A Standardized Approach for Building Decommissioning to Achieve Environmental Compliance

Authors: Karl De Looff, CHMM and Frederick W. Blickle, PE

Key Words: building decommissioning, hazardous waste management, sampling, disposal

Abstract: This paper will discuss a standardized approach to building decommissioning. The focus of the paper will be: industrial properties which may have hazardous materials, process sewers, waste water treatment plants, historical spills, asbestos, lead paint, PCBs, and other hazardous or environmental issues.

Some of the issues include:

- identification of areas of concern and appropriate local, state, and federal laws and regulations for compliance when a building is scheduled for sale, mothball, or demolition,
- development of sampling plans and systematic building inspections,
- identification of areas requiring decommissioning,
- development of specifications, and
- conduct and supervision of decommissioning activities.

The paper concludes that improperly abandoned properties are readily apparent in major cities. What is not readily apparent is the economic cost to the responsible party due to lowered property value based on environmental impairment, or even more costly CERCLA action. Proper building decommissioning is planning and supervision intensive. This approach will significantly reduce or eliminate a substantial liability exposure for the property owner and return the property to a beneficial reuse condition as quickly as possible. While on the surface there are similarities to a Phase I environmental assessment or a Phase II investigation, building decommissioning is dramatically different in its scope and final result. The goal of building decommissioning is the elimination of potential environmental and safety liabilities. While there may be significant environmental remediation remaining after a building decommissioning is completed, the comprehensive analysis of the property will provide the basis for an effective remediation plan and future property reuse.

INTRODUCTION

When an industrial building or plant exceeds its service life or loses its economic viability the plant is typically demolished, mothballed, or re-utilized (sold). In most cases the change in usage requires substantial modifications to the building or property. Building modifications generally follow one of two paths: a well-planned, deliberate approach or a haphazard approach that usually ends up creating huge environmental liabilities. American cities and federal reservations are littered with properties and buildings abandoned by their former operators and left for others to deal with the aftermath. Several government programs including the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Clean Michigan Initiative have been created, at least in part, to provide solutions to the problems that these properties present. While in some cases disasters or bankruptcies are the driving force, others are the result of improper planning and execution of decommissioning. This paper discusses a standardized approach to building or plant decommissioning that can be used by those involved in the planning and execution of the work to mitigate the potential detrimental effect of improper decommissioning.

DEFINITIONS:

Decommissioning refers to the planning, conduct, and supervision of the reduction or elimination of hazards and liability contained within a property.

Demolition refers to the physical destruction and removal of a structure.

Remediation refers to the mitigation of pre-existing environmental non-compliance or contamination.

THE NEED FOR DECOMMISSIONING

The goal of decommissioning is to reduce or eliminate the hazards and liabilities present in a building or plant whose use will change. Several factors usually drive the process:

1. Compliance with federal, state, and local regulations.

2. Compliance with business related contracts.
3. The need to minimize short and long term cost.
4. The need to minimize liabilities.
5. The need to have closure.

There are a myriad of regulations that businesses must comply with including those issued by the Occupational Safety and Health Administration (OSHA), the Environmental Protection Agency (EPA), the Department of Transportation (DOT), and others. Additionally, most states have agencies that correspond to the federal agency structure, which in some cases have regulations that differ from the federal agency. Local regulations also provide another layer of regulation and increase the complexity of compliance; zoning and stormwater are typically local regulations.

The task of simply identifying the regulations that apply to a particular building or business operation can be daunting. Because decommissioning a building involves multiple disciplines, it also involves multiple agencies and layers of government to achieve compliance. This is especially important because the decommissioning of a building is an infrequent event for most business operations.

Another regulatory impact on building decommissioning is the vacating of permits. Some permits are simply cancelled while others require substantial paperwork to close out. In some cases, follow-up reports are due two years after the last operating day of the facility.

Business contractual obligations often place pressure upon the decommissioning. Often buildings or the land is leased and the owner has an interest in the condition of the property when the building usage changes. Sometimes equipment is leased or rented, and must be returned. In many cases the suppliers of the business have an interest in the status of their bulk supplies. Typically, the direct customers of the business have a financial interest as well if the reason for the decommissioning is economic.

Those with the most direct financial interest in the decommissioning want to minimize the cost as much as possible. The short-term cost of performing the essential decommissioning work is weighed against the potential long-term cost of delay, often called "the option." In every case there is a budget and within it all activities must be conducted. While long and short term costs do not necessarily have to compete, careful planning can minimize these unwanted interactions between long and short term costs.

Those with even indirect interest in the decommissioning often want to minimize liability. One may consider the insurance company at this point. The insurance company does have a potential to pay for cleanup or restoration should some hazard or contamination be left uncontrolled after shut down. Insurance companies, however, only the most apparent. Others with potential liability are suppliers, customers, shareholders, and employees. Federal pollution laws, under CERCLA and SARA, are quite broad in determining who is responsible for "joint, strict, and several" liability. Those with the most indirect interest have liability, both civil and criminal, should some injurious act or omission be considered negligent or deliberate. The practice of searching for and suing deep pockets often forces this issue.

In business uncertainty is almost always considered a risk to be controlled by the provision of additional information, a procedure or policy, or a financial cushion. The absence of a standard to comply with can be a source of uncertainty. When closing a plant, if there is no decommissioning standard to apply, there is no way to provide verification that the project is completed. Projects that cannot be closed become a recurring process and have the attendant costs and liabilities.

THE 7-STEP APPROACH TO BUILDING DECOMMISSIONING

Decommissioning a plant is a 7-step process. By using this standardized approach, multiple site visits and the duplication of effort is significantly reduced or eliminated. The process is:

1. Initial Site Inspection;
2. Determination of Assessment Criteria;
3. Follow-up Assessment;
4. Development of List of Areas to be Decommissioned (Building Decommissioning Assessment (BDA));
5. Development of Decommissioning Technical Specifications;
6. Decommissioning Implementation; and
7. Decommissioning Documentation.

The key to this process is careful planning and matching to the client's expectation and the requirements of the regulations. The client's expectations are important because different regulations will apply depending upon the final disposition selected - sale/change of use, mothball, or demolition.

The client may wish to use the data developed during the Building Decommissioning Assessment to determine the final disposition of the building. If the client selects this approach, an even more inter-disciplinary approach may be required. Structural engineers and real estate consultants may be necessary to determine the structural integrity and marketability of the building and property. The more options to be evaluated, the more costly the process will be, due to the complexity of the regulations applicable to each potential building outcome.

THE REGULATIONS - DRIVING THE PROCESS

During the operation of a plant there is typically a comfort factor regarding compliance with routine regulations. There are people assigned, forms to fill out, and inspections and audits are conducted with checklists - a normal routine. During decommissioning that routine is eliminated and the task is like that of commissioning a new business unit or process. Some of those same regulations still apply, but often in new ways. Other regulations now apply that are very different from what was the former routine. The statutes that regulate a building decommissioning are:

- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- Resource Conservation and Recovery Act (RCRA)
- Clean Water Act (CWA)
- Clean Air Act (CAA)
- Safe Drinking Water Act
- Pollution Prevention Act (PPA)
- Occupational Safety and Health Act (OSHA)
- Toxic Substances Control Act (TSCA)
- Federal Water Pollution Control Act (FWPCA)
- National Pollutant Discharge Elimination System (NPDES)
- Emergency Planning and Community Right-to-Know Act (EPCRA)
- Oil Pollution Act (OPA 1990)
- Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)
- State levels for Clean-up Criteria

More specifically, several regulations are typically encountered in the course of building decommissioning. Examples of these regulations are in Table 1.

Table 1, Regulatory Citations

Citation	Subject
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response (HAZWOPER)
29 CFR 1910.132	General Employer Training
29 CFR 1910. 146	Permit Required Confined Spaces
29 CFR 1910.1001	Asbestos
29 CFR 1910.1017	Vinyl Chloride
29 CFR 1910.1025	Lead
29 CFR 1910.1028	Benzene
29 CFR 1910.1200	Hazard Communication
29 CFR 1926	PPE for the Construction Industry
40 CFR 50	Lead in Air
40 CFCR 61	Asbestos NESHAP
40 CFR 82	Protection of Stratospheric Ozone
40 CFR 112	Spill Prevention, Control, and Countermeasure
40 CFR 261	Resource Conservation and Recovery Act (RCRA) List of Hazardous Waste
40 CFR 262	Resource Conservation and Recovery Act (RCRA) Generators of Hazardous Waste
40 CFR 268	Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions
40 CFR 273	Universal Waste

40 CFR 280	Underground Storage Tanks
40 CFR 750 & 761	Polychlorinated Biphenyls (PCBs)
40 CFR 763	Asbestos
49 CFR 170	Transportation of Hazardous Materials
49 CFR 172	Hazardous Materials, Hazardous Substances, and Marine Pollutants Tables
49 CFR 172.600	Hazmat Employee Training Requirements
49 CFR 178	Packaging Requirements

Additionally, there are local regulations that will often have a profound impact on any decommissioning project including permits, work hour restrictions, transportation restrictions, and noise ordinances.

APPLYING THE 7-STEP APPROACH TO BUILDING DECOMMISSONING

The net result of all of these regulations is the need for careful tracking and in-depth research to ensure compliance. It takes an enormous amount of planning to determine all of the potential issues that will be faced in decommissioning. At the minimum, the items in Table 2 must be addressed in the first step, Initial Site Inspection.

The Initial Site Inspection should include exhaustive interviews with various plant personnel including:

1. Plant Manager
2. Purchasing agent
3. Environmental, Health and Safety Personnel
4. Medical personnel
5. Plumbers
6. Pipefitters
7. Electricians
8. Millwrights
9. Process engineers
10. Personnel responsible for waste handling

If the plant is older than the experience level of the most senior person, it may be necessary to interview retired plant personnel. In one case, old photographs from a neighboring property owner identified the location of some missing drums of spent solvents, saving weeks of geotechnical investigation.

Use of a form for collecting information regarding the building is highly recommended. The form varies from one project to another, depending upon the size and known project information. Essentially, the method of collection is a systematic inspection of the building room by room and process by process. It is essential to do both to determine where environmental problems may be. A process line may run for several hundred feet under the floor and may have leaked at various points along the way. The contaminants in the source may then be found in areas unanticipated from room-by-room inspection. The current process layout may have changed over time as the plant operations changed. It will be necessary to trace former processes throughout the building.

When the site is fully inspected and documented, the potential issues need to be matched to the appropriate regulations. It is important to note that several regulations may apply to one activity or substance. For example, lead is regulated differently from the industrial worker, construction worker, packaging, transportation, and disposal point of view. Do not assume that any definition is common for all regulations. The same term may have vastly different meanings from one regulation to another within the same Code of Federal Regulations title.

Table 2, Initial Site Inspection Considerations

Past and current site operations and conditions of the site
Site plans
Aerial photographs
Building floor plans
Underground mechanical and electrical drawings
Soil boring logs
Historical environmental reports prepared for the site
Historical asbestos survey reports
Solid waste accumulations

Potential Polychlorinated Biphenyls (PCB) areas
Ventilation machinery and duct work
Chlorofluorocarbons (CFC) containing equipment
Type of paint
Location and dimension of any sumps
Type of equipment present and any waste holding capacity
Asbestos-containing materials (ACM)
Underground storage tanks
Aboveground storage tanks
Type and location of lighting
Type and locations of transformers and capacitors
Process sewers and lines
Maintenance areas
Welding areas
Paint booths
Cleaning areas
Lead processing areas
Metal casting areas
Powerhouse
Collectors
Cooling towers
Air conditioning or refridrgation equipment
Medical waste
Mercury switches and previous locations of mercury-containing devices
Radioactive material
Structural component contamination
Flooring contaminated with or containing asbestos
Water processing systems
Wells (water, environmental, mineral, and injection)
Recycling operations
Previously filled in pits and sumps.
Logistical concerns, including equipment size and weight.
Location and use of any confined spaces.

The second step, the Determination of Assessment Criteria, involves making a determination of what areas require more scrutiny. The data from the initial site walk through needs to be compared to the potential regulatory compliance issues. Experience and a well-developed checklist are necessary to ensure all potential issues are uncovered here. The danger of using a checklist is the tendency for the checklist to fall out of date with the never-ending barrage of new rules and regulations. Constant checking with the Federal Register and state and local equivalents are necessary to prevent costly oversights. It is also important to know what the quasi-regulatory agencies like National Institute of Occupational Safety and Health (NIOSH) and the American Society of Safety Engineers (ASSE) are considering because they often anticipate new regulations. It may be more beneficial to the client to look ahead to the most stringent standard in practice than it would be to achieve compliance at a later date.

The output of the second step (Determination of Assessment Criteria) is usually a sampling plan for the potential areas of concern and potential areas of release. The sampling plan should be very specific regarding the constituent of concern, location, type of sample to be taken, method of collection, and safety factors. Although a site-specific health and safety plan must be written, a summary of specific personnel protective equipment and hazards should accompany the sampling plan.

The third step, Follow-up Assessment, is based upon careful comparison between known and unknown data and the regulatory standards. Additional investigation is usually necessary to determine the extent of changes from the documented building plans to the as-built reality. Sewer lines are abandoned, pits are filled in, and machinery is moved around. What may seem to be a minor change may be significant from a decommissioning point of view. For example, machinery pits were often filled in with foundry sand or other similar waste product and then capped with concrete. That fill is often contaminated.

The investigation into prior uses often will focus on production changes from year to year. The placement of machinery and the process piping that serves the tooling may have changed over the life of the plant. The process drawings and photographs are essential to determine what may lie hidden under the floor. Sometimes there are signs such as filled in pipes, concrete patches, and metal plates. However, if the

changes were significant, an entire floor section may have been replaced, effectively eliminating a surface history.

Proper sampling protocol is essential to prevent wasted or duplicated effort. Each sample location must be marked in a way that is permanent, legible, and will survive intensive cleaning, and be photographed close up and from at least two distant views. The exact sampling location should be precisely measured from points that will not be moved, even if the building is demolished. Spray paint on the floor is almost always inadequate.

There are two different goals for sampling: compliance and disposal. Although the two are not mutually exclusive, they are different in what they require. Often, when a material is sampled for compliance purposes, only specific criteria are tested for based upon the regulatory agency's sampling scheme. This is often inadequate for waste characterization purposes and may require duplicate sampling at a later date. Because disposal may require setting up a new waste profile, it may be beneficial to include the potential waste profile criteria to the initial sampling plan.

The fourth step, Development of List of Areas to be Decommissioned, leads to the Building Decommissioning Assessment Report. This step may require the use of backwards planning and a knowledge of demolitions. If the plant will be sold or re-used for a different purpose, then the new owners will be a part of this step. If the plant will be mothballed, an in-depth knowledge of building preparation for mothballing will be necessary. With the end result in mind, the plan for decommissioning will be drafted.

Assuming demolition is selected, the final disposition of all building material and debris must be determined. If the steel will be recycled, the scrap yard or smelter should be contacted to determine what condition the steel must be in. Considerations include:

- Will they accept lead paint and at what concentration?
- Can the landfill accept brick and block with lead paint?
- Where can the PCB contaminated debris go?
- What method of shipment will be used?
- What size can the scrap be?
- Where can the asbestos roofing material go?

These questions must be answered to determine the level of effort and the standards that will apply.

The goal in this stage of the decommissioning process is to determine what has to be done without missing any essential areas, but avoiding any extra, costly work. Looking at the situation from a waste perspective, then from a safety perspective, then from a work efficiency perspective often yields the best results.

The fifth step, Development of Decommissioning Technical Specifications, lead to a scope of work and standards which will apply to the building decommissioning contractor(s). The end result should govern the specification writing process. Determining the end result can sometimes be the most difficult part of this step. For example:

- What standard applies to lead paint? The Department of Housing and Urban Development (HUD) established a standard for living quarters which is designed to protect children. Should this standard be applied to an industrial setting?
- Lead paint is usually acceptable for scrap steel going directly to a smelter, but may not be acceptable to a particular scrap yard depending upon what environmental challenges it faces.
- Plants that will be re-used or mothballed will often have to remove flaking lead paint, but leave intact paint in place. If the lead concentrations are quite high, the paint waste may exceed the Toxicity Characteristic Leaching Procedure (TCLP) standards for landfill disposal without treatment should some section of the building be renovated.
- How does 29 CFR 1926 (Construction Safety) apply during decommissioning?

Technical specifications usually specify the desired end result. During decommissioning the methods are also critical. Many industrial cleaning contractors use pressure washers for many tasks. While effective, there may be negative consequences from a waste handling and equipment functioning perspective. In one case, pressure washing blew small metal stampings on conveyor rollers, rendering the system useless. Water from pressure washing has also buckled wood-block flooring and rendered a Process Logic Control (PLC) panel useless.

Safety of the workers is also paramount. Safety standards need to be built into the technical specifications. At minimum, worker PPE, personal air monitoring, health and safety supervision, confined space rescue, and excavation safety should be separate pay items.

The sixth step is the Decommissioning Implementation, actually performing the decommissioning work. The plant personnel and contractors, as appropriate, work to decommission the plant. Active oversight is essential in this stage. The personnel providing the oversight must be intimately familiar with the specifications, the means and methods in use, and health and safety standards. While this may be a step where clients prefer to try to save cost, active and total oversight is essential. The technical specifications need to be interpreted consistently throughout the project. Because no project ever progresses as it was conceived in the mind of the specification writer, constant adaptability is critical.

The documentation of the work in progress is as important as the decommissioning work itself. All activities should be documented with the pay item, location, personnel assigned, equipment used, PPE used, waste generated, problems encountered, and photographs portraying the work before, during, and after.

Small projects may need only one person supervising. Large projects with multiple locations may need a team of personnel to properly supervise the project. Supervisory personnel should be highly trained and experienced. Junior personnel may be used with intensive supervision, but should not be used independently.

All personnel must have the appropriate level of safety training including HAZWOPER, asbestos, confined space, fall protection, and respiratory protection training. Additionally, oversight personnel should have experience in the means and methods employed on the site. While it may seem that pressure washing is self-explanatory, the results and production rates achieved by experienced and inexperienced personnel tell another story.

Oversight personnel will also be required to conduct confirmatory sampling of the decommissioning. This may involve numerous protocols in a variety of locations. Ideally, the personnel who conducted the first sampling operation will be able to provide guidance, or take the confirmatory samples directly. The original sampling locations from the initial sampling program should be duplicated as closely as possible to ensure consistency.

Personnel involved in the handling, transportation, and disposal of waste materials require Department of Transportation (DOT) training and should have experience in profiling, sampling, DOT standards and restrictions, transportation routes and methods, disposal locations and methods, and RCRA paperwork. This position is critical to the success of the project. Nothing should be allowed off-site unless it has been properly documented.

The seventh step is the documentation of the entire building decommissioning process, the Building Decommissioning Report. The purpose of the report is to provide a record of all activities and final dispositions of waste and recycled products. The audience for this report is a regulator or technical person unfamiliar with the site and what was involved in the decommissioning. The table of contents of a typical report is listed in Table 3.

Table 3, Typical Building Decommissioning Report Table of Contents

1. Site history
2. Purpose of closure
3. Summary of the Building Decommissioning Assessment
4. Building Decommissioning Methodology
5. Initial Site Inspection
6. Determination of Assessment Criteria
7. Concrete Surfaces
8. Metal Surfaces
9. Lead Painted Surfaces
10. Flooring and Other Building Materials
11. Industrial Waste/Process Liquids, Oils, Sediment, Wastewater, Sludge
12. Compliance Issues
13. Sewer Systems

14. Asbestos Containing Materials
15. CFC-Containing Equipment
16. Follow-up Assessment
17. List of Areas to be Decommissioned
18. Building Decommissioning Assessment and Decommissioning Specifications
19. Selection of the Building Disposition Scenario
20. Original Building Decommissioning Scope of Work
21. Modifications to the Original Building Decommissioning Scope of Work
22. Flaking Lead Paint Abatement
23. PCB Contaminated Material Removal
24. Process Waste Piping
25. Product Supply Line Evacuation
26. Concrete Sump Cleaning
27. Fume Hoods and Exhaust Equipment Cleaning
28. Asbestos Containing Material Removal
29. Existing Waste Removal
30. Waste Management (Solid and Liquid)
31. Daily Project Log
32. Photograph Journal
33. Resource Conservation and Recovery Act (RCRA) Waste Documentation
34. Special Waste Documentation
35. Conclusions
36. Recommendations
37. Certification

Table 3 is not complete for all sites. The exact contents of the report will reflect the previous 6 steps. If the basic format is followed, the chances of missing an important detail are dramatically minimized.

DEVELOPING THE WORK PLAN

Aside from the initial investigation, the area that causes the greatest problem with building decommissioning is developing and executing the work plan. While the consulting engineer typically does not write the work plan - leaving that task to the contractor - there needs to be intense supervision over this process.

The problem with most building decommissioning work plans is the compartmentalization of tasks. While on many projects each element of the scope of work is relatively independent of other elements or follows a rather sequential critical path, decommissioning projects will have multiple critical path items that will relate many separate tasks. For example, the scope of work may call for the cleaning of air ducts. This cleaning may release metals onto the floor, into the floor drain, through the process sewer system, into the wastewater treatment plant, ultimately in the sludge tank. If the work is not sequenced well, the contractor may work on the wastewater treatment plant first since it may be the task requiring the greatest time and manpower without regard to the consequences of his actions.

Following the same example, if the metals level is high enough, it may make the sludge a hazardous waste and necessitate establishing a new waste stream. If the plant was a Small Quantity Generator, it may now reach the level of a Large Quantity Generator and have to comply with the additional regulatory burden during and after shutdown. Avoiding these situations requires active management in the planning stages.

The work plan should be written with the goal of minimizing the amount of waste generated, avoiding re-work, and labor and equipment efficiency. The best approach is to start with the end goal and then determine the predecessor element and related elements. This is sometimes called "backwards planning." While not a new concept - it has been used in military planning for thousands of years - it is not universally applied. Most state of the art software packages do not support it. Properly used it will discipline the planner to consider all of the inter-relationships between all tasks.

The work plan should then be committed to a critical path or Gantt chart. The critical path must be identified and tracked. Non-critical path items can then be used to balance labor, equipment, and logistics. If the schedule cannot be balanced, then changes must be made. For example, on one project the owner demanded the disposal of waste at a rate that exceeded the maximum capability of the landfill, disregarding all other customers. The schedule had to be adjusted to match reality. The result pushed

back a real estate transaction by two months. Other potential problems may involve trying to have too many workers in a limited area or work hour restrictions.

THE BENEFITS OF THE 7-STEP APPROACH TO BUILDING DECOMMISSIONING

While the preceding may seem overwhelming, it actually provides substantial financial and scheduling benefits. The primary benefit is the control of cost, both direct and indirect. Direct costs are controlled by defining the scope of work accurately and minimizing the amount of waste generated. This minimizes the number and severity of change orders. Indirect costs are controlled by providing an accurate assessment of what was developed and the work completed. In Michigan, the state uses a tool called a Baseline Environmental Assessment to protect new property owners from previous contamination. This puts the liability squarely on the previous property owner. Proper decommissioning and documentation serves as evidence of a clean site. Liability for all subsequent contamination is then transferred to the new property owner under the premise that any contamination on a clean site must be the responsibility of current operations.

Often, decommissioning is the result of negotiations between the seller and the buyer. The seller will use the decommissioning to raise the property value or minimize future liability. The buyer uses the decommissioning to shield himself from potential future liability by forcing the seller to eliminate potential problems.

Those who are familiar with the principles of Total Quality Management and ISO 9000 may notice that this process matches the Deming Plan-Do-Check-Act cycle. The 7-Step Approach to Building Decommissioning was developed using the best management practices in use within the project management genre while applying both quality and environmental management principles. Its use appeals most to those clients with functional quality systems, environmental management systems, and ISO 9000 and 14001 registration.

CONCLUSION

Improperly abandoned properties are readily apparent in major cities. What is not readily apparent is the economic cost to the responsible party due to lowered property value based on environmental impairment, or even more costly CERCLA action. Proper building decommissioning is planning and supervision intensive. This approach will significantly reduce or eliminate a substantial liability exposure for the property owner and return the property to a beneficial reuse condition as quickly as possible. While on the surface there are similarities to a Phase I environmental assessment or a Phase II investigation, building decommissioning is dramatically different in its scope and final result. The goal of building decommissioning is the elimination of potential environmental and safety liabilities. While there may be significant environmental remediation remaining after a building decommissioning is completed, the comprehensive analysis of the property provided by the 7-Step Approach to Building Decommissioning will provide the basis for an effective remediation plan and future property reuse.