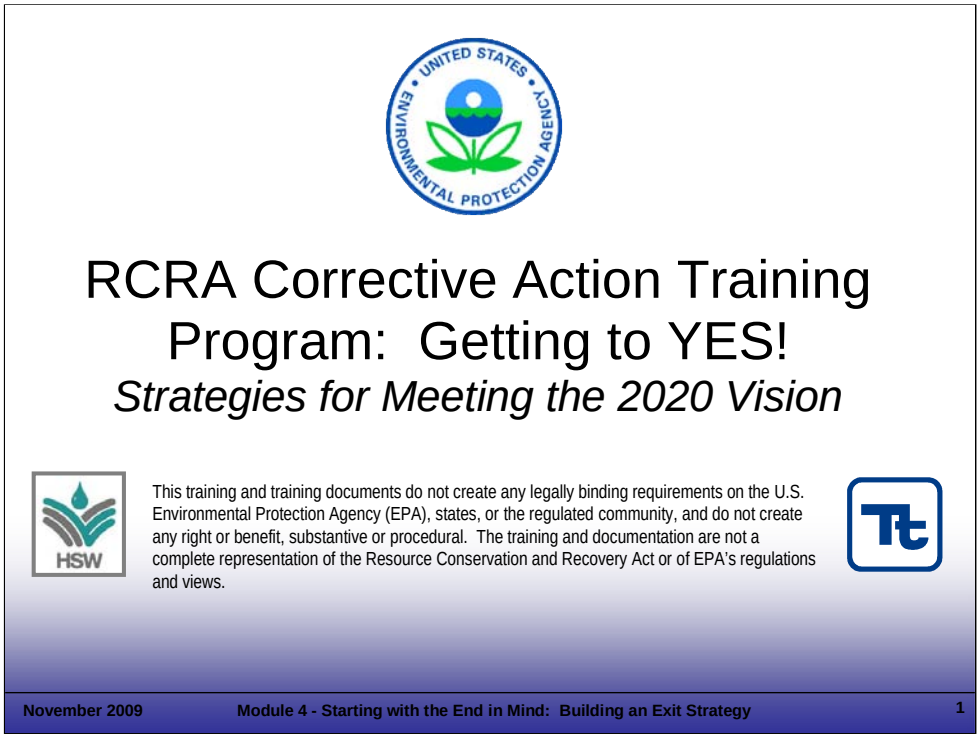


Notes:

Purpose of Slide

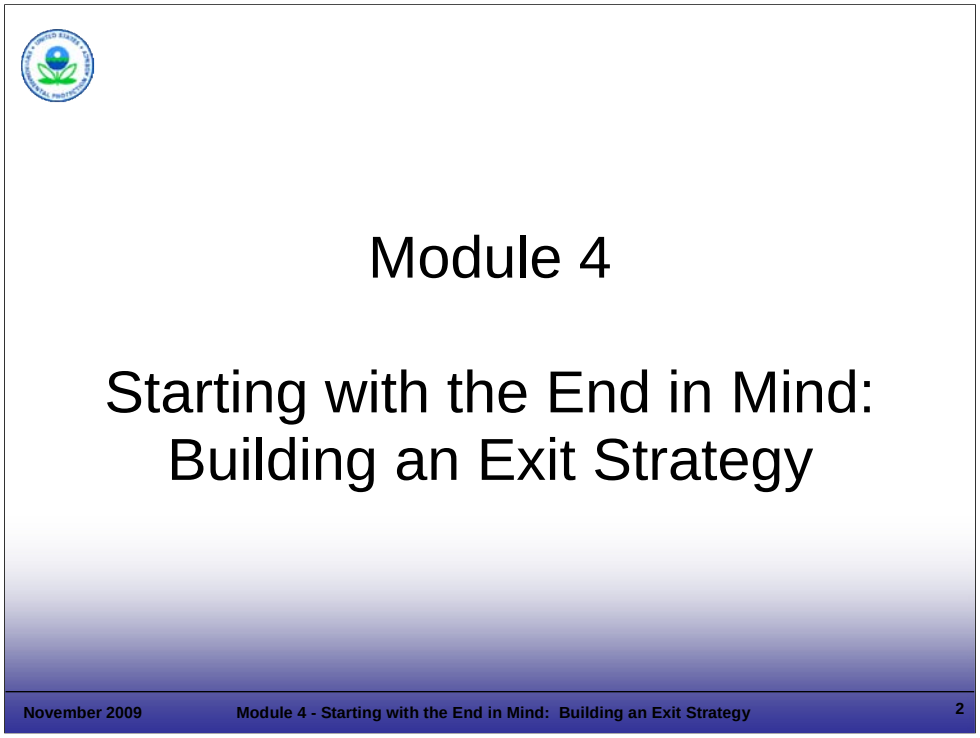
- Holder slide for Module 4, Starting with the End in Mind: Building an Exit Strategy.

Key Points

- This is a holder slide. No specific key points.

References

- None.



Notes:

Purpose of Slide

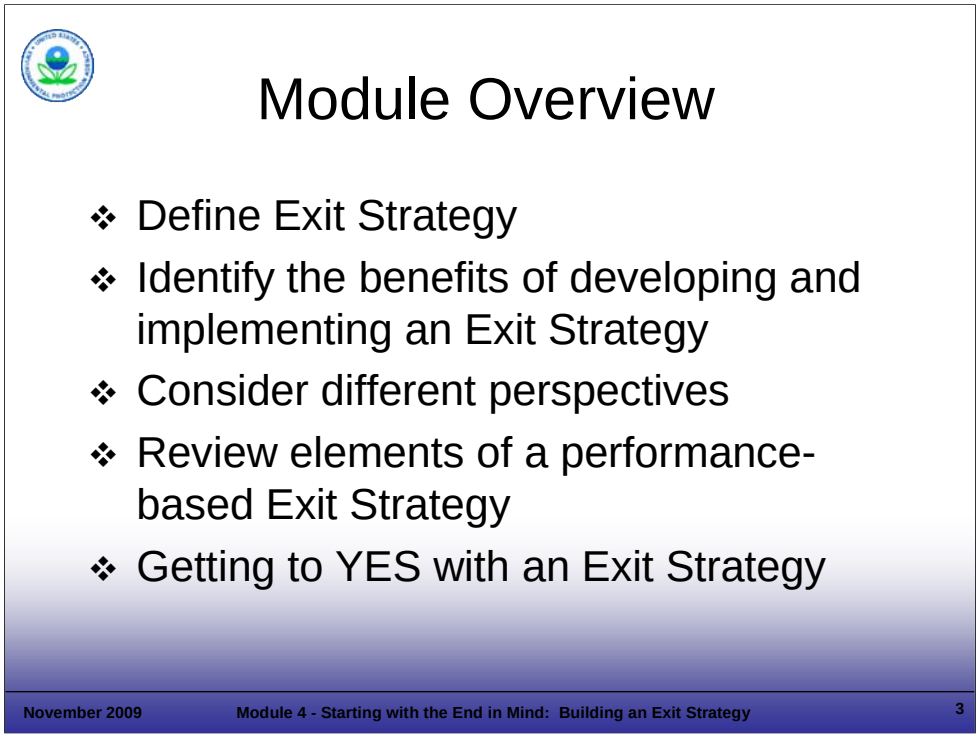
- Holder slide for Module 4, Starting with the End in Mind: Building an Exit Strategy.

Key Points

- This is a holder slide. No specific key points.

References

- None.



Notes:

Purpose of Slide: Introduce the module, which is placed at the beginning of the course to stress the importance of clear end goals in supporting rapid corrective action (CA) progress.

Key Points

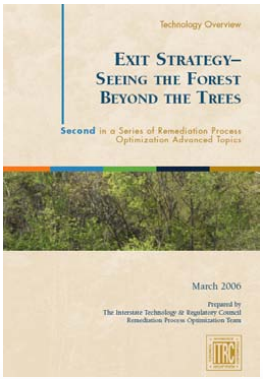
- This module will introduce the concept of an Exit Strategy and identify the benefits of "starting with the end in mind." An Exit Strategy can help streamline the CA process when all stakeholders agree to the Strategy. Also, it can integrate 2020 goals for CA.
- We will review the importance of understanding the perspectives of all the stakeholders, including the technical project manager, the regulator, the business owner, and the public.
- There is also a historical perspective. In the early days of Resource Conservation and Recovery Act (RCRA) CA, we tended to focus on the task at hand – preparing plans on how to install monitoring wells and sample those wells, evaluating technologies that would address the type of contamination present, writing work plans and reports, and responding to comments. In other words, we were process oriented because people (both the regulators and the regulated community) were not familiar with conducting cleanup. But now, our collective CA experience allows us to replace, in part, the process-driven approach with a results-based approach that accelerates the rate at which we address sites.
- Over time, we have come to realize that the best approach to CA (the results-based approach) addresses current and reasonably anticipated uses of a property. The results-based approach lends itself to development of an Exit Strategy for each site early in the CA process. The exit strategy will incorporate all phases of CA, including long-term stewardship when required.
- A facility that plans to change its use from industrial with historical hazardous waste disposal to a residential development or theme park will require a CA approach that is very different than if the same industrial facility intends to continue operating as an industrial plant. The Exit Strategy will reflect these plans.
- To illustrate how Exit Strategy use can support CA, we will provide examples of Exit Strategy implementation.
- ***Facilities can incorporate 2020 goals into Exit Strategies – hence, Getting to YES!***

References

- None.

Definition of Exit Strategy

- *A dynamic and succinct plan for accomplishing*
- *specific performance goals within a*
- *defined time period to*
- *assure protection of human health and the environment.*



November 2009 Module 4 - Starting with the End in Mind: Building an Exit Strategy 4

Notes:

Purpose of Slide

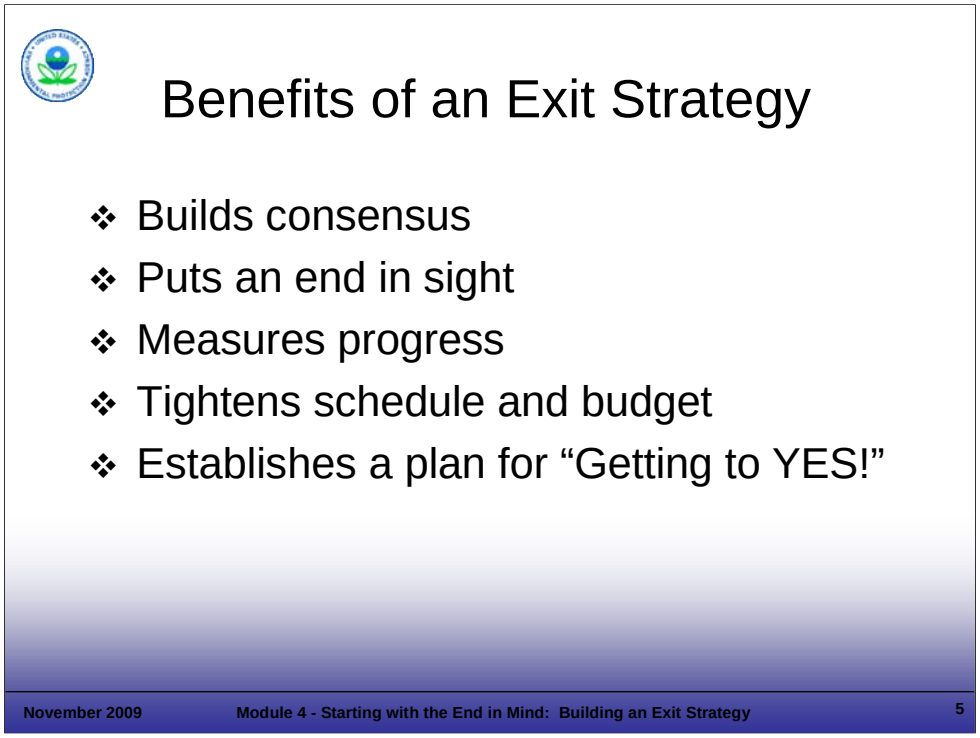
- Provide a definition of Exit Strategy.

Key Points

- An Exit Strategy is a clear, forward-looking plan for a site. The Exit Strategy should be dynamic and refined over time as knowledge of the site improves. The Exit Strategy and site understanding should be reviewed and updated, as appropriate, through routine reviews to take advantage of lessons learned. Preferably, the Exit Strategy is developed and updated by the facility and regulatory agency working together.
- To the extent possible, the Exit Strategy for a facility should be performance-based, so that it focuses on progress toward achieving remedial action objectives (RAOs). To support the identification of specific performance goals, the Exit Strategy should be based on a sound technical understanding of site conditions and appropriate remediation technologies. The Exit Strategy should be constructed using objective metrics to describe how progress toward meeting RAOs will be measured (i.e., how success will be measured). Once metrics are established, course corrections can be made if a selected remedy fails to perform as expected.
- Finally, an Exit Strategy should be designed to assure protection of human health and the environment based on current and reasonably anticipated uses for the site. The Exit Strategy should emphasize the evaluation and optimization of remedy performance to assure timely and cost effective protection of human health and the environment.

References

- Interstate Technology and Regulatory Council (ITRC). 2006. Exit Strategy – Seeing the Forest Beyond the Trees. Second in a Series of Remediation Process Optimization Advanced Topics. ITRC Remediation Process Optimization Team. March.



Notes:

Purpose of Slide

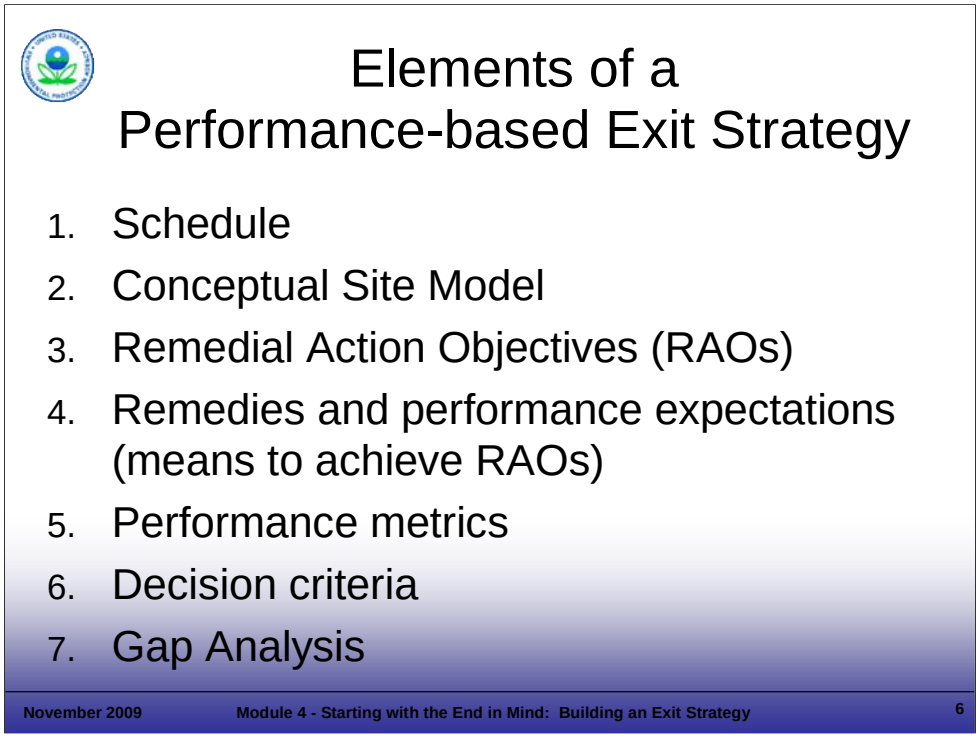
- Outline the benefits of having a clear Exit Strategy.

Key Points

- Having a clear end point and Exit Strategy can assist communication and understanding among multiple stakeholders. Reaching consensus on CA decisions is easier when the Exit Strategy is supported by all stakeholders. For example, if the Exit Strategy calls for long-term remediation with passive technologies, the parties are more likely to agree on less frequent sampling than for a rapid cleanup. This is because contaminant concentrations will change more rapidly for an aggressive remedy with a technology approach and therefore, will need to be monitored more frequently.
- An Exit Strategy will allow informed and timely decisions on the project path; such a strategy would typically include milestones and endpoints. For example, if a portion of a facility will be revitalized for a new use, while the remainder of the facility remains in operation, more aggressive remedial technologies may be chosen for the area designated for redevelopment, while passive technologies may be considered for the continued use area.
- Once milestones and endpoints are established, the owner/operator (o/o) can judge the level of effort required and set aside appropriate resources to achieve timely implementation.
- An Exit Strategy allows the o/o to track its schedule and expenses relative to site progress (such as reaching key milestones) and will allow forward planning to address any necessary changes in the approach.
- An Exit Strategy can help industrial and government facilities with their budget planning processes and support their budget tracking. Financial assurance considerations can be taken into account. Publicly traded companies, for example, must comply with Sarbanes Oxley, which deals with fiscal accountability for environmental liabilities and proper and accurate estimation of anticipated costs. Government facilities must make budget requests for future years within prescribed budgeting timelines.
- A plan and schedule for meeting 2020 CA goals (Getting to YES) can be included in an Exit Strategy.

References

- None.



Notes:

Purpose of Slide

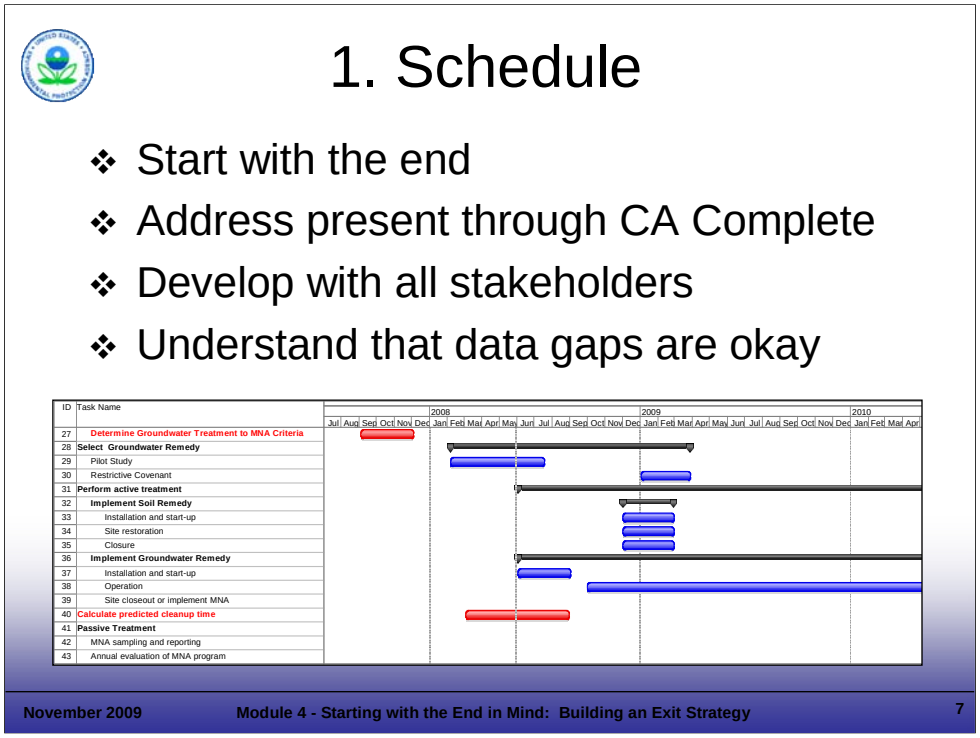
- Introduce the elements of a performance-based Exit Strategy.

Key Points

- A schedule is a key element of an Exit Strategy.
- The description of the environmental problem at a site typically takes the form of a conceptual site model (CSM), which is a summary of available information related to contaminant sources and release mechanisms, affected media, contaminant fate and transport, and receptor exposures.
- RAOs are CA completion criteria that must be met for a cleanup to be protective. RAOs are generally expressed in narrative form, sometimes with references to numerical standards.
- The remedy selected to achieve the RAOs may include treatment, contaminant containment, and receptor exposure controls (engineering and institutional controls). The remedy is generally expressed in a narrative form, although it may incorporate numeric cleanup goals. The description should include how the remedy is expected to perform over time.
- Performance metrics are the yardsticks against which progress (success/failure) toward meeting the objectives is measured.
- The decision criteria, in the form of a logic diagram or flowchart, can be a valuable component of an Exit Strategy. Examples of factors that can be incorporated into a decision logic diagram or flowchart include:
  - The number or frequency of "clean" samples required to terminate active remediation or to abandon monitoring wells;
  - The influent concentration required to eliminate treatment components, such as a second air stripper or off-gas treatment.
- Data gaps are expected in long-term cleanups and plans for closing these gaps should be developed.

References

- ITRC. 2006. Exit Strategy – Seeing the Forest Beyond the Trees. ITRC Remediation Process Optimization Team. March.
- ITRC. 2004. Remediation Process Optimization: Identifying Opportunities for Enhanced and More Efficient Site Remediation. September.
- ITRC. 2007. Improving Environmental Site Remediation Through Performance-Based Environmental Management. November.



Notes:

Purpose of Slide

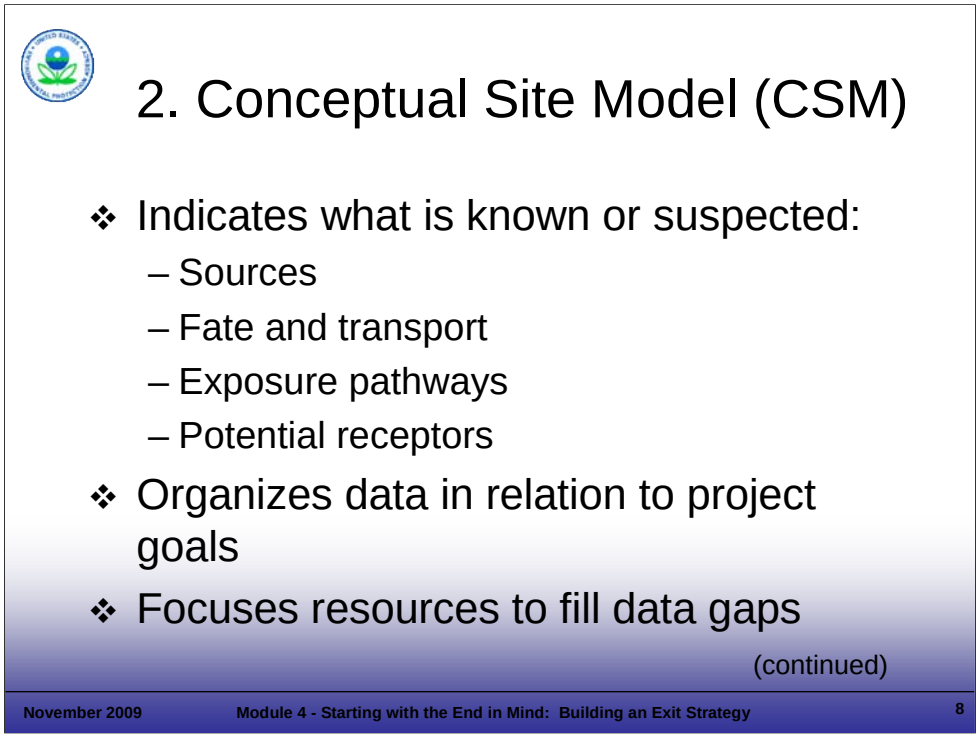
- Present the importance of including a schedule as part of an Exit Strategy

Key Points

- Schedule development begins by establishing endpoints, which are based on the RAOs.
- Ideally, the schedule will incorporate the entire period of CA (although some may begin with a schedule that spans only through the CA construction or through the initial years of remedy operation). Developing an Exit Strategy schedule is useful even if CA has been ongoing for many years.
- It is best to develop the schedule with multiple stakeholders including the o/o and agency.
- Data gaps are expected. In fact, one advantage of developing a long-term schedule early in the CA process is to identify data gaps and direct activities towards addressing those gaps.
- The pace of cleanup can differ based on the anticipated site use and the schedule for that use. For example, monitored natural attenuation (MNA) may be selected as a remedy at a facility with ongoing operations where groundwater is not used for water supply, even though it might take decades to achieve final cleanup criteria (for example, drinking water standards) because MNA has the lowest life-cycle cost (total cost of remediation to achieve final cleanup criteria) and is protective for anticipated uses.
- On the other hand, a facility undergoing revitalization for a new use would likely be on a faster track for cleanup, even though many remedies can continue operating after the site is redeveloped. Often, groundwater treatment may continue, but source and contaminated soil removal is expedited to allow reuse of the land for new purposes. The life cycle cost of this approach may be higher compared to alternative remedies, but the value of the land for alternative uses may drive the remedy selection.
- Also, the complexity of a cleanup and the risks posed at a site may impact the cleanup schedule and the overall Exit Strategy.

References

- None.



Notes:

Purpose of Slide

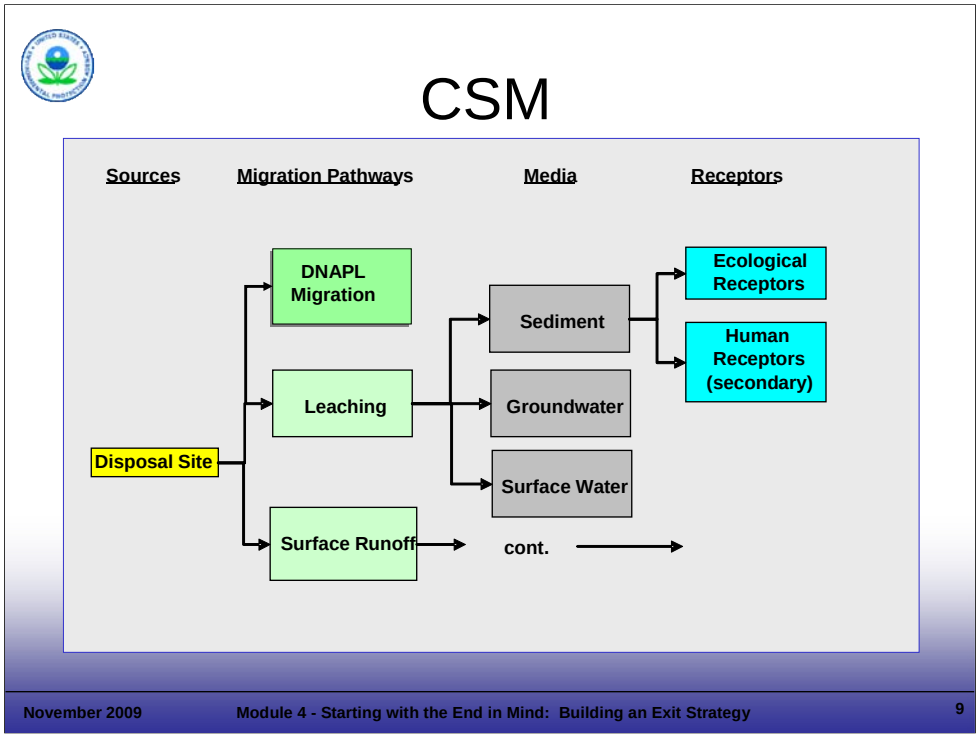
- Discuss the CSM and how it is used in developing and implementing an effective Exit Strategy.

Key Points

- The CSM identifies sources of contamination and how that contamination moves through the environment to receptors when the migration pathways are complete.
- A CSM is important for organizing known information, but also provides the framework to identify what is not known about the site and what decisions need to be made. The CSM focuses on identifying data gaps that must be closed to meet site goals.
- The CSM is dynamic and should be updated as new site information becomes available.

References

- EPA. 2001. Current Perspectives in Site Remediation and Monitoring: Using the Triad Approach to Improve the Cost Effectiveness of Hazardous Waste Site Cleanups. Author listed: DM Crumbling. EPA-542-R-01-016. October.



Notes:

Purpose of Slide

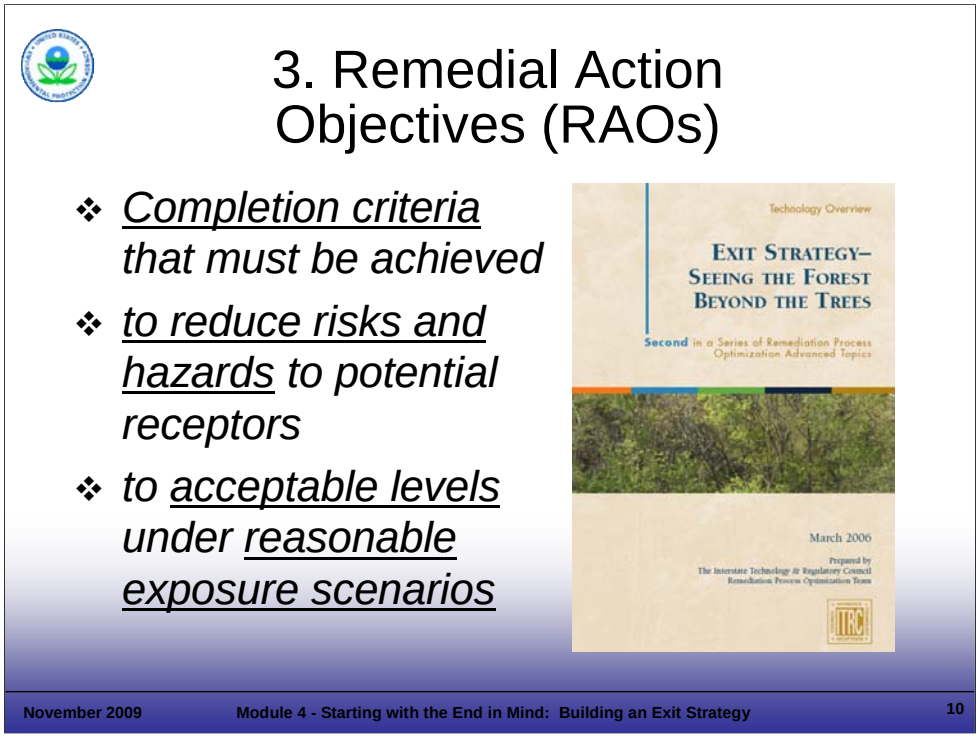
- Provide an example of a CSM.

Key Points

- A CSM can be presented in the form of graphs, cross-sectional maps, simple diagrams, tables, flowcharts, plan view maps, and/or verbal descriptions. The purpose is to identify sources, migration pathways, impacted media, and potential receptors.
- A CSM is also used to evaluate engineering controls and institutional controls (ICs) for their potential to prevent or limit exposure.
- A single project may have more than one CSM.
- The CSM is used to guide field work that gathers information to address data gaps.

References

- EPA. 2001. Current Perspectives in Site Remediation and Monitoring: Using the Triad Approach to Improve the Cost Effectiveness of Hazardous Waste Site Cleanups. Author listed: DM Crumbling. EPA-542-R-01-016. October.



Notes:

Purpose of Slide

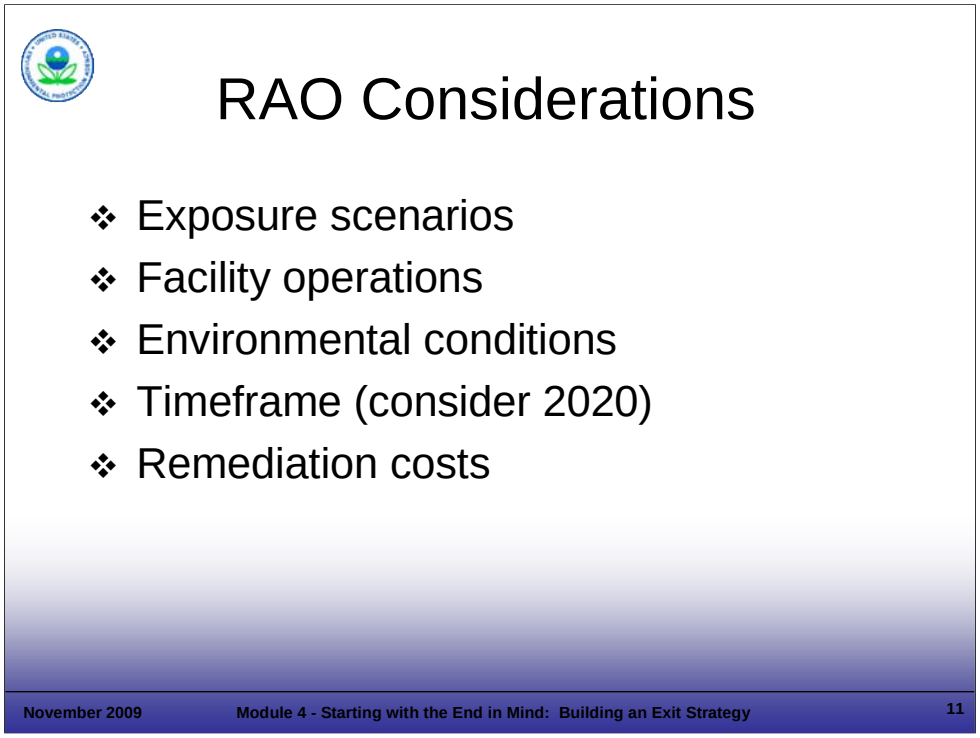
- Provide an operating definition of RAOs.

Key Points

- RAOs are remediation completion criteria achieved to reduce risks and hazards to potential receptors to acceptable levels under reasonable exposure scenarios. An example of a RAO is to "prevent exposure of on-site workers to arsenic in soils above the applicable industrial soil cleanup criterion."
- Well defined and achievable RAOs are vital to efficient site remediation. The Project Manager and facility should work to establish RAOs that are reasonably attainable as well as protective of human health and the environment.

References

- ITRC. 2006. Exit Strategy – Seeing the Forest Beyond the Trees. Second in a Series of Remediation Process Optimization Advanced Topics. ITRC Remediation Process Optimization Team. March.
- EPA. 2002. Elements for Effective Management of Operating Pump and Treat Systems. Fact Sheet. December.



Notes:

Purpose of Slide

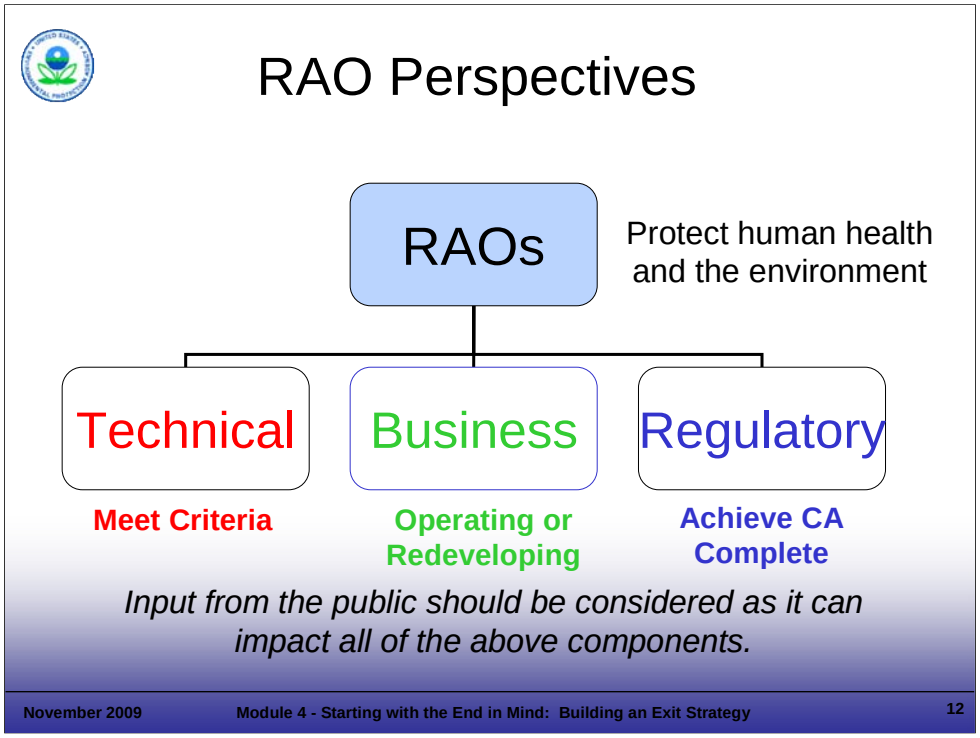
- Explain the basis of RAOs.

Key Points

- An understanding of current and anticipated ***land*** uses and exposure scenarios is important to identify acceptable cleanup levels under reasonable exposure scenarios. If there are no risks, remedial actions and RAOs are unnecessary.
- Facility operations, financial considerations, and the schedule for redevelopment, if applicable, are important in developing RAOs, which are tailored to each site's specific environmental conditions.
- RAOs should be achievable in a reasonable timeframe and in a cost effective manner. The 2020 Vision for CA and associated goals come into play here; they are important elements to consider in defining a reasonable end point. EPA's goal is to have remedies implemented by 2020 at facilities in the CA universe; however, while the remedy is implemented, all cleanup objectives may not be achieved by that year. For example, complex groundwater and non-aqueous phase liquid (NAPL) remedies could take many years for the goals to be achieved. Thus, the remedy construction goal can be met by 2020, with the cleanup criteria achieved over a longer time period. The ultimate goal for the facility is to complete CA and have CA obligations removed from the permit or have the CA order terminated, depending on the regulatory mechanism.
- The EPA Groundwater Handbook is a source that discusses reasonable timeframes as this concept relates to groundwater:
  - *After achieving short-term goals [eliminating unacceptable risks and preventing plumes from spreading], facilities can move toward final cleanup goals in a timeframe commensurate with the technical difficulties and potential risks.*
- Anticipated remediation costs and financial assurance are also considered in establishing RAOs.

References

- ITRC. 2006. Exit Strategy – Seeing the Forest Beyond the Trees. Second in a Series of Remediation Process Optimization Advanced Topics. ITRC Remediation Process Optimization Team. March.
- EPA. 2004. Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action for Facilities Subject to Corrective Action Under Subtitle C of the Resource Conservation and Recovery Act. EPA 530-R-04-030. Update. April.



Notes:

Purpose of Slide

- Point out that there are various ways of looking at RAOs or an Exit Strategy.

Key Points

- There are different ways of looking at an Exit Strategy and its components. These different perspectives might include those of the technical project manager, the regulator, and the facility owner. It is important to understand these perspectives because each of these stakeholders needs to take ownership of the Exit Strategy for it to work.
- The technical project manager looks for a technology that will address the contaminants that are present. His or her milestones and endpoints are technical, such as cleanup to a certain concentration level. He or she is also responsible for meeting certain performance metrics, such as discharge criteria. However, there are often multiple effective technologies for a family of contaminants, so other considerations, such as facility goals for reuse, also affect the technology selection.
- The regulator has different endpoints or RAOs that must be met, such as meeting CA Complete (CA 900 or CA 999).
- The owner has other factors to consider. For example, the owner may need to ensure a portion of a facility is ready for sale to a prospective purchaser by a given date. The anticipated use of that parcel can have direct consequences for remedy selection. For example, a facility may select capping for contaminated soil for continued industrial use of a parcel, but may select excavation with off-site disposal under a redevelopment scenario.
- When there are no imminent risks, the different perspectives and associated approaches to remedial decision making can have significant impacts on the remedial choices that are made.
- In developing the Exit Strategy, these various perspectives should be considered.

References

- None.

Notes:

Purpose of Slide

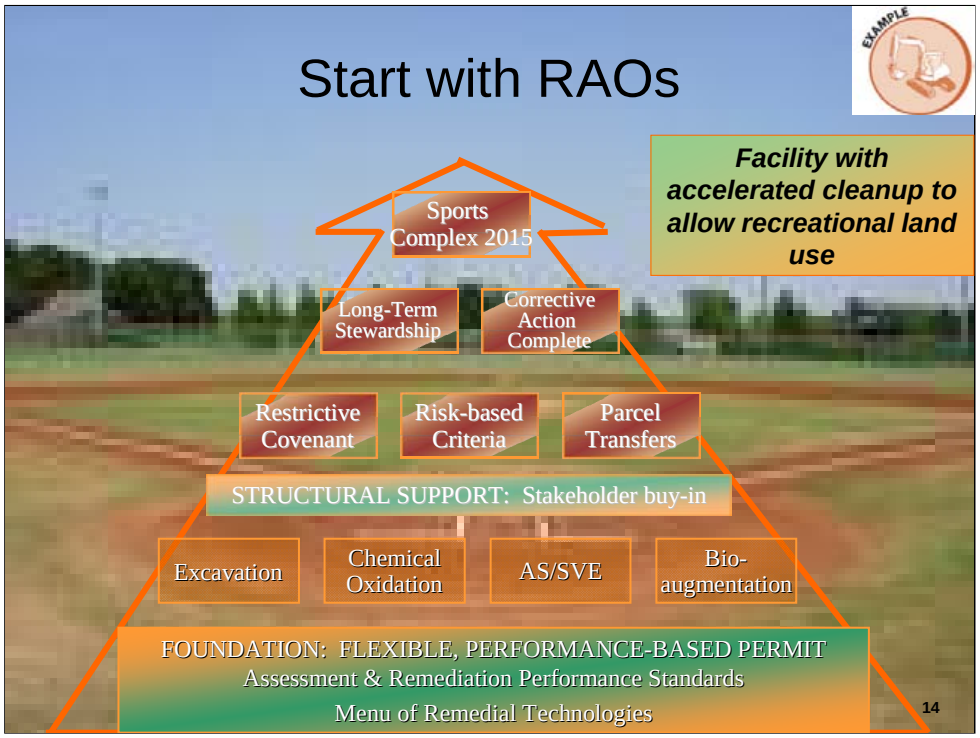
- Illustrate different perspectives or components of the Exit Strategy.

Key Points

- In this example, soil at a former fire training center has been excavated; all source material, including dense non-aqueous phase liquids (DNAPL), has been removed but the groundwater does not meet risk-based criteria. The endpoints, established based on technical, regulatory, and business perspectives, are identified in the Exit Strategy as the following:
  - The technical endpoint is to design a remedy that will meet the state criteria by 2012 within the available budget and consistent with financial assurance requirements.
  - The regulatory endpoint is to assure that sufficient monitoring data are available to support a permit modification for No Further Action (NFA) by 2015 (considerable lead time is necessary for permit modifications – for example, to accommodate public notice requirements). This will also constitute a CA Complete with Controls decision, based on meeting the state's criteria (such as plume stability) for NFA with ICs.
  - The business endpoint is to close out the liability associated with the property and donate the land to the County for use as a sports complex.

References

- None.



Notes:

Purpose of Slide

- Provide an example of an Exit Strategy. This strategy was developed "with the end in mind" – in other words, it is based on the anticipated use of the facility as a sports complex. This example shows how a permit was used to support progress. While certain significant treatment system modifications may require permit modifications under 240 CFR 270.42, this course focuses on the flexibility that can be built into permits, through up-front planning. Examples are provided to illustrate how adjustments to field activities and treatment technologies can be planned for by including clear and appropriate performance standards in permits. The facility can then make changes within the specified parameters and report the changes to the agency, which provides review and oversight during the implementation process.

Key Points

- This slide shows that the Exit Strategy begins with a rough conceptual blueprint of where the facility wants to go; it then incorporates regulatory concerns, issues, and milestones. The details of the Exit Strategy, such as cleanup goals ("the what, the where, and the when", as we will discuss in more detail in Module 7) can then be developed. The Exit Strategy can take many forms, and it does not create a need for unnecessary or additional documentation. Rather, it is meant to provide a roadmap that helps to guide, justify, and track CA decisions.
- This facility wants to transfer ownership of land that was formerly used as a fire training center to the town government by the year 2015. It also wants to have all active remediation completed prior to property transfer.
- A RCRA CA permit is the regulatory mechanism governing the facility; this permit required renewal at about the same time the Exit Strategy was being developed.
- Because the final remedial technology had not been selected for the facility before the permit was renewed, a number of possible remedies were included in the new permit to avoid the need for multiple permit modifications and regulatory approval cycles when new technologies were implemented. The permit required that any remedy selected for implementation had to meet certain performance standards, which were established in the permit. So, the foundation of the Exit Strategy became a performance-based permit, which included a menu of potential technologies including those shown on the slide.
- The facility envisioned implementing one or more of the technologies after the permit was renewed, and anticipated that active remediation would be completed by the time the permit again required renewal. Anticipating that site cleanup criteria would be met following the second permit renewal, a number of forward-looking conditions were included in the permit, such as: performance standards and parcel transfer language. These permit conditions set the stage for completing CA and reaching the remediation endpoint according to the 2015 schedule.

References

- None.

Notes:

Purpose of Slide

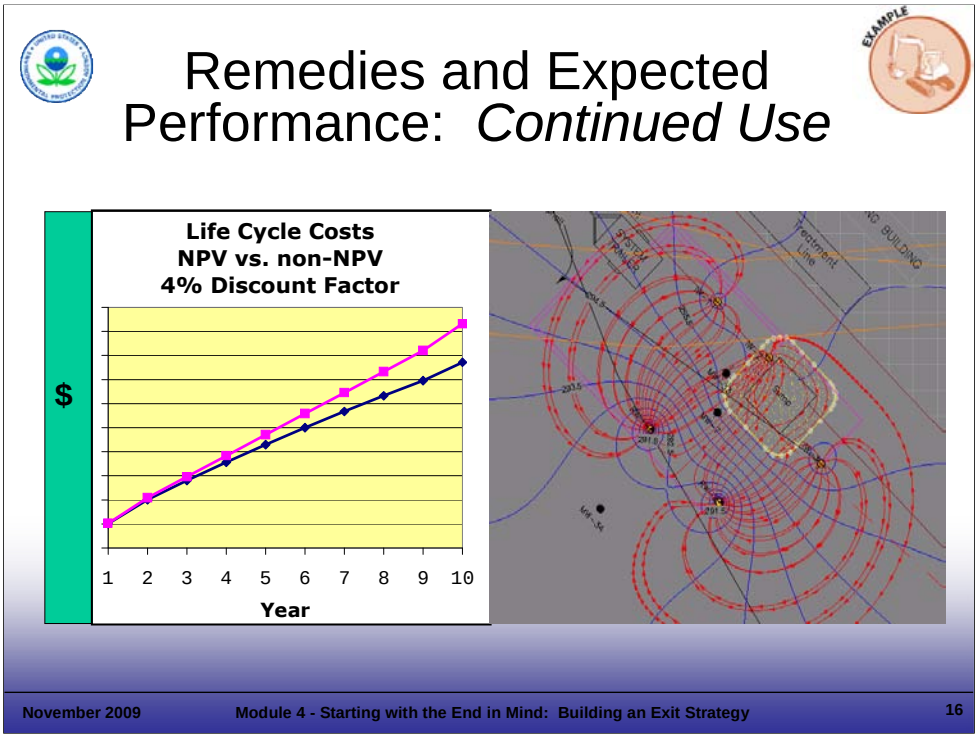
- Discuss the selection of the remedy or remedies that will be used at a facility to meet the RAOs, which are related to the anticipated use of the facility. This example includes a combination of remedies established for a facility undergoing revitalization.

Key Points

- Identifying the remedy and anticipating how it will perform over time are important components of the Exit Strategy.
- In this example, a developer purchased a large tract of land (1,500 acres) where 5 industrial landfills were located. The remedies were (1) excavation of the landfills and the surrounding contaminated soil, (2) groundwater pump and treat, and (3) chemical oxidation. Closure is now linked to meeting non-numeric goals, such as plume stability, that the state has established for risk-based CA (RBCA). Also, the CSM identified many potential ecological receptors and a decision was made to include development of an ecological corridor as part of the remedy.
- When the property was first purchased, RBCA was not an option; the cleanup standards for groundwater were maximum contaminant levels (MCLs). RBCA is now in place and ICs have been established.
- The land is considered a RCRA facility and regulated by a Hazardous and Solid Waste Amendments (HSWA) permit. Each landfill is a solid waste management unit (SWMU).
- The land will be developed in phases for mixed uses – including commercial, ecological, and residential.
- The remedy components are implemented in phases, as parcels are scheduled for redevelopment. Remedy implementation and performance are linked to development plans.

References

- None.



Notes:

Purpose of Slide

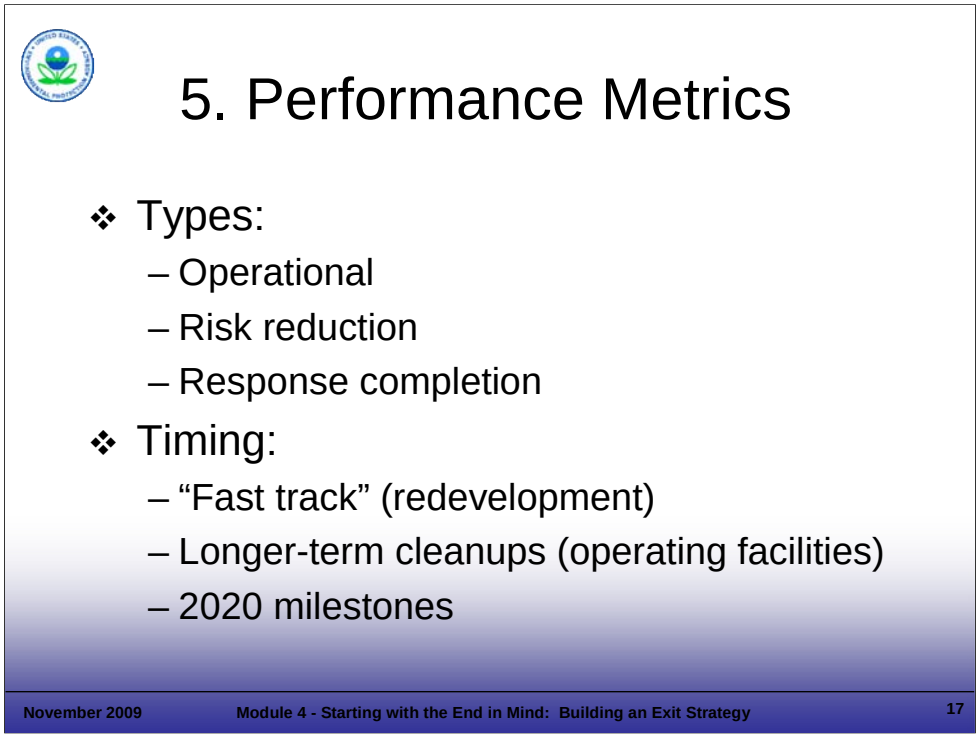
- Provide an example of developing a remedy for an operating facility, where timing often is not as critical as for sites undergoing property transfers and changing uses.

Key Points

- Annual operating costs, capital cleanup expenses, and life cycle remediation costs are important to operating facilities, which generally evaluate costs based on net present value (NPV), the long-term costs in terms of today's dollars. On the other hand, property values are critical to land owners and developers considering revitalization of facilities to support redevelopment; therefore, reuse considerations can significantly affect the pace of cleanup and the selection of technologies.
- Correctly anticipating performance is important because poor performance can increase cleanup times and costs substantially. Remedies need to be well-maintained once implemented to keep costs in check and maintain remedy performance. We discuss remedy performance further in Module 11.
- Plume stability – eliminating migration – is important for a variety of reasons, including attaining or maintaining Environmental Indicator (EI) 750 (groundwater migration under control) and avoiding third party issues with adjacent property owners. The figure on the right shows results from a groundwater fate and transport model developed to evaluate plume stability at an operating facility.
- The Exit Strategy should include a remedy that the facility and agency anticipate will meet the RAOs (including remediation completion criteria) associated with continued industrial use.
- Whether a site will be revitalized through a new use or remediated for continued use as an industrial facility, use of an Exit Strategy will support effective CA implementation.

References

- None.



Notes:

Purpose of Slide

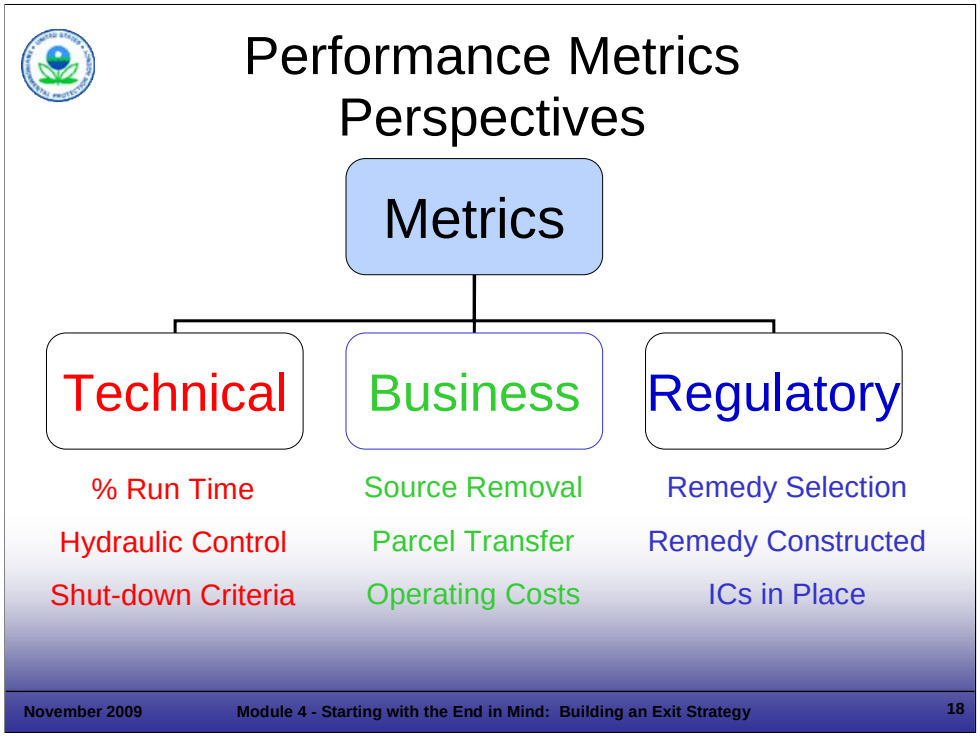
- Present how performance metrics are used within an Exit Strategy, in the context of different RAOs.

Key Points

- Performance metrics should be objective and specific. They generally fall into three categories: (1) operational metrics for engineered systems (extraction rates, treatment system efficiencies, discharge requirements); (2) risk reduction metrics (plume stability or recession, product or soil removal, land-use controls); and (3) response completion metrics or site close-out criteria (meeting cleanup criteria).
- Metrics can also be used as triggers for contingencies described in decision logic flowcharts. For example, if an operational performance metric of 99% removal efficiency for an air stripper is not achieved during three consecutive monthly sampling events, this could serve as a trigger for the requirement to add a carbon polishing unit.
- In the case of phased remediation (e.g., removal followed by bioaugmentation), interim metrics (milestones) may trigger the next phase of action. Similarly, there may be a step-wise optimization (scale down) of remedial actions and monitoring requirements as risks are reduced (e.g., as a plume shrinks or concentrations of the contaminants of concern decline). The Exit Strategy should identify these metrics and provide a decision logic that specifies what conditions must be met before proceeding.
- Facilities on a fast track for cleanup may have more intensive metrics to support changing land uses.
- Longer-term cleanups generally require less frequent sampling (over a greater length of time). If the CSM shows that contamination is stable, the facility is intended for continued use as an operating facility, and there are no threats to human health or the environment, the Exit Strategy may allow decades for site cleanup, in which case annual or less frequent sampling may be environmentally sound. O&M will be an important component of long-term cleanups to address factors such as aging equipment. In addition, appropriate ICs and monitoring will ensure that exposure assumptions based on continued use remain appropriate.
- 2020 milestones (such as Remedy Construction) can be included in an exit strategy as performance metrics.

References

- ITRC. 2006. Exit Strategy – Seeing the Forest Beyond the Trees. Second in a Series of Remediation Process Optimization Advanced Topics. ITRC Remediation Process Optimization Team. March.



Notes:

Purpose of Slide

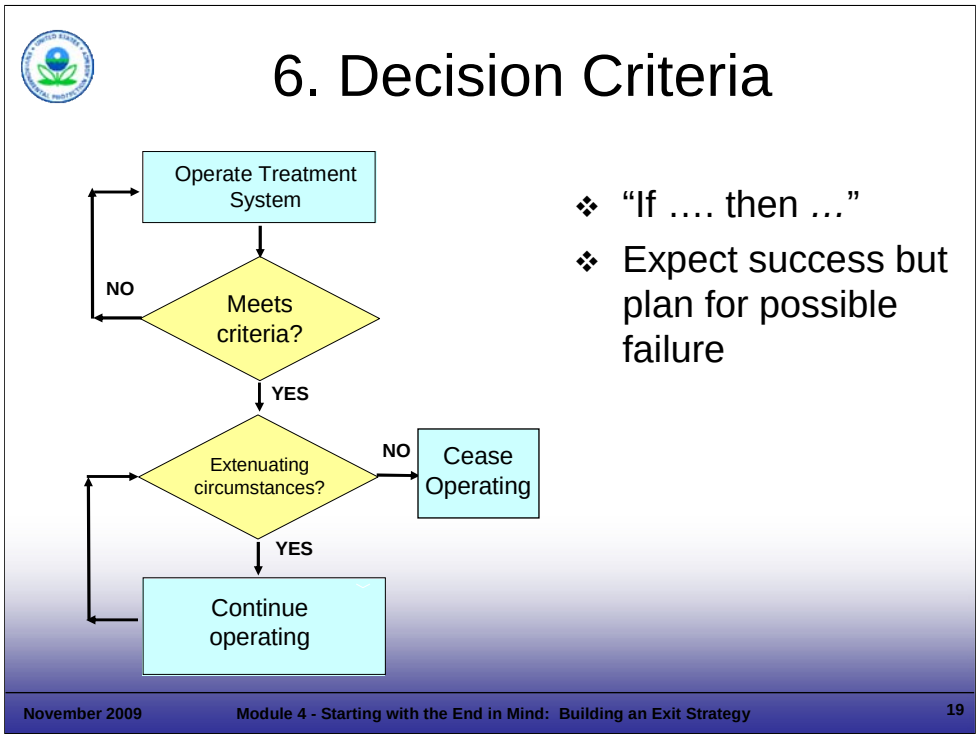
- Illustrate various perspectives on performance metrics.

Key Points

- This slide illustrates technical, business, and regulatory perspectives on performance metrics.
- Technical metrics can include performance metrics that are used to measure progress towards milestones or endpoints and should be objective and specific. They generally fall into three categories: (1) operational metrics for engineered systems (extraction rates, treatment system efficiencies, discharge requirements); (2) risk reduction metrics (plume stability or recession, product or soil removal, land-use controls); and (3) response completion metrics or site close-out criteria (meeting cleanup criteria). Metrics can also be used as triggers for contingencies described in decision logic flowcharts. For example, if an operational performance metric of 99% removal efficiency for an air stripper is not achieved during three consecutive monthly sampling events, this could serve as a trigger for the requirement to add a carbon polishing unit.
- Business milestones may relate to source removal, property sales, or reducing annual or life cycle costs. Facilities on a fast track for cleanup may have more intensive metrics to support changing land uses.
- Regulatory milestones, such as the 2020 goals (e.g., Remedy Construction) can be included in an Exit Strategy as performance metrics.

References

- None.



Notes:

Purpose of Slide

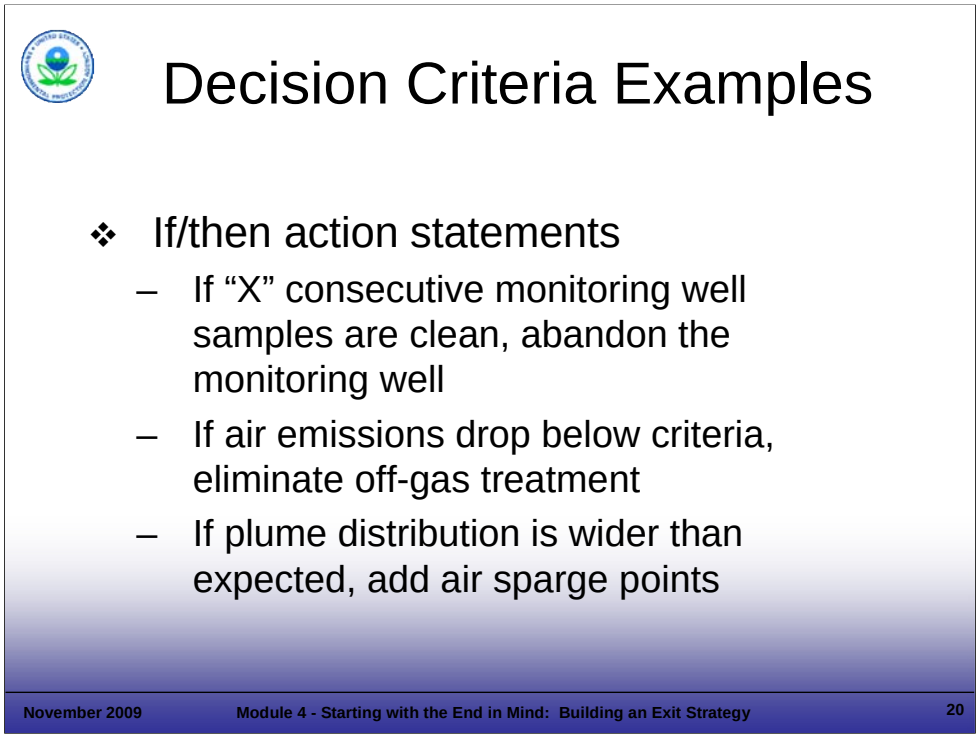
- Explain why decision criteria should be established as part of an Exit Strategy. Establishing decision logic allows implementation of a pre-determined process with stakeholder buy-in to efficiently and cost-effectively evaluate performance monitoring data and make corrections, implement contingency actions, or scale-down operational or monitoring requirements, depending on progress toward meeting RAOs.

Key Points

- Performance-based exit strategies should expect success but plan for possible failures. It is best to have a predetermined process, with stakeholder buy-in, to deal with eventualities that can occur during the CA process.
- From ITRC 2000: *Exit strategies must include quantitative criteria that will be used to assess system performance, and ultimately determine when the remedial technology has achieved its intended goal. Without predefined metrics, any uncertainty resulting from collected data may lead to a seemingly endless process of additional sampling and analysis to support a decision ("Let's collect one more round of samples to see what that tells us.")*
- Flow diagrams can be used to graphically depict decision logic, such as the flow diagram shown on this slide. It was developed cooperatively by a facility and the State agency.
- For example, the facility samples for chemicals of concern, and must meet cleanup criteria for at least "X" rounds before turning off a recovery well. The "X" would be agreed upon and documented by the agency and the o/o, and would be protective of human health and the environment based on current and reasonably anticipated uses.
- If there are "X" clean rounds, and there are no extenuating circumstances, then the facility can terminate recovery operations. Since the agency and facility developed this decision logic flowchart cooperatively, the facility can turn off the recovery well immediately upon achieving cleanup levels – a separate agency approval is not necessary.

References

- ITRC. 2006. Exit Strategy – Seeing the Forest Beyond the Trees. ITRC Remediation Process Optimization Team. March.
- ITRC. 2007. Improving Environmental Site Remediation Through Performance-Based Environmental Management. November.
- U.S. Department of Energy. 2000. Developing Exit Strategies for Environmental Restoration Projects DOE/EH-413-0013



Notes:

Purpose of Slide

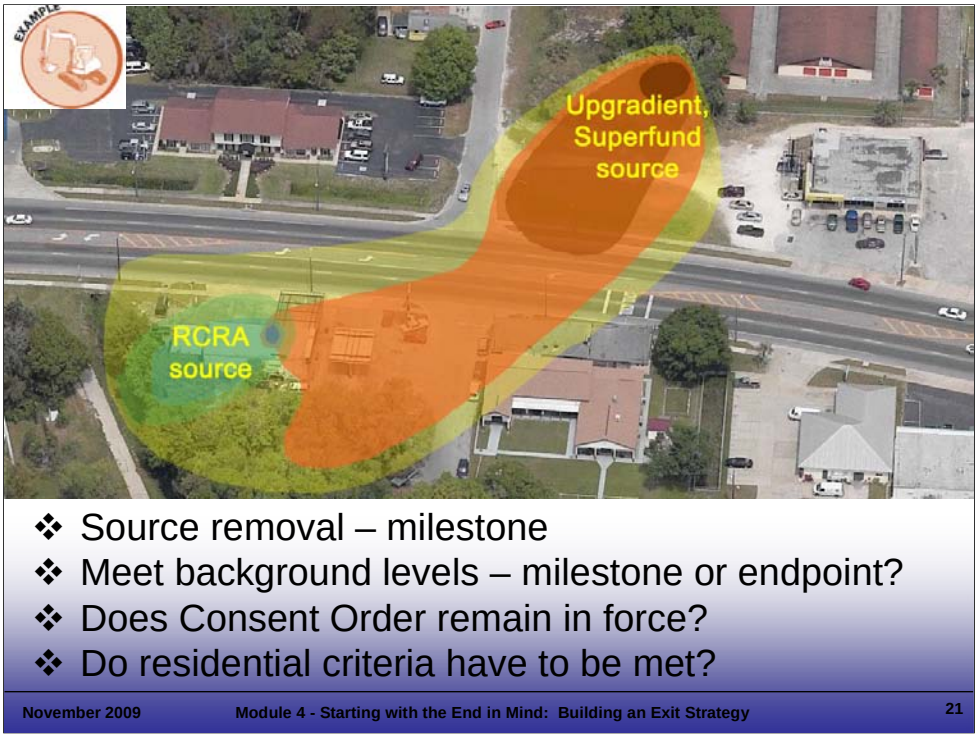
- Provide examples of decision criteria and endpoints.

Key Points

- Simple "if (a specific condition occurs) … then (a certain response action is taken) …" uses the monitoring data and performance metrics to make decisions and keep the process moving. This slide provide examples of decision criteria that address changing conditions and associated contingencies.
  - A RAO may be to meet cleanup criteria; the first bullet provides a specific action (abandon the monitoring well) associated with a specific definition of when the criteria are met ("X" clean events).
  - The second bullet anticipates performance and a decision point - air emissions will drop below criteria. The associated action is to eliminate off-gas treatment.
  - On the other hand, additional treatment may be necessary when a plume is larger or deeper than expected.
- Establishing these criteria in the Exit Strategy streamlines actions and will lead to faster, cheaper cleanups.

References

- ITRC. 2006. Exit Strategy – Seeing the Forest Beyond the Trees. ITRC Remediation Process Optimization Team. March.
- U.S. Department of Energy. 2000. Developing Exit Strategies for Environmental Restoration Projects. DOE/EH-413-0013. March.



Notes:

Purpose of Slide

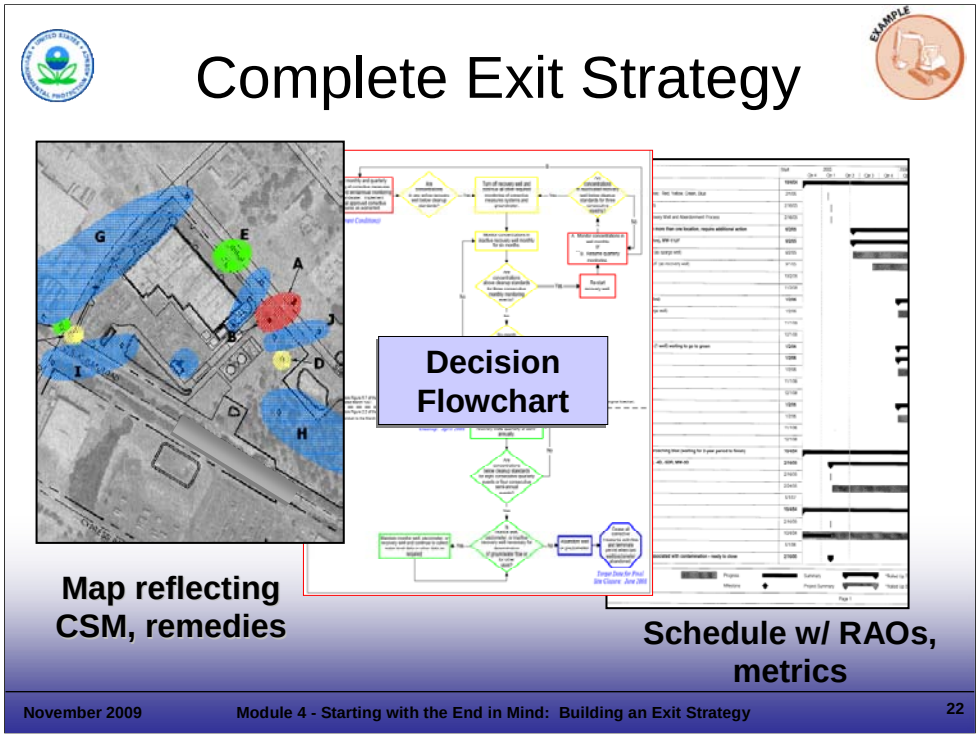
- Provide a case study example of issues that can make development of an Exit Strategy difficult.

Key Points

- At this site, trichloroethylene (TCE) has been released from a SWMU. Upgradient, there was a tetrachloroethylene (PCE) release from a Superfund site, which is degrading to TCE and the two plumes are now commingling.
- Developing an Exit Strategy for this site is difficult because establishment of the cleanup criteria is complicated for the following reasons:
  - The groundwater cleanup standard in this state is residential groundwater criteria at the RCRA CA facility.
  - The facility considers meeting background concentrations as the appropriate technical endpoint (so as not to create an "island of purity"). However, the regulatory agency considers residential criteria as the endpoint and meeting background concentrations as an interim milestone.
  - A schedule was established for meeting background concentrations and that schedule was met.
  - No schedule or cost estimate can be established for meeting residential criteria because that is dependent on the upgradient source.
  - The result is that the facility is on the Consent Order "hook" indefinitely, until the upgradient source is remediated.

References

- None.



Notes:

Purpose of Slide

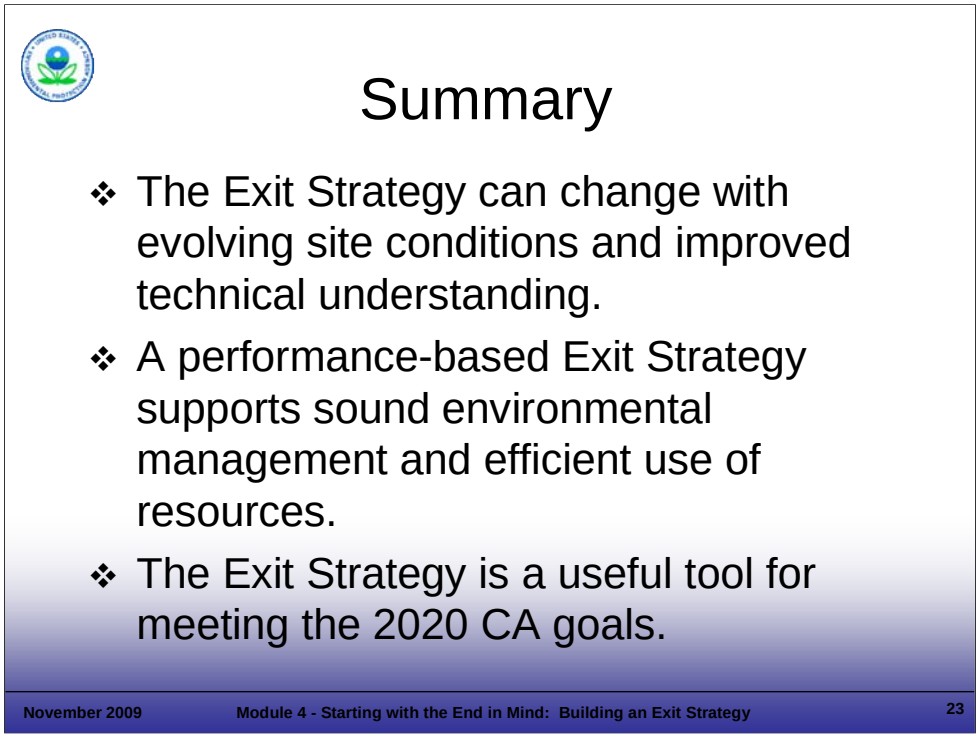
- Provide an example of an efficient, focused Exit Strategy that has been distilled to a few key figures and charts.

Key Points

- This Exit Strategy has 3 components:
  - A **CSM** shows different categories of groundwater contamination (blue represents areas that have been clean for 2 years of monitoring; green represents areas that have been clean for less than 2 years; yellow represents an isolated pocket of contamination; and red represents areas with more widespread contamination). This is the CSM element of the Exit Strategy.
  - A **flowchart** shows remediation contingencies and the logic ("if/then") used to make decisions. The flow chart describes the circumstances under which the facility can discontinue sampling of groundwater monitoring wells, discontinue pumping of recovery wells, discontinue sampling of recovery wells, and abandon either type of well. The flowchart represents a performance-based approach that is self-implementing.
  - A **schedule** shows the anticipated activities over time (air sparge, pump and treat, monitoring, reporting, permitting) and the schedule required to meet the remedial action objectives. This schedule includes meeting health-based groundwater criteria in 5 years (at a cost of under $1 million), and includes regulatory milestones (construction complete), based on a cooperative approach by the regulators and the facility.

References

- None.



Notes:

Purpose of Slide

- Summarize the main points of this module.

Key Points

- A performance-based Exit Strategy provides a practical framework to support RCRA CA; remember, keep the end in mind.
- The Exit Strategy can change with evolving site conditions and improved technical understanding.
- The Exit Strategy supports sound environmental management and an efficient use of resources.
- The Exit Strategy can integrate and help focus progress towards 2020 CA goals.

References

- None.