank is provided before each item to aid in documenting the individual components and where they can be found.

Site Name: Site ID:
Site Address: County:

1.0 UTILITIES AND PROCESS PIPING

_____ Maps, figures, and cross-sections of the building provide the location and depths of all underground utilities and/or process piping near the soil or groundwater impacts.

2.0 BUILDINGS (RECEPTORS)

_____ Maps identify:
- Existing or proposed buildings
- Vacant parcels
- Property boundaries

_____ Description of the occupancy and use of all properties/buildings

_____ Construction of each structure includes (if applicable):
- General construction style (e.g., basement, crawlspace, slab on grade)
- Floor construction (e.g., concrete, dirt)
- Depth below grade of lowest floor
- Building layout (e.g., large and open, small rooms)
- Height (and number of floors)
- Sumps or foundation drains
- Alternate ventilation system
- Elevator(s)

_____ Heating, ventilation or air conditioning system in each structure is described and includes (if applicable):
- Type (e.g., forced air, radiant)
- Equipment location (e.g., basement, crawlspace, utility closet, attic, roof)
- Source of return air (e.g., inside air, outside air, combination)
- System design considerations relating to indoor air pressure (e.g., positive pressure may be the case for commercial office buildings)

_____ Installed sub-slab ventilation systems or moisture barriers present are described and identified on all building figures

3.0 SOURCE AREA(S)

_____ Description and known history of the release.

_____ Maps and figures identify and show the location of all vapor source(s) in relation to each structure (including the presence, distribution, and composition of any non-aqueous phase liquid at the site).

_____ Cross-sections showing example building, construction styles, and relationship to source of vapors (actual number will vary as appropriate).

_____ Description of the potential migration characteristics (e.g., stable, increasing, decreasing).

4.0 GEOLOGY/HYDROGEOLOGY

_____ Maps, figures, cross-sections, and/or description identify soil lithology and characteristics:

- Heterogeneity/homogeneity of soils and the lithologic units encountered including:
  - Depth and lateral continuity of any confining units that may impede contaminant migration
  - Depth and lateral continuity of any highly transmissive units that may enhance contaminant migration
- Depth of vadose zone, capillary fringe, and phreatic zone including:
  - Any seasonal water table fluctuations
  - Groundwater flow direction
  - Presence of any perched groundwater
  - Note where the water table intersects the well screen interval or the presence of a submerged screen.

_____ Description and location of distinct strata (soil type and moisture content, e.g., moist, wet, dry) and the depth intervals.

_____ Description and location of all fill or non-native materials.

_____ Depth to groundwater identified on all cross-sections.

_____ General groundwater characteristics provided (e.g., seasonal fluctuation, hydraulic gradient).

5.0 SITE CHARACTERISTICS

_____ Map of the site (to scale) showing all paved areas, surface cover, locations of all structures, and ground cover.

_____ Map identifying all potential sources of vapors.

6.0 REFERENCES

Interstate Technology & Regulatory Council. 2007. Vapor Intrusion Pathway: A Practical Guideline, January 2007. Accessed at http://www.itrcweb.org/Documents/VI-1.pdf.

Attachment B: Appendix C.6 Checklist for Reviewing the Design of a Passive Mitigation System

APPENDIX C.6
Checklist for Reviewing the Design of a Passive Mitigation System

The information included in this checklist may be useful for reviewing a passive mitigation system. Though it is generally understood that the actual design of the system may vary, many of the design components should be very similar in purpose. A blank is provided before each item to aid in documenting the individual components and where they can be found.

Site Name: Site ID:
Site Address: County:

1.0 GENERAL

_____ Engineer or design firm is identified and mitigation system is designed by a professional engineer with demonstrated experience designing passive mitigation systems.

_____ Product manufacturer is provided.

_____ Requirements for installation are provided and if required by the manufacturer, the certification for the product applicator.

_____ General site conditions including a conceptual site model are provided.

_____ Concentrations identified at the site are provided including sampling methodology.

_____ All utility and other penetrations are identified on a print.

_____ Surface preparation is identified and includes:

- If applied onto an existing concrete surface it shall be free of any dirt, debris, loose material, release agents, or curing compounds.
- Voids more than 1/4 inch deep and 1/4 inch wide are filled.
- If applied directly on the sub-grade, the sub-grade shall be compacted to a minimum relative compaction of 90 percent or as specified by a civil/geotechnical engineer and the surface prep shall be smooth, uniform, and free of debris and standing water.

_____ Building/Fire Codes: Document states mitigation systems shall be designed and installed to conform to applicable building and fire codes and maintain the function and operation of all existing equipment and building features including doors, windows, access panels, etc.

_____ Drains that perforate the liner must be equipped with a dranjer style drain or dripline to a trap that allows water to flow into sumps and floor drains while sealing out soil gases from the sub-floor area or alternate method is provided.

2.0 LINER DESIGN AND SPECIFICATIONS

_____ Detailed specifications of the liner are provided including transmission rates and/or diffusion coefficients for compounds of interest.

_____ Concentrations in the subsurface have been evaluated for the liner including the required thickness applied and/or overall selection of the product by the engineer or design firm.

_____ Details are provided for areas that require specialized completion including all penetrations and terminations.

_____ Horizontal venting or perforated piping has a minimum in-plane flow rate of 21 gallons per minute per foot per unit width at a hydraulic gradient of 1.0 percent when tested in accordance with the American Society for Testing and Materials D 4716. Greater flow rates may justify greater spacing.

_____ Dewatering has been considered and incorporated into the design.

_____ Horizontal venting (or perforated piping) runs are identified at a maximum rate of one per every 50 feet perpendicular to the length of the run for the expected coverage. Calculations may provide justification for different spacing.

3.0 SYSTEM MONITORS AND LABELING

_____ System labels are placed on the mitigation system and other prominent locations including the exterior venting locations.

_____ Description of signage and locations are provided.

- *Contain language indicating the mitigation vent that may contain volatile organic compounds.*
- *Figure identifying locations of all signs.*
- *Each roof exhaust point.*
- *Piping run (each individual exhaust line).*
  - o *Vertical one per floor.*
  - o *Horizontal one per 25 feet.*

_____ For tenants that will be occupying the structure, a notice has or will be prepared.

4.0 PIPING

_____ When crossing pipe or pipe sleeves over or under footings or grade beams, document identifies it has been evaluated by an environmental engineer and/or structural engineer for appropriate use and placement materials.

_____ Preliminary piping and routing diagrams including manifolds are provided.

_____ Preliminary horizontal vent locations are identified on a print by the professional engineer.

_____ All pipe joints and connections, both interior and exterior, are permanently sealed.

_____ All exhaust pipes are supported and secured in a permanent manner.

_____ Horizontal piping runs in the mitigation system are sloped or designed to ensure condensation drains downward into the ground beneath the slab.

_____ All vent stack piping is identified as solid, rigid pipe.

_____ Justification of number and location of vent riser locations either based on Table A.6.1 or alternate method provided.

Table A.6.1
Spacing of Perforated Horizontal Piping
and Number of Vent Risers

Vent Riser Pipe Diameter (inches)	Number of Vent Risers per Building Footprint Area (Square Feet)
1 1/2	1/1,250 (min of 2 risers)
2	1/2,500 (min of 2 risers)
2 1/2	1/5,000 (min of 3 risers)
3	1/7,500 (min of 4 risers)
4	1/10,000 (min of 4 risers)

Notes:
1) Riser length shall be a maximum of 100 foot measure along solid pipe including bends.
2) Vent risers maximum spacing shall be 100 feet between each.
3) When the application of the spacing and location requirement of this table results in the fractional number of vent risers, any fraction shall be construed as one vent riser.
4) Number of required vent risers shall be determined by the selected riser pipe diameter and the rate of vent riser per building footprint area.

_____ Vertical piping runs terminate in a location that can drain naturally or that can be verified to be free of water or moisture.

_____ For structures less than 2,500 square feet vertical piping is at least:

- *Not less than three inches (75 millimeters) inside diameter (ID).*
- *Vent stack piping's ID shall be at least as large as the largest used in the manifold piping.*
- *Manifold piping's ID shall be at least as large as that used in any suction point.*
- *Manifold piping to which two or more suction points are connected shall be at least four inches (100 millimeters) ID.*
- *If smaller IDs are proposed, appropriate documentation showing design calculations has been submitted.*

OR

_____ For structures greater than 2,500 square feet piping is:

- *Identified and justified by measurements and estimated static pressure, air velocity, and rate of airflow measurements, and head loss calculations based on preliminary exhaust piping design prints.*
- *Documented using the methodologies found in "Industrial Ventilation: A Manual of Standard Practice, 23rd Edition," or its equivalent.*

5.0 PIPING COMPLETION SPECIFICATIONS

(minimums, further distance may be required by exhaust concentrations and primary wind flow direction)

_____ Pipes are completed with a rain cap or wind turbine.

_____ To reduce the risk of vent stack blockage, confirm that the discharge from vent stack pipes is:

- *Vertical and upward, outside the structure, at least ten feet (three meters) above the ground level, above the edge of the roof, and shall also meet the separation requirements below. Whenever practicable, they shall be above the highest roof of the building and above the highest ridge.*
- *Twenty feet (six meters) or more away from any window, door, or other opening into conditioned or otherwise occupiable spaces of the structure, if the discharge point is not at least three feet (one meter) above the top of such openings.*
- *Twenty feet (six meters) or more away from any opening, vent, or occupiable spaces of any building including adjacent structures. Chimney flues shall be considered openings into conditioned or otherwise occupiable space.*
- *For vent stack pipes that penetrate the roof, the point of discharge shall be at least 12 inches (0.3 meters) above the surface of the roof. For vent stack pipes attached to or penetrating the sides of buildings, the point of discharge shall be vertical and a minimum of 12 inches (0.3 meters) above the edge of the roof and in such a position that it can neither be covered with snow or other materials nor be filled with water from the roof or an overflowing gutter.*
- *When a horizontal run of vent stack pipe penetrates the gable end walls, the piping outside the structure shall be routed to a vertical position so that the discharge point meets the requirements described above.*
- *Points of discharge that are not in a direct line of sight from openings into conditioned or otherwise occupiable space because of intervening objects such as dormers, chimneys, windows around the corner, etc., shall meet the separation requirements as stated above.*

6.0 QUALITY ASSURANCE/QUALITY CONTROL INSTALLATION PLAN REQUIREMENTS IDENTIFIED IN THE DESIGN DOCUMENT

_____ Contractor identifies steps to document the effectiveness of the mitigation system.

- Coupon sampling – recommended at one sample per 500 square feet.
- Smoke testing – full coverage is necessary and must be based on the area that it can be confirmed that smoke has migrated to through visual observation.
- On-site installation oversight by the design firm.
- Documentation verifying the installation per project specification and that any areas noted for repair have been completed.
- Estimated quantities of the product to be utilized are provided.

Appendix D – Vapor Intrusion Screening Values

Table of Contents

Screening Values for the Vapor Intrusion Pathway

Sampling Location	Appropriate Vapor Intrusion Screening Value (SV_{vi})	Immediate Response Activity Screening Levels (IRASLs)
Soil sample	Soil concentration that identified a source of vapors (S_{vi})	- - - - -
Air within the interior space of a building derived from VI sources	Acceptable indoor air value for VI (IA_{vi})	Indoor air values for consideration of an acute exposure for VI (AIA_{vi})
Soil gas collected from the subsurface	Soil gas concentrations for VI (SG_{vi})	Soil gas concentrations for consideration of an acute exposure for VI (ASG_{vi})
Sub-slab soil gas from beneath a building slab	Soil gas concentrations collecting less than five feet bgs or lowest point of a structure (SG_{vi-SS})	ASG_{vi} – see description above
Groundwater in contact with a structure	Groundwater concentrations when water is in contact or entering a structure for VI ($GW_{vi\text{-}sump}$)	Groundwater concentrations for consideration of an acute exposure when water is in contact or entering a structure for VI ($AGW_{vi\text{-}sump}$)
Groundwater beneath, but not in direct contact with a structure	Groundwater concentrations for VI (GW_{vi})	Groundwater concentrations for consideration of an acute exposure for VI (AGW_{vi})

Attachment C: Appendix C.5 Checklist for Reviewing the Design of an Active Mitigation System

APPENDIX C.5
Checklist for Reviewing the Design of an Active Mitigation System

The information included in this checklist may be useful for reviewing the design of an active mitigation system. Though it is generally understood that the actual design of the system may vary, many of the design components should be very similar in purpose. The information in this checklist is based on American Society for Testing and Materials (ASTM Standard E2121, 2009). A blank is provided before each item to aid in documenting the individual components and where they can be found.

Site Name:	Site ID:
Site Address:	County:

1.0 DEFINITIONS

Backdrafting: A condition where the normal movement of combustion products up a flue (due to the buoyancy of the hot flue gases) is reversed, so that the combustion products enter the building (see *pressure-induced spillage*).

Depressurization: A negative pressure induced in one area relative to another.

Diagnostic tests: Procedures used to identify or characterize conditions under, beside, and within buildings that may contribute to radon entry or elevated radon levels or that may provide information regarding the performance of a mitigation system.

Manifold piping: Piping that collects the flow of soil gas from two or more suction points and delivers that collected soil gas to the vent stack piping. In the case of a single suction point system, there is no manifold piping since the suction point piping connects directly to the vent stack piping. The manifold piping starts where it connects to the suction point piping and ends where it connects to the vent stack piping.

Mitigation system: Any system or steps designed to reduce concentrations of a contaminant in the indoor air of a building that originates in the subsurface.

Natural draft combustion appliance: Any fuel burning appliance that relies on a natural convective flow to exhaust combustion products through flues to outside air.

Pressure-field extension: The distance that a pressure change, created by drawing soil gas through a suction point, extends outward in a sub-slab gas permeable layer, under a membrane, behind a solid wall, or in a hollow wall (see *communication test*).

Pressure-field extension test: A diagnostic test to evaluate the potential effectiveness of a sub-slab depressurization system by applying a vacuum beneath the slab and measuring, either with a micromanometer or with a heatless smoke device, the extension of the vacuum field.

Pressure-induced spillage: The unintended flow of combustion gases from an appliance/venting system into a dwelling, primarily as a result of building depressurization (see *backdrafting*).

2.0 GENERAL

_____ Report identifies that the design does not interfere with the normal venting functions for appliances and backdrafting will not occur.

_____ Pressure field extension test (e.g., diagnostic communication test) has been performed.

- *For buildings over 10,000 square feet multiple tests throughout the building are completed.*

_____ Detailed specifications are provided on products utilized including fan, piping, and caulk.

_____ System is designed by a professional engineer with demonstrated experience designing mitigation systems.

_____ Building/Fire Codes: Document states mitigation systems shall be designed and installed to conform to applicable building and fire codes and maintain the function and operation of all existing equipment and building features including doors, windows, access panels, etc.

_____ Discharge Calculations: Estimated calculations for discharge pursuant to Part 55, Air Pollution Control, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA) and the associated Administrative Rules. Single-family homes are exempt.

3.0 SYSTEM SEALING REQUIREMENTS

Openings that could lessen the effectiveness of the mitigation system are sealed using methods and materials that are permanent and durable.

☐ Cracks and joints:

_____ Openings and cracks where the slab meets the foundation wall have been addressed.

_____ Concrete slab (flooring) above the active mitigation system is free of cracks or cracks have been adequately sealed.

_____ For joints greater than 1⁄2 inch (13 millimeters) in width, a foam backer rod or other comparable filler material should be inserted into the joint before the application of the sealant.

☐ Penetrations:

_____ Openings around the suction point piping penetrations of the slab have been adequately addressed.

_____ Vaults, sumps, other large openings, and utility access points in the foundation walls and/or floor slab are sealed using measures that still allow future access.

4.0 SYSTEM MONITORS AND LABELING

_____ Mitigation systems contain mechanisms to monitor performance (airflow or pressure).

_____ Mechanism is simple to read and interpret and is located where it is easily seen or heard.

_____ System provides a visual and/or audible indication of system degradation and failure.

☐ Monitor has reliable power source:

_____ If powered by house current, it shall be installed on a non-switched circuit and be designed to reset automatically after a power failure. Battery backup for the monitoring system in the event of power failure is recommended.

OR

_____ If the monitor is battery powered, it shall be equipped with a low-battery power warning feature.

_____ Mechanical system monitors, such as manometer type pressure gauges are clearly marked to indicate the initial pressure readings.

_____ System labels are placed on the mitigation system, the electric service entrance panel, and other prominent locations including the exterior venting locations.

_____ The circuit breaker(s) controlling the circuits on which the mitigation system and system failure warning devices operate are labeled using the word “Vapor Mitigation.” For example, “Vapor Intrusion (VI) System” or if multiple circuits “VI System” and “VI Monitor” as appropriate. No other rooms or appliances should be on the same circuit.

_____ Description of signage and locations are provided.

- *Contain language indicating the mitigation vent that may contain volatile organic compounds.*
- *Figure identifying locations of all signs.*
- *Each roof exhaust point.*
- *Piping run (each individual exhaust line).*
    - *Vertical one per floor.*
    - *Horizontal one per 25 feet.*

_____ For tenants that will be occupying the structure, a notice has been prepared and provided for review.

5.0 PIPING

_____ All pipe joints and connections, both interior and exterior, are permanently sealed.

_____ System piping installed in the interior or on the exterior of a building should be insulated where condensation may occur inside the pipe; and then freeze or block the soil gas exhaust.

_____ Suction point pipes are supported and secured in a permanent manner that prevents their downward movement to the bottom of suction pits, sump pits, or into the soil.

_____ Horizontal piping runs in the mitigation system are sloped to ensure condensation drains downward into the ground beneath the slab.

_____ All vent stack piping is identified as solid, rigid pipe.

_____ For structures less than 2,500 square feet.

- *Exhaust piping not less than three inches (75 millimeters) inside diameter (ID).*
- *Vent stack piping’s ID shall be at least as large as used in the manifold piping.*
- *Manifold piping’s ID shall be as large as used in any suction point.*
- *Manifold piping to which two or more suction points are connected shall be at least four inches. (100 millimeters) ID.*
- *If smaller IDs are proposed, appropriate documentation showing design calculations has been submitted.*

OR

_____ For structures greater than 2,500 square feet.

- *Pipe sizes are identified and justified by field diagnostic measurements and estimated static pressure, air velocity, and rate of airflow measurements.*
- *Piping sizes are justified using the methodologies found in “Industrial Ventilation: A Manual of Standard Practice, 23rd Edition,” or its equivalent.*

6.0 PIPING COMPLETION SPECIFICATIONS

_____ Pipes are completed with a rain cap or wind turbine.

_____ To reduce the risk of vent stack blockage, confirm that the discharge from vent stack pipes is:

- *Vertical and upward, outside the structure, at least ten feet (three meters) above the ground level, above the edge of the roof, and shall also meet the separation requirements below. Whenever practicable, they shall be above the highest roof of the building and above the highest ridge.*
- *Twenty feet (six meters) or more away from any window, door, or other opening into conditioned or otherwise occupiable spaces of the structure, if the discharge point is not at least three feet (one meter) above the top of such openings.*
- *Twenty feet (six meters) or more away from any opening, vent, or occupiable spaces of any building (including adjacent structures). Chimney flues shall be considered openings into conditioned or otherwise occupiable space.*
- *For vent stack pipes that penetrate the roof, the point of discharge shall be at least 12 inches (0.3 meters) above the surface of the roof. For vent stack pipes attached to or penetrating the sides of buildings, the point of discharge shall be vertical and a minimum of 12 inches (0.3 meters) above the edge of the roof and in such a position that it can neither be covered with snow or other materials nor be filled with water from the roof or an overflowing gutter.*
- *When a horizontal run of vent stack pipe penetrates the gable end walls, the piping outside the structure shall be routed to a vertical position so that the discharge point meets the requirements described above.*
- *Points of discharge that are not in a direct line of sight from openings into conditioned or otherwise occupiable space because of intervening objects such as dormers, chimneys, windows around the corner, etc., shall meet the separation requirements as stated above.*

7.0 FAN INSTALLATION REQUIREMENTS

_____ Fan sizing calculations are provided that estimate the pressure difference and airflow characteristics under which the system will operate.

Schematics identify:

_____ Fan(s) are to be installed either outside the building or inside the building, outside of occupiable space, and above the conditioned (heated/cooled) spaces of a building.

_____ Fan(s) that are mounted on the exterior of buildings are rated for exterior use or installed within a weather proof protective housing.

_____ Fan(s) are to be connected to the vent pipe using removable couplings or flexible connections that can be tightly secured to both the fan and the vent pipe (facilitate maintenance and future replacement).

_____ Outside air intake vents of fan(s) are screened to prevent the intake of debris. Screens shall be removable to permit cleaning or replacement and building owners shall be informed of the need to periodically replace or clean such screens.

8.0 ADDITIONAL REQUIREMENTS IN THE DESIGN DOCUMENT

_____ Contractor identifies steps to document the effectiveness of the mitigation system. This is typically demonstrated by measuring the pressure differential across the building slab while the VI mitigation system is operating.

_____ Concentrations in the subsurface have been evaluated for the duration and frequency which the system can be out-of-service (including power outages) prior to implementing actions necessary to address the potential risk to the occupants.

_____ Actions are identified to address conditions during periods the system is not operating.

_____ Establish and identify a negative pressure that will be continuously maintained.

- Typically requires higher negative pressure than a radon mitigation system.
- Establish a monitoring program.

_____ Establish a monitoring program for Permit or Permit to Install Exemption pursuant to the Part 55 Rules.

9.0 REFERENCES

ASTM Standard E2121. 2009. Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings.