SECTION 6
CLOSURE

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

6.0 CLOSURE

6.1 Statutory and Regulatory Considerations

6.1.1 Decommissioning and Site Closure and Stabilization Plan

The applicant shall provide a decommissioning and site closure and stabilization plan, including those design features, activities, and preparations which are intended to facilitate disposal site closure and to eliminate the need for ongoing active maintenance after closure and an estimated date of site closure which is to be updated as required. [H&SC §401.112(a)(13)] & [30 TAC §§336.708(a)(11), 336.719]

The Waste Control Specialists LLC (WCS) facility design approach is to incorporate waste placement and stabilization features into routine waste operations so that final closure activities are minimized, and those needing to be accomplished will be simplified and streamlined. This approach allows the major closure activities of cover placement and site stabilization to be completed in phases for the majority of the waste disposal units by qualified operations personnel during the 35-year operating period. Table 6.1.1-1 lists the time frame when each phase and cell within the FWF and CWF are expected to be closed. As the time of final site closure nears, only surface facility decommissioning and closure of the final phase of each disposal unit will remain to be accomplished. Figure 6.1.1-1 and 6.1.1-2 depict the planned facility configuration at the time when the closure period starts which is estimated to be 35 years after the start of operations. This approach satisfies Design Criterion G7, which requires that closure and stabilization be carried out as each disposal unit is filled and covered. The design criteria are presented in Section 3.0.

Disposal Unit	Estimated Operational Year of Closure of the First Opened Cell	Estimated Number of Years of Closed Cell Performance Data Available at Time of Facility Closure
FWF-CDU	12	23
FWF-NCDU	16	19
CWF	12	23

The following design features contribute to simplifying final site closure:

- Depth of disposal is significantly greater than 5 meters (16.4 feet) for all waste.
- All waste is structurally stable or in a canister when placed.
- Voids inside canisters will have been filled at the time of placement.
- Voids between canisters are filled at the time of placement.

- Reinforced concrete canisters and concrete grout provide disposal system structure and stability and minimize settlement.
- Placement specifications and operating procedures for the disposal of all wastes whether in canisters or as bulk waste minimize settlement.
- Leveling fill (interim cover) and final cover system placement progress as disposal cells are filled. Only the last portion of the final cover system over the last cells of each disposal unit (CWF, FWF-CDU, and FWF-NCDU) will need to be constructed during final closure. The early placement of the final cover system over the majority of the CWF, FWF-CDU, and FWF-NCDU during the operating period ensures that anticipated settlement of the final cover system over these closed disposal unit cells occurs during the operational period. The record of settlement for these closed cells then is a measure of anticipated settlement performance for the then open disposal cells that are closed during the closure period.
- Withdrawal of precipitation collected during operations removes storm water from the waste array.
- Settlement is minimized by strict compliance with placement specifications and due to the lengthy, deliberate placement schedule.

Each of these design attributes is described in Section 3.0-1. Waste placement and disposal operations are presented in Section 5.0. WCS recognizes that Texas Commission on Environmental Quality (TCEQ) approval of a systematic closure plan is required to demonstrate closure is technically practicable. The Decommissioning and Site Closure Plan is provided as Appendix 6.1.1-1. The Decommissioning and Site Closure Plan is a living document and will remain open to revision based on actual, verified conditions at the end of the operational period. While the Decommissioning and Site Closure Plan is intended to contain important plans and procedures, it can only reflect what is known or estimated at the time it is written or revised. The exact details of the final facility conditions at time of closure are not known at this time. Rather Appendix 6.1.1-1 reflects current plans and practices and the projected facility conditions that these plans and practices will produce. Therefore, the Decommissioning and Site Closure Plan will be modified periodically throughout the operating period to account for actual facility conditions along with any modifications to WCS plans and procedures. The Decommissioning and Site Closure Plan will be finalized prior to the site transition from operations to closure. The final Decommissioning and Site Closure Plan (Appendix 6.1.1-1) will reflect site conditions at the time of closure and describe all activities necessary to close the facility..

WCS also considered the case of an unplanned and premature closure. More information on this analysis, its drawings, and associated cost estimate can be found Section 16.2.2 of the WCS LLRW Decommissioning and Site Closure Plan (Appendix 6.1.1-1).

6.1.2 Facility Design and Closure/Stabilization Procedures

The applicant shall provide a description of the facility design and procedures related to disposal site closure and stabilization, elimination to the extent practicable of long-term disposal site maintenance, inadvertent intrusion, occupational exposures, disposal site monitoring, and adequacy of the size of the buffer zone for monitoring and potential mitigative measures. [30 TAC §§336.707(4), 305.54(f)]

The WCS Low-Level Radioactive Waste (LLRW) Disposal Facility will proceed through five distinct, but partially overlapping phases:

- **Construction** – Construction will be the initial phase as surface facilities are constructed and the initial disposal cells area excavated. Both the Compact Waste Facility (CWF) and Federal Waste Facility (FWF) will be constructed in discrete phases. Only the initial phase of disposal cell within the CWF and FWF will be constructed during the construction phase. The remaining disposed cells within the FWF and CWF are constructed during the facility operations phase. Information on initial cell excavation and progressive expansion is provided in Section 4.2.
- **Operation** – Facility operations will begin approximately 12 months after a license is issued to WCS, and will continue for an estimated 35 years. WCS intends to construct disposal cells as they are needed (see Section 3.0 and Appendix 3.0-1) and to close and cover each disposal cell as they are filled. The general schedule for cover placement will be to begin placing leveling fill (consisting of non-select red bed clay) as soon as sufficient waste has been placed to reach the final intended top of waste elevation. The placement of the leveling fill will progress as additional waste reaches this elevation. Installation of the remaining layers of the final cover system (see Appendix 3.0.1) will be placed as the area covered by leveling fill expands and is sufficient to support the required cover layer placement. Under this approach, the majority of the CWF and FWF used for disposal will be covered, and closed when operations terminate. Information on operations is provided in Section 5.4, and disposal cover attributes and materials are provided in Section 3.5. Also, permanent markers will be placed on the final cover to indicate the location of the disposal units.
- **Closure** – As described above, and shown in Figures 6.1.1-1 and 6.1.1-2. The majority of the CWF and FWF will have the final cover system fully in place prior to the start of the closure period. During the closure period a number of closure activities will be accomplished after all off-site waste has been received and the operations period is complete. Deconstruction and removal of surface structures, modification of surface water and erosion controls, removal of site access roads, completion of final disposal cover installation, and installation of permanent markers will be accomplished during this phase. Information on specific operations and activities to be accomplished during the closure period are presented in Sections 3.4, 3.5, and 5.4, with a work breakdown and proposed schedule provided in Appendix 6.1.1-1.
- **Post-Closure Monitoring and Surveillance** – After closure is complete and the entire CWF and FWF have the final cover systems installed WCS will continue to conduct routine environmental monitoring, surveillance, and inspection activities. WCS will

also operate the Leachate Collection System as necessary to support the Closure and Post-Closure Monitoring Plan (Appendix 7.1.1). The detailed monitoring that is planned for the Post-Closure Period is described in Appendix 6.1.2-1, "Closure and Post-Closure Monitoring Plan."

- **Institutional Control** – Upon completion of site decommissioning activities and the post-closure control period, WCS will apply to terminate its license and transfer control of the CWF and FWF to their respective custodial agencies. It is anticipated that custodial agency will continue to monitor the site and provide passive maintenance as required For the duration of the institutional control period.

WCS' closure strategy is to perform specific closure-related activities during the operational period, so that at the time of site closure, most of the cells are already closed with the final cover already in place. Closure will involve a range of activities and administrative support items, including:

- A comprehensive radiological survey of the facility radiological control areas, in addition to operational records and reports, will be created. This survey will include an evaluation of historical or identified radiation or contamination areas that will be mitigated during closure. A ground survey using current technology and methods will be completed so that accurate spatial coordinates are available to compile final radiation measurements and survey information.
- Removal of buildings or structures that are not required to support long-term care will take place. The site closure plan identifies which buildings will be removed. Radiological surveys will be conducted in accordance with 30 TAC §§336 Subchapter G (Decommissioning Standards) to ensure that the buildings and equipment are either releasable or disposed of as contaminated waste.
- Closing final open disposal cells. This activity will be accomplished using the same process followed for cover placement over other disposal cells that were closed during the operations phases. These final cells will be closed only after the disposal of any decontamination and decommissioning (D&D) waste has been accomplished.
- Final grading of the disposal cells that have not yet received a final cover will be performed to match the final grades specified in the construction plans. The entire site will be graded to drain precipitation off the site at velocities that will minimize erosion. The final site grading plan is detailed in the design drawings (see Drawing C0.11 in Appendix 3.0-2). An updated drawing of final site contours will be included in the final Decommissioning Site Closure Plan.
- Permanent markers will be placed on each disposal cell to identify its boundaries when the cell is closed, and additional durable monuments will be installed as notices to future intruders. See Drawings C1.33 and C2.37 for more information on these monuments.
- Roads and culverts will be removed if they are not needed during the post-operational monitoring and maintenance period or the institutional control period. Some roadways are likely to be needed to provide access to portions of the site.

- Revegetation/stabilization of the disposal site. All disturbed areas of the site that have not been previously re-vegetated or stabilized will be planted with selected plant species (see 3.9.3.1 of Section 3.0).

Several design elements that support this closure strategy include:

- Canister placement and internal canister grouting eliminate waste matrix voids, ensuring volumetric changes and consolidation will not complicate cover placement (see Appendix 3.0-1, "WCS LLRW Disposal Engineering Report" and Appendix 4.2.3, "Technical Specifications").
- Immediate placement of leveling fill minimizes the potential of water requiring active leachate management, and is consistent with the final cover design and placement (see Appendix 3.0-1, "WCS LLRW Disposal Engineering Report" and Appendix 4.2.3, "Technical Specifications").
- Cover system material placement is coordinated with disposal cell excavation and liner construction, allowing the same materials that are excavated from the cell to be used as appropriate, for cover extension construction (see Appendix 3.0-1, "WCS LLRW Disposal Engineering Report" and Appendix 4.2.3, "Technical Specifications").

Final cover system components are designed to use locally available source materials, several of which will be acquired from the disposal cell excavation and can be placed directly without intermediate staging and multiple transfers.

Administrative support activities during the closure period will include:

- Completion of the active site operations monitoring program (see Appendix 6.1.2-1, "Post-Closure Plan")
- Establishment of the long-term monitoring program (see Appendix 6.1.2-1, "Post-Closure Plan")
- Completion of tests and analysis of disposal unit cover subsidence relating to backfill, closure, and sealing of the disposal units (see Appendix 6.1.2-1, "Post-Closure Plan")
- Conducting radiological surveys to identify areas to be decontaminated and to confirm that the decontaminated buildings and equipment are acceptable for release (see Appendix 6.1.2-1, "Post-Closure Plan")
- Assembly of data and documentation to be used in eventual application to terminate the disposal facility license and effect transfer to the respective custodial agencies.
- Support for all licensing and closure activities

A planning-level schedule for closure is provided in Appendix 14.4-1.

6.1.2.1 Site Closure / Stabilization Strategy

6.1.2.1.1 Final Closure of Open Cells

After waste receipt operations are terminated, each remaining open disposal cell will be closed as described in this License Application. During the closure phase, the last three open disposal cells will be capped and graded to the final contours. Final grading and shaping necessary to complete the site closure will be performed and revegetation activities will be undertaken. Closing of the last three disposal cells will be performed in the same manner as the disposal closed during the operations phase, as specified in the construction plans.

The following sections provide information on closure activities as they are anticipated from the current design basis.

6.1.2.1.2 Surface Drainage and Erosion Protection

Surface drainage and erosion protection features that will lead to site stability include a combination of both natural site conditions and man-made features. The natural slope offers little potential for long-term erosion but is sufficient to promote natural drainage away from the disposal units. These natural conditions will be augmented by a cover system and surface contours designed to drain water away from or over the units at velocities that will avoid erosion (see Appendix 4.2.3, "Technical Specifications" and SWAT Analysis, Appendix 3.0-3).

The disposal unit covers are designed to minimized infiltration of water into the disposal unit, to direct percolating or surface water away from disposed waste, and to resist degradation by surface geologic processes and biotic activity. The designs and calculations to support these measures are described below.

Hydrologic Analysis: The top layer of the final cover system was specifically designed to meet the recommendations of NUREG-1623 for a 1,000 year erosion barrier. The calculations included in Attachment 3.0-3.18 were performed to evaluate the potential for erosion for the native topsoil and sand layers (evapotranspiration cover) directly beneath the erosion barrier, in the event that they are exposed directly to surface precipitation. WCS estimated erosion initially using the USLE deterministic equation but also performed a more complex analysis using the Soil and Water Assessment Tool (SWAT) developed by the USDA Agricultural Research Service at the Grassland, Soil and Water Research Laboratory in Temple, Texas.

Various scenarios were developed and performed in order to account for possible long-term trends of variable meteorological periods. Graphing the normalized cumulative losses, it is calculated that over the first 50,000 years following facility closure, total gravel mulch cover loss due to erosion is calculated by SWAT to be 4.26 inches (0.355 feet) for current Hobbs climate and for the projected future climate. The SWAT calculation is Attachment 3.0-3.29. Even under the projected future climate, the projected 4.26 inches of erosion does not reach the biobarrier layer of the cover which is 4 feet below final site grade.

Erosion and Flooding Prevention: To meet the design objectives established by the regulations and standards, the design of erosion protection can be significantly affected by several natural phenomena and consideration of the following was exercised in the design calculations:

- Selection of an appropriate design basis flood or rainfall event
- Control of gully initiation and gully development
- Occurrence of flow concentrations and drainage network development
- Effectiveness of vegetation in arid areas
- Appropriate use of permissible velocity and tractive force methods
- Long-term durability of rock erosion protection

Erosion protection was calculated using the shear stress (tractive force) methods as prescribed in NUREG-1623, Design of Erosion Protection for Long-Term Stabilization. This calculation is provided in Appendix 3.0-3.14 and presents the requirement for the top layer of the final cover to minimize long-term water erosion. The steepness of slope, the length of slope, and the rainfall intensity were the controlling factors for the tractive force method. The maximum calculated rainfall intensity was chosen to provide the most conservative solution. The slopes were chosen for their steepness, length, and the combination of steepness and length. The calculations concluded that a 1-1/2-inch layer of 1-1/2-inch minus, uniformly graded gravel mulch placed as the top layer of the final cover exceeds the requirements in NUREG-1623 to provide protection from water erosion.

Also, WCS performed an assessment of current site conditions to determine the extent to which erosion is occurring at the LLRW disposal site (see Appendix 6.4-3 to Appendix 2.6.1). It has been determined that the site currently has stable topsoil, that generally speaking the site is aggrading, and erosion that is not an active process on the site. WCS will monitor erosion during the closure and post-closure periods, as described in Appendix 4.4-1.

6.1.2.1.3 Protection During Operational Period

The portion of the disposal units closed during the operations phase will be protected during the remainder of the operational period by isolation berms between the units as shown in Drawings C1.42 and C2.56. Selected species of vegetation will be established on top of the final disposal system covers to protect against water and wind erosion (see 3.9.3.1 of Section 3.0).

During the operational period, the perimeter berm, drainage channels, and final cover over closed cells will be routinely monitored in accordance with the operations monitoring program. Should excessive erosion be identified during this period, the erosion will be repaired, and control features will be modified to avoid the reoccurrence of the excessive erosion thereby avoiding the need for active maintenance.

6.1.2.1.4 Protection After Operation is Complete

During the closure period, the remainder of the site will be provided with a specified grade that will function to shed water such that minimal erosion will occur. See the final site grading plan in Drawing C0.11 in Appendix 3.0-2. The surface will be seeded with appropriate xeric vegetation in a bed of pea gravel mulch, as discussed below.

6.1.2.1.4.1 Stability

An additional design feature is the inclusion of long-term volumetric stability of the waste array by the use of concrete canisters, concrete grout, and reserve red bed fill material in the cover system. These components will provide additional assurance that active maintenance will not be required after facility closure. Modular concrete canisters will be used for waste that may degrade with time, and accessible voids will be filled with specified sand backfill as these waste packages are placed for disposal.

6.1.2.1.4.2 Intruder Protection

Both passive and active design features will be used to protect the inadvertent intruder. A fence will be constructed around the facility to prevent intrusion. Durable markers will also be used to alert potential intruders that the site contains radioactive waste, and to delineate the extent of the subsurface waste array. These markers will be located at each corner of the disposal unit, and at each corner of the buffer area. These features are intended to alert the casual intruder of the previous activities at the site.

The incorporation of a shotcrete header above the topmost layer of canisters in the CWF also serves as an indication of human activity. While the grout in both the FWF-CDU and CWF may pose a minimal challenge for drilling equipment, the presence of visibly alternating layers that can be readily identified from the red bed clay host formation will be a reliable indicator (see Section 3.5.2 for information on the cover system). The waste matrix itself should provide a similar indication for most waste streams as well.

6.1.2.1.4.3 Revegetation

The final cover will be vegetated with locally hardy grasses, such as Side Oats Grama, Switchgrass (Blackwell), Blue Grama, Plains Bristlegrass, Sand Dropseed, Buffalo grass, or similar varieties (see 3.9.3.1 of Appendix 3.0-1 for more information). Deep-rooted plants will be controlled throughout operations to maintain the vegetative cover, and supplemental watering will be used to establish initial vegetative species so that undesirable species are controlled during the initial decade of post-closure.

6.1.2.1.5 Radiation Protection Design Features

The major features that will provide radiation protection during closure will be the concrete canisters and grout, the multilayer cover system, and the physical separation of the waste from workers. Exposure potential during closure is expected to be less than during operations because closure is an extension of the operational activities and the radiation sources will be covered by layers of clay, a final grout or shotcrete layer (CWF), modular concrete canister covers (FWF-CDU), and a clean multi-layer cover system in all disposal units. Also, both the FWF and CWF have a 100-foot buffer zone around them. The buffer zone size is adequate for the placement of monitoring wells and allows easy access for periodic monitoring of the wells.

6.1.2.1.6 Facility Decontamination and Decommissioning

The applicant will decontaminate and decommission the facility in a manner that protects human health and the environment. The facility will be constructed and operated so that there will be minimal contamination requiring attention prior to closure. During operation, radioactive

contamination will be identified by the radiation monitoring program and will be addressed and recorded as part of operations. WCS has developed a decommissioning plan which is included in Appendix 6.1.1-1, "Decommissioning and Site Closure Plan."

The applicant will use industry-standard radiological survey guidelines for radiological survey and decontamination planning for equipment and structures. While decontamination and survey techniques are anticipated to evolve before final site closure anticipated for 35 years after start of operations, current industry practices provide reasonable assurance that decontamination of surface structures can be accomplished using routine techniques.

Analytical results for soil sampling will be compared with baseline data collected during the preoperational period and the operational period. Both direct and indirect monitoring methods will be used to obtain a complete assessment of building and equipment matrices and surfaces. Direct measurement of an item will be followed by wipe surveys of representative portions of the surface(s). The Decommissioning and Site Closure Plan is included as Appendix 6.1.1-1.

State-of-the-art portable survey equipment and laboratory radiation measurement instruments that fulfill the survey requirements at the time of closure will be used. The specific instruments to be used for decontamination surveys will be identified in the final site closure plan and in the operating and emergency procedures. Operational health and safety and radiation safety plans and procedures are provided in Appendices 5.5 and 5.5.2-1, respectively, and the site closure plan is included in Appendix 6.1.2-1.

6.1.3 Site Design Features

The applicant shall demonstrate that the site design features are directed toward long-term isolation and avoidance of the need for continuing active maintenance after site closure so that there is reasonable assurance that the performance objectives of 30 TAC §336.723 will be met. [30 TAC §336.729(a)]

Both the waste disposal placement system and overlying cover system are designed with various features to ensure long-term isolation and avoid the need for active maintenance after closure.

The following design features contribute to long-term isolation and stability:

- Depth of disposal is significantly greater than 5 meters (16.4 feet) for all waste.
- All waste is structurally stable or in a canister when placed.
- Voids inside canisters will have been filled at the time of placement.
- Voids between canisters are filled at the time of placement.
- Reinforced concrete canisters and concrete grout provide disposal system structure and stability and minimize settlement.
- Placement specifications and operating procedures for the disposal of all wastes whether in canisters or as bulk waste minimize settlement
- Leveling fill (interim cover) and final cover system placement progress as disposal cells are filled. Only the last portion of the final cover system over the last cells of each disposal unit (CWF, FWF-CDU, and FWF-NCDU) will need to be constructed during final closure. The early placement of the final cover system over the majority

of the CWF, FWF-CDU, and FWF-NCDU during the operating period ensures that anticipated settlement of the final cover system over these closed disposal unit cells occurs during the operational period. The record of settlement for these closed cells then is a measure of anticipated settlement performance for the then open disposal cells that are closed during the closure period.

- Withdrawal of precipitation collected during operations removes storm water from the waste array.
- Settlement is minimized by strict compliance with placement specifications and due to the lengthy, deliberate placement schedule.

Site design features that contribute to long-term passive maintenance are also presented in Sections 3.0 and 6.1.1. Long-term maintenance activities are presented in Section 7.1. Also, several parameters will be monitored, and this monitoring will provide information that will insure that these design features are performing as expected. Monitoring parameters and plans are discussed in Section 6.2.

Also, WCS completed two models that demonstrate that the site design is directed towards long-term isolation and avoidance of the need for continuing active maintenance after site closure. One of these is the Fast Lagrangian Analysis of Continua (FLAC) model, which models the structural behavior of stacked concrete canisters and bulk waste and shows that the CWF, FWF-CDU and FWF-NCDU will be stable and avoid excessive settlement. More information on this model is contained in Appendix 3.0-3.

The other analysis that demonstrates the long-term stability of the site is the Soil and Water Assessment Tool (SWAT) analysis. This analysis estimated the extent to which water erosion could occur on the disposal site and in the area immediately adjacent to the disposal site. This analysis calculated that over the first 50,000 years following facility closure, total gravel mulch cover loss due to erosion is calculated by SWAT to be 4.26 inches (0.355 feet) on future climate. The SWAT calculation is Attachment 3.0-3.29.

The results of these two analyses provide assurance that the site is directed towards long-term isolation and avoidance of the need for continuing active maintenance after site closure.

6.1.4 Disposal Site Closure Plan Compatibility

The applicant shall demonstrate that the disposal site design and operation are compatible with the disposal site closure plan and lead to disposal site closure that provides reasonable assurance that the performance objectives of 30 TAC §336.723 will be met. [30 TAC §336.729(b)]

An important design consideration contributing to effective long-term closure and minimized long-term maintenance of the WCS LLRW disposal facility is the location of the site itself. The proposed WCS LLRW Disposal Site located at an exceptional site based on site characteristics and features. The dry steppe climate that occurs at the site provides low average precipitation, which combined with surface soils and vegetation, provides a high level in evapotranspiration giving a very low amount of water for infiltration. The red bed clay lithology of the site is also an outstanding site attribute, as this formation has a demonstrated hydraulic conductivity of $4x10^{-9}$ cm/sec. The site also has very low potential for significant seismic ground motion at levels that

would complicate subsurface structures and foundations. The depth to the uppermost fully-saturated sandstone zone under the WCS site is approximately 225 feet, but this zone does not meet water industry criteria for development as a sustaining aquifer because withdrawal rates are too low and the water quality is of poor quality. Finally, the site is close to a topographic divide that limits the quantity of surface water that could flow onto the site, and the overall topographical slope of the site is sufficient to promote drainage without creating sediment transport or erosion. For additional information on site characteristics, seismicity, and topography, see Section 2.0.

An important design feature related to long-term stability is the increased depth of disposal offered by the WCS LLRW disposal system. The overall thickness of low-permeability clay-fill layers cover system is 25 to 45 feet. In addition to reduced hydraulic cover conductivity, the extra thickness acts as a layer to ensure that localized settlement can be accommodated by plastic deformation. The increased cover thickness imposes a permanent load on the waste array as soon as the cover is installed, allowing any time-dependent consolidation to be achieved and addressed during the 35-year operational period.

Construction, operation, and closure activities of the WCS LLRW disposal unit as proposed by WCS are also designed to provide a stabilized waste array that will support the cover system with minimal settlement, and with very little potential for differential settlement that would compromise or degrade the cover system. The WCS disposal design incorporates concrete elements as required by TCEQ regulation, but the concrete components are engineered to provide multiple design functions. Concrete canisters are used to provide structural stability to waste that may be volumetrically unstable after placement, but this system is also used to ensure that void spaces around waste packages are filled by backfilling and grouting. The canister array will also be protected by a Shotcrete layer all around the waste array, complete with reinforcing to provide predictable shear and moment resistance. This header layer in the CWF ensures that any local settlement will not result in a discontinuity at the cover. Also, because the disposal cells are closed and covered as they are filled, WCS will have the opportunity to observe the performance of the design over time, as operations continue. For example, when the first cell is closed and covered.

Degradation of the concrete components is undesirable. Moisture is a prerequisite for most aerobic degradation processes, and water within the waste array will be removed by the WCS leachate collection system until the disposal cell is closed.

One of the most important features of the design is that there is no surface projection of the landfill facilities. The final grading plan is designed so that there is no surface profile. This feature provides enhanced long-term sustainability because of the ability to “fit” the facility into the surrounding environment.

Technical information on all design features and their relation to long-term closure and function in eliminating the need for active maintenance is provided in Section 3.1.3. Long-term performance assumptions are presented in Section 8.0, and supporting engineering calculations are provided in Appendix 3.2.1-1.

6.1.5 *Cost Estimates for Site Closure and Stabilization*

The applicant shall provide cost estimates approved by the executive director for site closure and stabilization of the disposal site including decontamination and dismantlement of land disposal facility structures. Cost estimates shall take into account total costs that would be incurred if an independent contractor were hired to perform the closure and stabilization work. [30 TAC §336.736(b)]

The closure cost estimate for planned WCS closure is provided in Appendix 6.1.5-1. Cost estimates for hypothetical, unplanned closure during the planned 35-year operating period are provided in Appendix 6.1.5-2. Unplanned closure estimates are provided for years one and two of the 35-year operating period, along with an estimate for the facility configuration resulting in the maximum unplanned closure cost. A description of assumptions related to unplanned closure is included in Appendix 6.1.5-2.

6.2 Closure Environmental Monitoring

6.2.1 *Baseline, Operational and Long-Term Environmental Monitoring Programs*

The applicant shall provide a description of baseline, operational, and long-term environmental monitoring programs, including radioactive and chemical characteristics, and the plan for taking corrective measures if migration of radionuclides or chemical constituents is indicated. [30 TAC §336.708(a)(10)]

As shown in the figure below, WCS will employ several different monitoring plans that will be in effect at different periods of time.

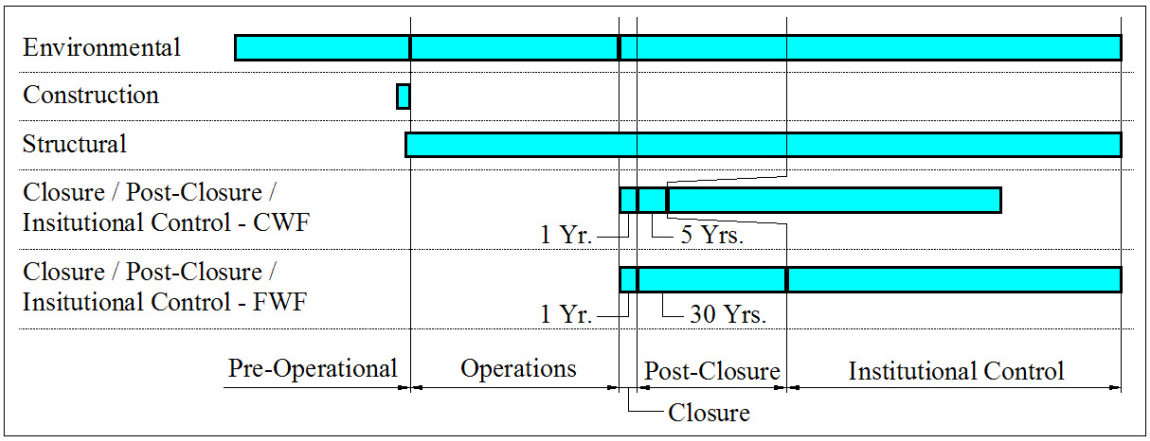

Figure 6-1. Timeline of Monitoring Plans

The following list shows where the monitoring plans above can be found in the LLRW Application.

- Environmental Monitoring Plans – Appendix 2.10.1-2, Appendix 2.10.2-2
- Construction Monitoring Plan – Section 4.4
- Structural Monitoring Plan – Appendix 4.4-1
- Closure Monitoring – Appendix 6.1.2-1
- Post-Closure Monitoring – Appendix 7.1.1
- Institutional Control Monitoring – Appendix 7.2.2

Also, the Early Warning and Corrective Action Plan is given as Appendix 7.3.2.

6.2.2 Post-Operational Surveillance Monitoring Program

The applicant shall provide a post-operational surveillance monitoring program based on the operating history and the closure and stabilization of the disposal site. The monitoring system shall be capable of providing early warning of releases of radionuclides and chemical constituents before they leave the disposal site boundary. [30 TAC §336.731(c)]

WCS proposes a comprehensive program of performance monitoring for the WCS disposal site during and after closure. The figure above lists the several monitoring programs and their effective durations and they discuss all of the items and parameters that will be monitored during and after closure. These plans include activities for monitoring groundwater, soil, vegetation, fauna, settlement of the final cover, strains in the concrete barriers, leachate detection, erosion, and others. For more detail on these items, refer to the individual plans, as listed above.

6.2.3 Corrective Measures Plan

The licensee shall have a plan for taking corrective measures if migration of radionuclides and chemical constituents would indicate that the performance objectives of 30 TAC §336.723 may not be met. [30 TAC §336.731(c)]

WCS has a plan for taking corrective action, should an unexpected contaminant release occur. These corrective measures are discussed in Section 7.3, “Corrective Action” and Appendix 7.3.2, “Early Warning and Corrective Action Plan.”