

Regulatory Comparative Analysis

Iowa Administrative Code 567 Chapter 113

Sanitary Landfills for Municipal Solid Waste:

Groundwater Protection Systems for the Disposal of Nonhazardous Waste



Prepared By:


Shaw® Shaw Environmental, Inc.

Prepared For:



February 2007

REGULATORY COMPARATIVE ANALYSIS REPORT

***Iowa Administrative Code 567 Chapter 113
Sanitary Landfills for Municipal Solid Waste:
Groundwater Protection Systems for the
Disposal of Nonhazardous Wastes***

Shaw Project No. 125304

February 28, 2007

Prepared for:



Iowa DNR
The Iowa Department of Natural Resources

Prepared by:



Shaw® Shaw Environmental, Inc.

Table of Contents

1.0	Introduction	1
1.1	Purpose	1
1.2	Scope of Services	1
2.0	Comparative Analysis and Evaluation	3
2.1	Groundwater Monitoring Network and Point of Compliance Location	3
2.1.1	Federal	3
2.1.2	Iowa	3
2.1.3	Illinois	3
2.1.4	Kansas	4
2.1.5	Minnesota	4
2.1.6	Missouri	5
2.1.7	Nebraska	5
2.1.8	Wisconsin	5
2.1.9	Comparison Summary	6
2.2	Groundwater Monitoring Well Spacing	7
2.2.1	Federal	7
2.2.2	Iowa	7
2.2.3	Illinois	7
2.2.4	Kansas	7
2.2.5	Minnesota	8
2.2.6	Missouri	8
2.2.7	Nebraska	8
2.2.8	Wisconsin	9
2.2.9	Comparison Summary	9
2.3	Groundwater Detection Monitoring	11
2.3.1	Federal	11
2.3.2	Iowa	11
2.3.3	Illinois	11
2.3.4	Kansas	12
2.3.5	Minnesota	12
2.3.6	Missouri	13
2.3.7	Nebraska	13
2.3.8	Wisconsin	13
2.3.9	Comparison Summary	14

Table of Contents

2.4	Design for Leachate Collection Systems	15
2.4.1	Federal	15
2.4.2	Iowa	15
2.4.3	Illinois	15
2.4.4	Kansas	16
2.4.5	Minnesota	16
2.4.6	Missouri	16
2.4.7	Nebraska	16
2.4.8	Wisconsin	17
2.4.9	Comparison Summary	17
2.5	Soil and Hydrogeological Investigations	19
2.5.1	Federal	19
2.5.2	Iowa	19
2.5.3	Illinois	19
2.5.4	Kansas	20
2.5.5	Minnesota	20
2.5.6	Missouri	21
2.5.7	Nebraska	22
2.5.8	Wisconsin	22
2.5.9	Comparison Summary	22
2.6	Alternative Liner Systems	23
2.6.1	Federal	23
2.6.2	Iowa	23
2.6.3	Illinois	23
2.6.4	Kansas	23
2.6.5	Minnesota	24
2.6.6	Missouri	24
2.6.7	Nebraska	24
2.6.8	Wisconsin	24
2.6.9	Comparison Summary	25
2.7	Surface Water Monitoring	26
2.7.1	Federal	26
2.7.2	Iowa	26
2.7.3	Illinois	26
2.7.4	Kansas	26

Table of Contents

2.7.5	Minnesota	26
2.7.6	Missouri	27
2.7.7	Nebraska	27
2.7.8	Wisconsin	27
2.7.9	Comparison Summary	27
2.8	Waste to Groundwater Separation	28
2.8.1	Federal	28
2.8.2	Iowa	28
2.8.3	Illinois	28
2.8.4	Kansas	28
2.8.5	Minnesota	28
2.8.6	Missouri	29
2.8.7	Nebraska	29
2.8.8	Wisconsin	29
2.8.9	Comparison Summary	29
2.9	Basic Disposal Operation	30
2.9.1	Federal	30
2.9.2	Iowa	30
2.9.3	Illinois	31
2.9.4	Kansas	31
2.9.5	Minnesota	31
2.9.6	Missouri	31
2.9.7	Nebraska	32
2.9.8	Wisconsin	32
2.9.9	Comparison Summary	32
2.10	Final Covers	33
2.10.1	Federal	33
2.10.2	Iowa	33
2.10.3	Illinois	33
2.10.4	Kansas	34
2.10.5	Minnesota	34
2.10.6	Missouri	34
2.10.7	Nebraska	35
2.10.8	Wisconsin	35
2.10.9	Comparison Summary	35

Table of Contents

2.11	Quality Control and Assurance Programs.....	37
2.11.1	Federal	37
2.11.2	Iowa.....	37
2.11.3	Illinois	37
2.11.4	Kansas	37
2.11.5	Minnesota.....	37
2.11.6	Missouri.....	38
2.11.7	Nebraska.....	38
2.11.8	Wisconsin	38
2.11.9	Comparison Summary.....	38
2.12	Field Permeability Testing of Liners.....	39
2.12.1	Federal	39
2.12.2	Iowa.....	39
2.12.3	Illinois	39
2.12.4	Kansas	39
2.12.5	Minnesota.....	39
2.12.6	Missouri.....	40
2.12.7	Nebraska.....	40
2.12.8	Wisconsin	40
2.12.9	Comparison Summary.....	40
3.0	Summary and Closing	41

- Appendix A Groundwater Monitoring Well Network / Point of Compliance Regulations
- Appendix B Groundwater Monitoring Well Spacing Regulations
- Appendix C Groundwater Detection Monitoring Regulations
- Appendix D Leachate Collection System Design Regulations
- Appendix E Soil and Hydrogeologic Investigation Regulations
- Appendix F Alternate Liner Regulations
- Appendix G Surface Water Monitoring Regulations
- Appendix H Bottom of Waste to Top of Groundwater Separation Distance Regulations
- Appendix I Basic Operation Regulations
- Appendix J Final Cover Thickness Regulations
- Appendix K Quality Control and Assurance Program Regulations
- Appendix L Liner Field Permeability Testing Regulations

1.0 Introduction

1.1 Purpose

The Iowa Department of Natural Resources (Department) has developed proposed Municipal Solid Waste Landfill (MSWLF) regulations to gain compliance with the Federal criteria found in Title 40, Section 258 of the Code of Federal Regulations (40 CFR Part 258) and to ultimately prevent “groundwater contamination from MSWLFs to the maximum extent possible”. On the behalf of the Department, Shaw Environmental Inc. (Shaw) has developed this Regulatory Comparative Analysis Report. The purpose of this document is to assist the Department during the adoption of the new MSWLF regulations to Section 567, Chapter 113 of the Iowa Administrative Code (567 IAC Chapter 113).

1.2 Scope of Services

Shaw entered into an agreement with the Department on January 30, 2007 to provide an independent comparative analysis of Iowa’s proposed MSWLF regulations to the Federal criteria (40 CFR Part 258 or Subtitle D) and MSWLF regulations enacted by Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin. The Department’s scope of work limited Shaw’s comparative analysis to the following subject areas:

1. Groundwater monitoring network and point of compliance location in reference to the waste management unit boundary for landfills designed with alternative liners. In addition to the regulatory comparative analysis, Shaw attempted to determine typical point of compliance distances approved at each of the surrounding states included within this analysis.
2. Groundwater monitoring well spacing. In addition to the regulatory comparative analysis, Shaw attempted to determine typical groundwater monitoring well spacing distances approved at each of the surrounding states included within this analysis.
3. Groundwater Detection Monitoring.
4. Leachate collection system design, with particular emphasis on drainage layer media.
5. Soil and hydrogeological investigation.
6. Design for alternative liners.

7. Surface water monitoring.
8. Separation distance from the bottom of waste to the groundwater surface.
9. Basic operating methods, including but not limited to: staking at the landfill, filling operations and covering wastes.
10. Final cover thickness.
11. Construction quality control and assurance programs.
12. Field permeability testing of liners, if any.

Except where indicated, Shaw further limited the comparative analysis only to regulations pertaining to modern MSWLFs. Shaw performed the analysis utilizing information compiled by the Department, and posted on the Department's internet site (<http://www.iowadnr.com/waste/policy/landfill.html>), and also relied on certain verbal information and representations provided by state government representatives.

This report has been prepared in accordance with Shaw's understanding of regulations in effect as of the date this report was created. New or additional regulations may be adopted between the date of this report and the Department's use of any information contained in the report. Regulatory interpretations may change as well as Shaw's understanding of current regulations. Further, Shaw is not licensed to practice municipal law, environmental law or any other law and the Department is urged to consult with an attorney for advice in these areas.

As requested, the twelve subject areas are itemized within the report in the order indicated by the Department. Each itemized section is then structured to present discussion regarding the applicable language within Subtitle D, the proposed Iowa regulations, and the regulations of the six identified comparison states. It should be noted that the following text provides summaries of the various applicable regulations. Should more specific detail be required, the reader is urged to review the regulatory language reviewed by Shaw that is compiled in the applicable referenced Appendices.

2.0 **Comparative Analysis and Evaluation**

2.1 *Groundwater Monitoring Network and Point of Compliance Location*

2.1.1 *Federal*

Federal guidelines pertaining to the location of groundwater monitoring networks and points of compliance are typically located within 40 CFR Parts 258.40(d) and 258.51(a)(2)(a) (**Appendix A.1**). Generally, the Federal regulations indicate that the groundwater monitoring network should be located so that representative groundwater samples may be obtained from positions hydrogeologically upgradient and downgradient of a MSWLF unit for the establishment of baseline groundwater quality and to ensure the detection of impacts within the uppermost aquifer potentially attributable to landfilling activities. The Federal guidance requires landfills to be adequately designed so that chemical parameters within groundwater samples collected at a defined distance from the waste management unit boundary (known as the “point of compliance”) remain below pre-established groundwater protection standards. The point of compliance is established by the Director of an approved State based on various characteristics of the facility and the surrounding area. The Federal regulations do not establish a specific point of compliance distance, but indicate that it can be located no more than 150 m (492 ft) from the waste management unit boundary, and located on land owned by the owner of the MSWLF.

2.1.2 *Iowa*

The proposed Iowa MSWLF regulations pertaining to the location of groundwater monitoring networks and the relevant point of compliance are typically located within 567 IAC Chapters 113.7(5)“a”(2)2 and 113.10(2)“a” (**Appendix A.2**). The proposed Iowa regulations generally indicate that MSWLFs should establish a relevant point of compliance 50 ft from the waste management unit boundary on land owned by the owner of the MSWLF. Downgradient monitoring wells should be screened within the uppermost aquifer at the point of compliance to detect groundwater impacts potentially originating from landfilling activities.

2.1.3 *Illinois*

The Illinois regulations pertaining to the location of groundwater monitoring networks and the relevant point of compliance are typically located within Title 35 Illinois Administrative Code Section 811.318(b) and 811.320(c) (**Appendix A.3**). Illinois requires the establishment of a 100-ft Zone of Attenuation (ZOA) surrounding the waste management unit boundary. Monitoring wells are to be screened within the uppermost aquifer or other potential identified contaminant pathways, and located: (1) as close to the waste management unit boundary as possible without interfering with daily operations, and (2) within half the distance of the waste management unit boundary and the edge of the zone of attenuation (e.g., 50 ft). Illinois requires

at least one downgradient monitoring well installed at the edge of the ZOA, 100 ft from the waste management unit boundary.

Shaw contacted a representative with the Illinois Environmental Protection Agency to ascertain actual point of compliance distances typically utilized at MSWLFs within the State. The contact indicated that the 100-ft point of compliance or zone of attenuation distance is enforced.

2.1.4 Kansas

The Kansas regulations pertaining to the location of groundwater monitoring networks and the relevant point of compliance are typically located within Kansas Administrative Regulations 28-29-111(f)(4) (**Appendix A.4**). The regulations indicate that groundwater monitoring wells should be screened within horizons that could serve as potential contaminant pathways. Kansas does not establish a specific point of compliance distance; however, the regulations require groundwater monitoring wells to be located no more than 150 m (492 ft) from the waste management unit boundary and maintain a minimum 50-ft buffer from the property boundary.

Shaw contacted a representative with the Kansas Department of Health and Environment, Bureau of Waste Management to ascertain actual point of compliance distances typically utilized within the State. The representative did not reveal an average relevant point of compliance distance; however, the Federal maximum distance of 150 m (492 ft) is enforced.

2.1.5 Minnesota

The Minnesota regulations pertaining to the location of groundwater monitoring networks and the relevant point of compliance are typically located within Minnesota Rules Chapter 7035.2815 Subpart 4 (A)–(E) and Subpart 10(C) (**Appendix A.5**). Minnesota regulations allow the owner or operator to propose a compliance boundary distance based upon various physical factors associated with the site and surrounding area. Although the regulations indicate that this distance should not exceed 200 ft, exceptions are possible with adequate demonstration that an alternate maximum distance would not present a greater risk to water quality or water use. In addition to horizontal point of compliance boundaries, the Minnesota regulations also provides for the establishment of a “lower compliance boundary” in situations where a deep aquifer is susceptible to vertical contaminant migration and a “surface water compliance boundary” in situations where groundwater may discharge to surface water. Similarly, the regulations allow the owner/operator to propose well locations sufficient for the early detection of contaminants potentially originating from the landfill based on site-specific conditions.

Shaw contacted a representative with the Minnesota Pollution Control Agency to ascertain actual point of compliance distances typically utilized within the State. The representative indicated the relevant point of compliance boundary is determined based on site specific factors, but cannot exceed 200 ft.

2.1.6 Missouri

The Missouri regulations pertaining to the location of groundwater monitoring networks and the relevant point of compliance are typically located within Title 10 Code of State Regulations, Division 80, Chapter 3 (11) (**Appendix A.6**). The regulations do not designate, or discuss a specific point of compliance boundary distance.

Shaw contacted a representative with the Missouri Department of Natural Resources to ascertain actual point of compliance distances typically utilized within the State. The representative did not provide an average point of compliance distance, indicating it is based upon site-specific hydrogeological conditions. The representative indicated that Missouri does enforce the maximum 150 m (492 ft) distance established within Subtitle D.

2.1.7 Nebraska

The Nebraska regulations pertaining to the location of groundwater monitoring networks and the relevant point of compliance are typically located within Title 132, Chapter 3, Section 003.04D and Chapter 7 Section 002.01B of the Nebraska Department of Environmental Quality Rules and Regulations (**Appendix A.7**). The regulations require downgradient groundwater monitoring systems to be screened in the uppermost aquifer and installed at the relevant point of compliance, established at the waste management unit boundary (e.g., 0 ft from the waste management unit boundary). The owner or operator may request an alternate point of compliance up to, but not exceeding 150 m (492 ft) from the waste management unit boundary and located on land owned by the owner of the MSWLF facility. The request and the ultimate approval are based upon various characteristics of the site and surrounding area.

Shaw contacted a representative with the Nebraska Department of Environmental Quality to ascertain typical point of compliance distances typically utilized within the State. The representative did not reveal an average relevant point of compliance distance; however, the Representative did indicate that the maximum distance is 150 m (492 ft).

2.1.8 Wisconsin

The Wisconsin regulations pertaining to the location of groundwater monitoring networks and the relevant point of compliance are typically located within Wisconsin Administrative Code Chapters NR 140.22(3) and NR 507.15. (**Appendix A.8**). The regulations generally define the "Design Management Zone" as a distance from the waste management boundary for which groundwater quality shall comply with pre-established "preventative action limits". The Design Management Zone distance for modern MSWLFs is located 150 ft from the waste management boundary. The owner and/or operator are required to propose a groundwater detection monitoring network, inclusive of a minimum of four "Subtitle D Wells". Subtitle D Wells are loosely defined as wells for which the location and depth have been approved, specifically for the monitoring purposes under Subtitle D of RCRA. The proposal and the ultimate approval of a

groundwater monitoring network is based upon various site specific factors including the facility size, waste type, facility design, and the geologic and hydrogeologic setting.

Shaw contacted a representative with the Wisconsin Department of Environment to ascertain typical point of compliance distances typically utilized within the State. The representative indicated that the regulatory requirements for relevant point of compliance distances (150 ft) are enforced.

2.1.9 Comparison Summary

Shaw completed a comparison of Iowa's proposed groundwater monitoring well networks and relevant point of compliance distance regulations to those enacted by the Federal government, Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin. In accordance with the Federal guidance, the reviewed regulations generally indicate that monitoring well networks are to be positioned within, and at the edge of the relevant point of compliance to assure early detection of groundwater impacts potentially attributable to the MSWLFs. Following is a summary of the relevant point of compliance distances:

Groundwater Monitoring Well Location and Relevant Point of Compliance Boundary	
Comparison Entity	Distance from Waste Management Unit Boundary
Federal	Based on site specific conditions, not to exceed 150 m (492 ft)
Iowa (proposed)	50 ft
Illinois	With the exception of at least one well installed at the downgradient edge of the Zone of Attenuation (100 ft from the waste management unit boundary), downgradient monitoring wells are to be installed no greater than 50 ft from the waste management unit boundary without interfering with site operations.
Kansas	Based on site specific conditions, not to exceed 150 m (492 ft)
Minnesota	Based on site specific conditions, not to exceed 200 ft
Missouri	Based on site specific conditions, no standard
Nebraska	0 ft, but an alternate distance less than 150 m (492 ft) can be requested
Wisconsin	150 ft

Shaw's comparison indicates Iowa, Illinois, and Wisconsin specify exact point of compliance distances. While establishing and maintaining a maximum, the remaining entities tend to rely more on professional evaluation of site-specific conditions to establish site-specific point of compliance distances.

2.2 *Groundwater Monitoring Well Spacing*

2.2.1 *Federal*

Federal MSWLF guidelines pertaining to the spacing of downgradient groundwater monitoring wells are typically located within 40 CFR Part 258.51 (**Appendix B.1**). The Federal regulations do not establish limitations with regard to the groundwater monitoring well spacing distance. Rather, the regulations indicate that the groundwater monitoring network should consist of a sufficient number of wells, “installed at appropriate locations and depths” to facilitate the collection of representative upgradient and downgradient groundwater samples from the uppermost aquifer.

2.2.2 *Iowa*

The proposed Iowa regulations pertaining to the spacing of downgradient groundwater monitoring wells at MSWLF facilities are typically located within 567 IAC Chapter 113.10(2)“e” (**Appendix B.2**). Iowa’s proposed regulations indicates that the downgradient groundwater monitoring well system should be designed based on site-specific geologic and hydrogeologic conditions, and establishes a maximum groundwater monitoring well spacing of 300 ft.

2.2.3 *Illinois*

The Illinois regulations pertaining to the spacing of downgradient groundwater monitoring wells at MSWLF facilities are typically located within Title 35 Illinois Administrative Code Section 811.318(b) (**Appendix B.3**). Similar to the Federal guidance, Illinois regulations do not limit specific groundwater monitoring well spacing distance. The regulations indicate that the groundwater monitoring network should be adequately designed to detect “any discharge of contaminants from any part of the potential source of discharge”.

Shaw contacted a representative with the Illinois Environmental Protection Agency to ascertain actual groundwater monitoring well spacing distances at MSWLFs in Illinois. While 300-ft to 400-ft downgradient groundwater monitoring well spacing has been approved in the past, the representative indicated that spacing greater than 250 ft is scrutinized.

2.2.4 *Kansas*

The Kansas regulations pertaining to the spacing of downgradient groundwater monitoring wells at MSWLF facilities are typically located within Kansas Administrative Regulations 28-29-111(f)(4)(C) (**Appendix B.4**). The Kansas regulations do not contain limitations with regard to the spacing of groundwater monitoring wells. Rather, the regulations generally indicate that the number, spacing and depths of groundwater monitoring wells should be determined based on site-specific hydrogeologic conditions.

Shaw contacted a representative with the Kansas Department of Health and Environment, Bureau of Waste Management to ascertain actual downgradient groundwater monitoring well

spacing distances at MSWLFs in Kansas. The representative indicated that well spacing is based upon site-specific hydrogeological conditions and did not comment with regard to a Kansas State average, but indicated spacing should not exceed 500 ft.

2.2.5 Minnesota

The Minnesota regulations pertaining to downgradient groundwater monitoring well spacing at MSWLF facilities are typically located within Minnesota Rules Chapter 7035.2815 Subpart 10(B) (**Appendix B.5**). Minnesota regulations do not contain limitations regarding the spacing of groundwater monitoring wells, but rely upon the owner/operator of the facility to design and demonstrate the effectiveness of the monitoring well network based upon various factors associated the site and surrounding area.

Shaw contacted a representative with the Minnesota Pollution Control Agency to ascertain typical downgradient groundwater monitoring well spacing at MSWLFs within the State. The representative indicated that groundwater monitoring wells are spaced based upon site specific geological and hydrogeological factors, and estimated that monitoring well spacing distances are typically 200 to 400 ft.

2.2.6 Missouri

The Missouri regulations pertaining to downgradient groundwater monitoring well spacing at MSWLF facilities are typically located within Title 10 Code of State Regulations, Division 80, Chapter 3 (11) (**Appendix B.6**). The regulations do not contain limitations regarding specific groundwater monitoring well spacing. Rather, the regulations state that at least one groundwater monitoring well should be installed in a hydrogeologically upgradient position for purposes of determining background groundwater quality and at least three wells should be installed in a hydrogeologically downgradient position to ensure the detection of “any significant amounts of fluids generated by the sanitary landfill” released to the groundwater. The exact quantity, location and depth of the monitoring wells are to be determined based upon site-specific conditions.

Shaw contacted a representative with the Missouri Department of Natural Resources to ascertain actual groundwater monitoring well spacing distances within the State. The representative indicated groundwater monitoring well spacing is based on site-specific hydrogeological conditions, but mentioned that typical well spacing in the State falls between 200 and 600 ft.

2.2.7 Nebraska

The Nebraska regulations pertaining to the location of downgradient groundwater monitoring networks and the relevant point of compliance are typically located within Title 132, Chapter 7, Section 002.04 of the Nebraska Department of Environmental Quality Rules and Regulations (**Appendix B.7**). The regulations require the number, spacing, and depths of monitoring wells

to be determined based upon site-specific geological and hydrogeological conditions. The regulations do not contain limitations regarding groundwater monitoring well spacing.

A representative with the Nebraska Department of Environmental Quality indicated that the downgradient monitoring well spacing is determined on a site-by-site basis, utilizing site-specific geological and hydrogeological data. The Representative declined to comment on average well spacing distances at MSWLFs within the State.

2.2.8 Wisconsin

The Wisconsin regulations pertaining to spacing of downgradient groundwater monitoring wells at MSWLF facilities are typically located within Wisconsin Administrative Code Chapters NR 507.15 and NR 507.19(1) (**Appendix B.8**). The Wisconsin regulations do not contain limitations regarding the spacing of groundwater monitoring wells. Rather, the owner/operator is required to propose a groundwater detection monitoring network, inclusive of a minimum of four "Subtitle D Wells". Subtitle D Wells are loosely defined as wells for which the location and depth have been approved, specifically for the monitoring purposes under Subtitle D of RCRA. The proposal and the ultimate approval of a groundwater monitoring network is based upon various site specific factors including the facility size, waste type, facility design, and the geologic and hydrogeologic setting.

Based on a conversation with a representative with the Wisconsin Department of Natural Resources, monitoring well spacing at MSWLFs in Wisconsin is ultimately driven by site-specific geologic and hydrogeologic factors. However, the regulations establish requirements for the quantity of wells that should be installed during a hydrogeological investigation during siting procedures. The quantity of wells is acreage-driven, and generally equates to five wells per acre for the first five acres, then one well for every acre thereafter. The Representative indicated that typically, with the exception of one or two wells installed within a future waste management unit, nearly all of the wells installed during the hydrogeological investigation are monitored during subsequent operations.

2.2.9 Comparison Summary

Shaw completed a comparison of Iowa's proposed groundwater monitoring well spacing regulations to those enacted by the Federal government, Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin. Although a majority of the reviewed regulations require the groundwater spacing distances to be based on site-specific conditions, Shaw was able to ascertain typical spacing distances for many of the entities evaluated. Following is a summary of the downgradient groundwater monitoring well spacing distances:

Downgradient Groundwater Monitoring Well Location Spacing	
<i>Comparison Entity</i>	<i>Groundwater Monitoring Well Spacing</i>
Federal	Based on site specific conditions.
Iowa (proposed)	Based on site specific conditions, not to exceed 300 ft
Illinois	Based on site specific conditions, typically less than 250 ft
Kansas	Based on site specific conditions, typically less than 500 ft
Minnesota	Based on site specific conditions, typically between 200 ft to 400 ft
Missouri	Based on site specific conditions, typically between 200 ft to 600 ft
Nebraska	Based on site specific conditions
Wisconsin	Based on site specific conditions

Shaw's comparison revealed that a maximum groundwater monitoring well spacing is only established by Iowa's proposed regulations; however, the proposed maximum distance generally coincides within the actual groundwater monitoring well spacing ranges for the other entities evaluated (about 200 ft and 600 ft).

2.3 *Groundwater Detection Monitoring*

2.3.1 *Federal*

Federal guidelines pertaining to groundwater detection monitoring are typically located within 40 CFR Part 258.53 – 258.54 and Appendix I (**Appendix C.1**). The federal regulations require modern MSWLF facilities to establish a groundwater monitoring program that facilitates the early detection of groundwater contaminants potentially attributable to landfilling activities. The detection monitoring guidelines generally indicate that groundwater sampling events, consisting of the collection of representative groundwater samples from all approved upgradient and downgradient wells and the determination of groundwater flow rate and direction (via groundwater elevation measurements), should occur at a frequency no greater than semi-annually. The Federal guidelines indicate that groundwater samples should be analyzed for 15 specified inorganic and 47 specified organic chemical parameters listed within Appendix I of 40 CFR Part 258.54. The regulations provide the Director of an approved State authority to prescribe an alternate sampling frequency no greater than annually and to alter the federal chemical parameter list based upon site-specific factors. Should the statistical comparison of analytical groundwater monitoring results to background groundwater quality reveal a potential degradation in groundwater quality, the Federal guidelines generally require the owner/operator to report the “statistically significant increase over background” to the State within 14 days, and then within 90 days either demonstrate that the perceived impact to groundwater quality is not a result of landfilling activities, or to initiate an assessment monitoring program.

2.3.2 *Iowa*

The proposed Iowa MSWLF regulations pertaining to groundwater detection monitoring are typically located within 567 IAC Chapter 113.10(4) – 113.10(5) and Appendix I (**Appendix C.2**). With the exception of requiring the field measurement of sample temperature, pH and specific conductivity and the laboratory analysis of chloride and chemical oxygen demand, the proposed Iowa regulations largely mirror the minimum Federal guidelines, requiring semi-annual events for the analysis of 15 inorganic constituents and 47 organic constituents and groundwater elevation.

2.3.3 *Illinois*

The Illinois regulations pertaining to groundwater detection monitoring are typically located within Title 35 Illinois Administrative Code Section 811.318, 811.319(a), 302.304 and 620.405(a) (**Appendix C.3**). The Illinois regulations establish a detection monitoring program that requires the owner/operator to perform a groundwater monitoring event on a quarterly basis for an initial five-year period following initial permit issuance. Following the initial five year period, the sampling frequency can be conditionally reduced to a semi-annual basis. Groundwater samples are analyzed for parameters determined on a facility-specific basis, but generally include approximately 30 inorganic parameters on a quarterly basis and, at minimum, the 51 organic constituents listed within the Federal guidelines on an annual basis. In addition to the

parameters described above, the following field parameters must be evaluated during routine groundwater detection monitoring events: groundwater elevation, depth of the well below the ground surface, sample pH, temperature, and specific conductance.

As previously discussed, Illinois establishes a point of compliance boundary known as the Zone of Attenuation, located 100 ft from the waste management unit boundary. Groundwater detection monitoring wells are to be located as close to the waste management unit boundary as possible without interfering with daily operations, but not to exceed 50 ft. The Illinois regulations require the establishment of "Maximum Allowable Predicted Concentration (MAPCs)" for each sampled constituent at each monitoring point. MAPCs are established via groundwater modeling utilizing site-specific and chemical-specific parameters, and represent the maximum concentration of a given constituent that can attenuate to concentrations less than the applicable groundwater quality standard over the distance from the monitoring point to the edge of the zone of attenuation.

An "Observed Increase" of a monitored constituent is generally defined as: (1) a progressive increase in concentration over four consecutive monitoring events, (2) the concentration exceeds the applicable MAPC value, (3) the concentration of an organic constituent exceeds the preceding measured concentration, or (4) the concentration exceeds the applicable groundwater quality standard at the edge of the zone of attenuation. Statistically significant increases trigger notification, confirmation sampling, potential assessment monitoring, and potential corrective action requirements. It should be noted that Illinois is in the process of revising their groundwater monitoring requirements, which may affect the validity of the information summarized within this section.

2.3.4 Kansas

The Kansas regulations pertaining to groundwater detection monitoring are typically located within Kansas Administrative Regulations 28-29-112 and 28-29-113(a) and Appendix I (**Appendix C.4**). The Kansas regulations resemble the Federal guidelines summarized above. In addition to measurement of groundwater elevation, depth to the bottom of the well, pH, temperature, specific conductance, and observation of the physical characteristics, groundwater samples are to be analyzed for 44 chemical parameters (9 inorganic, 35 organic) on a semi-annual basis. Statistically significant increases trigger notification, confirmation sampling, potential assessment monitoring, and potential corrective action requirements.

2.3.5 Minnesota

The Minnesota regulations pertaining to groundwater detection monitoring are typically located within Minnesota Rules Chapter 7035.2815 Subpart 4(f) and Subpart 14 (**Appendix C.5**). Minnesota regulations allow for the groundwater detection monitoring programs to be established based on facility-specific factors. However, until the specific monitoring program is established, the owner/operator is required to perform groundwater monitoring events three times a year. The groundwater samples are analyzed for approximately 41 organic parameters

three times a year and 22 inorganic parameters are analyzed once a year. Field parameters, including pH, specific conductance, temperature, and groundwater elevation are evaluated during each sampling event. Analytical groundwater monitoring results that exceed pre-established groundwater protection standards trigger notification, confirmation sampling, potential assessment monitoring, and potential corrective action requirements.

2.3.6 Missouri

The Missouri regulations pertaining to groundwater detection monitoring are typically located within Title 10 Code of State Regulations, Division 80, Chapter 3(11)(C)(2)-(6) and Appendix 1 (**Appendix C.6**). The Missouri regulations resemble the Federal guidelines summarized above. Groundwater detection monitoring events are to be conducted on a semi-annual basis to analyze groundwater for 32 inorganic parameters, 48 organic parameters, and the following field parameters: pH, specific conductance, and groundwater elevation. Statistically significant increases trigger notification, confirmation sampling, potential assessment monitoring, and potential corrective action requirements.

2.3.7 Nebraska

The Nebraska regulations pertaining to groundwater detection monitoring are typically located within Title 132, Chapter 7, Section 003 - 004 and Appendix I (**Appendix C.7**). The Nebraska regulations largely resemble the minimum Federal requirements for groundwater detection monitoring summarized above. Nebraska requires groundwater monitoring events to be conducted on a semi-annual basis and samples laboratory analyzed for 15 inorganic parameters and 47 organic parameters. Statistically significant increases trigger notification, confirmation sampling, potential assessment monitoring, and potential corrective action requirements.

2.3.8 Wisconsin

The Wisconsin regulations pertaining to groundwater detection monitoring are typically located within Wisconsin Administrative Code Chapters NR 140.14 – NR 140.28 and NR 507.15 – NR 507.19 and Appendices I and III (**Appendix C.8**). The Wisconsin regulations generally indicate that groundwater detection monitoring is to occur at MSWLF facilities on a semi-annual basis. Groundwater samples are semi-annually analyzed for approximately 42 organic parameters from Subtitle D wells, and annually for non-Subtitle D wells. In addition to groundwater elevation, groundwater samples from all monitoring points are analyzed semi-annually for alkalinity, chloride, specific conductivity, pH, temperature, and hardness. The Wisconsin regulations require owner/operators to establish and compare groundwater detection monitoring data to “Preventative Action Limits (PALs)” and “Enforcement Standards (ESs)”. Exceedances trigger notification, confirmation sampling, potential assessment monitoring, and potential corrective action requirements.

2.3.9 Comparison Summary

Shaw completed a comparison of Iowa's proposed groundwater detection monitoring regulations to those enacted by the Federal government, Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin. Following is a summary of select parameters regarding the compared groundwater detection monitoring regulations:

Groundwater Detection Monitoring				
Comparison Entity	Maximum Sampling Frequency	Sampling Parameters		
		Field / Indicator	Inorganic	Organic
Federal	Semi-Annually	1	15	47
Iowa (proposed)	Semi-Annually	6	15	47
Illinois	Quarterly for 5 years, then Semi-Annually	5	~30	~50
Kansas	Semi-Annually	6	9	35
Minnesota	Tri-Annually	4	22 (annually)	41
Missouri	Semi-Annually	3	32	48
Nebraska	Semi-Annually	1	15	47
Wisconsin	Semi-Annually	4	2	42

Based on the results of this comparative analysis, it is Shaw's opinion that Iowa's proposed groundwater detection monitoring program appears to be generally consistent with the Federal requirements and a majority of the regulations enacted by the comparison states.

2.4 *Design for Leachate Collection Systems*

2.4.1 *Federal*

Federal guidelines pertaining to leachate collection systems are typically located within 40 CFR Part 258(a)(2)(a) (**Appendix D.1**). The Federal regulations do not contain specific leachate system design parameters. Rather, the guidelines indicate that modern MSWLF facilities to be constructed with a leachate collection system that is “designed and constructed to maintain less than a 30-cm depth of leachate over the liner”.

2.4.2 *Iowa*

The proposed Iowa MSWLF regulations pertaining to leachate collection systems are typically located within 567 IAC Chapters 113.7(5)“b” (**Appendix D.2**). In accordance with Federal guidance, the proposed regulations indicate that the leachate collection system should be designed and constructed to maintain a maximum 30-cm (1-ft) leachate depth on the liner. The proposed regulations describe the minimal design of the leachate collection system to consist of the following (from bottom to top):

- ❑ A geotextile cushion above the flexible membrane liner;
- ❑ 4-in minimum diameter collection piping;
- ❑ One of the following “high hydraulic-conductivity materials” surrounded by overlying and underlying geotextile media capable of preventing the transmission of particles equal to that of coarse granular materials utilized in the design:
 - Gravel layer (6-in minimum thickness with “minimal carbonate content”) or
 - Geosynthetic drainage media (300-mil minimum thickness); and
- ❑ 6-in minimum thickness protective coarse sand layer.

The leachate collection system should be designed to operate during the entire active life of the facility and constructed of materials that are capable of withstanding expected loads, minimal carbonate content, and should have hydraulic conductivities no less than 1×10^{-2} cm/s. Finally, the system should provide for leachate head measurement and leachate pipe clean-out.

2.4.3 *Illinois*

The Illinois regulations pertaining to leachate collection systems are typically located within Title 35 Illinois Administrative Code Section 811.307 and 811.308 (**Appendix D.3**). The Illinois regulations do not specify leachate collection system design components. However, it is generally indicated that the leachate collection system should be designed and constructed to operate over the entire design period, maintain a maximum leachate head on the liner system

less than 1 ft, and to be constructed of materials chemically resistant to expected leachate quality and capable of withstanding expected loads. The drainage layer should be capable of allowing laminar flow of leachate via gravity, be no less than 1 ft in depth, maintain a hydraulic conductivity no less than 1×10^{-3} cm/s, and utilize materials consisting of coarse gravel or geotextile.

2.4.4 Kansas

The Kansas regulations pertaining to leachate collection systems are typically located within Kansas Administrative Regulations 28-29-104(g) and 28-29104(h) (**Appendix D.4**). In accordance with Federal guidelines, the Kansas regulations indicate that the leachate collection system should be designed and constructed to maintain a maximum 1 ft head of leachate on the liner system. The regulations do not specify leachate collection system design components, and for all practical purpose, closely resemble the Illinois requirements summarized above.

2.4.5 Minnesota

The Minnesota regulations pertaining to leachate collection systems are typically located within Minnesota Rules Chapter 7035.2815 Subpart 9 (**Appendix D.5**). The Minnesota regulations indicate that the leachate build-up on the liner should not exceed 1 ft. While specific leachate collection system components are not addressed, the regulations do specify that the system should provide for leachate detection/measurement, leachate extraction/sampling, a leachate storage area, and system cleanout. All components of the system are to be capable of withstanding the expected loading and be chemically compatible with the expected leachate quality. Leachate drainage media is not addressed by the Minnesota regulations.

2.4.6 Missouri

The Missouri regulations pertaining to leachate collection systems are typically located within Title 10 Code of State Regulations, Division 80, Chapter 3(9) (**Appendix D.6**). The Missouri regulations provide broad guidance with regard to the requirements of the leachate collection system. The regulations indicate that the leachate collection system should be designed and operated to maintain less than 1 ft of leachate on the liner and operate the entire design life of the facility. Leachate drainage media is not addressed by the Missouri regulations.

2.4.7 Nebraska

The Nebraska regulations pertaining to leachate collection systems are typically located within Title 132, Chapter 3, Section 003.04B of the Nebraska Department of Environmental Quality Rules and Regulations (**Appendix D.7**). The Nebraska regulations indicate that the "leachate collection and treatment system shall be constructed where necessary to protect the waters of the State". The regulations further indicate that the system should maintain less than 1-ft leachate head on the liner system. Specific leachate design components and leachate drainage media are not addressed within the Nebraska regulations.

2.4.8 Wisconsin

The Wisconsin regulations pertaining to leachate collection systems are typically located within Wisconsin Administrative Code Chapters NR 540.06(5) (**Appendix D.8**). The Wisconsin regulations indicate that leachate collection systems should be designed so as to maintain less than 1 ft leachate head on the liner system. Following is a generalized summary of select specifications within the Wisconsin regulations:

- ❑ Leachate collection piping systems should be designed with schedule 80 PVC pipe with 6 in maximum diameter.
- ❑ The leachate piping should be packed within the trench utilizing granular material with a maximum particle diameter of 1½ in. Granular material should be placed a minimum of 4 in below and a minimum of 6 in above the leachate collection pipe.
- ❑ A 1 ft thick granular drainage blanket should be placed over the liner. If the particle size of the drainage blanket exceeds ¼ in, then a non-woven geotextile should be installed below the drainage blanket to protect the liner.
- ❑ The hydraulic conductivity of the leachate collection blankets should be no less than 1×10^{-2} cm/s.

The leachate collection system should be designed to route leachate via gravity flow to the perimeter of the landfill, constructed of materials capable of withstanding anticipated loads and chemically resistant to the expected leachate quality.

2.4.9 Comparison Summary

Shaw completed a comparison of Iowa's proposed leachate collection system design regulations to those enacted by the Federal government, Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin. Following is a summary of select parameters regarding the compared leachate collection system design regulations:

Leachate Collection System Design			
Comparison Entity	Minimum Allowable Hydraulic Conductivity of Drainage Material	Minimum Thickness of Granular Drainage Material	Maximum Allowable Leachate Head on Liner
Federal	Not Specified	Not Specified	30 cm (1 ft)
Iowa (proposed)	1×10^{-2} cm/s	1 ft	30 cm (1 ft)
Illinois	1×10^{-3} cm/s	1 ft	30 cm (1 ft)
Kansas	Not Specified	1 ft	30 cm (1 ft)
Minnesota	Not Specified	Not Specified	30 cm (1 ft)
Missouri	Not Specified	Not Specified	30 cm (1 ft)
Nebraska	Not Specified	Not Specified	30 cm (1 ft)
Wisconsin	1×10^{-2} cm/s	1 ft	30 cm (1 ft)

Based on the results of this comparative analysis, Iowa's proposed leachate collection system design parameters listed above appear relatively similar to those specified by the other comparison states.

2.5 *Soil and Hydrogeological Investigations*

2.5.1 *Federal*

Federal guidelines loosely pertaining to soil and hydrogeological investigations are typically located within 40 CFR Parts 258.51(d) (**Appendix E.1**). While the Federal regulations do not directly address soil and hydrogeological investigation requirements, the referenced section implies a required thorough characterization of the following:

- ❑ Aquifer thickness;
- ❑ Groundwater flow rate;
- ❑ Groundwater flow direction (including seasonal and temporal fluctuations); and
- ❑ Thickness, stratigraphy, lithology, hydraulic conductivity, porosity, effective porosity, etc. of the saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer and materials comprising the confining unit beneath the uppermost aquifer.

2.5.2 *Iowa*

The proposed Iowa MSWLF regulations pertaining to soil and hydrogeological investigations are typically located within 567 IAC Chapters 113.6(3) (**Appendix E.2**). The proposed Iowa regulations establish minimal requirements for subsurface investigations conducted to assess “potential contaminant migration via groundwater”. The regulations require a work plan be submitted for Department approval prior to conducting soil and hydrogeological investigations. The regulations require investigations to include at least 1 boring per acre, advanced to a minimum depth of 25 ft below ground surface and at least 10 ft below the groundwater surface. At least half of the borings should extend 20 ft into the uppermost aquifer, 50 ft below the groundwater surface, or 10 ft into bedrock. At least one boring should extend 10 ft into bedrock or 100 ft below the ground surface. The proposed regulations also establish standards for field methods, data needs, and data analyses.

2.5.3 *Illinois*

The Illinois regulations pertaining to soil and hydrogeological investigations are typically located within Title 35 Illinois Administrative Code Section 811.315 (**Appendix E.3**). The Illinois regulations generally establish a three-tiered subsurface investigation to collect sufficient data for the purposes of performing groundwater impact assessment and establish a groundwater monitoring system. The investigation should essentially consist of the following phases:

- ❑ The initial phase consists of a minimally invasive investigation where the regional and local geological and hydrogeological settings are established mainly through documentation review. This phase requires one boring to be placed near the geometric

center of the facility to determine if the actual setting is consistent with that inferred from the documentation review. Data obtained during this phase of the investigation is utilized to facilitate the design of the second phase.

- ❑ The second phase of the investigation consists of an intrusive hydrogeological investigation conducted to assess various geological and hydrogeological characteristics of the site, generally including hydraulic conductivities, vertical extent of the uppermost aquifer, and the direction and rate of groundwater flow. The regulations do not establish a boring quantity requirement, but do indicate that borings, piezometers, and/or monitoring wells should be placed at the topographic high point, the topographic low point, and at the corners of the facility.
- ❑ The third phase of the investigation is intended to augment previous investigation results via additional characterization of the subsurface conditions. The regulations specify a minimum boring requirement for this phase, but state that additional data can be collected via methods including additional borings, and/or test pitting.

2.5.4 Kansas

The Kansas regulations pertaining to soil and hydrogeological investigations are typically located within Kansas Administrative Regulations 28-29-104(b) (**Appendix E.4**). The Kansas regulations require a hydrogeological investigation of a proposed MSWLF location to acquire sufficient information to facilitate the design of the unit and the groundwater monitoring system. Similar to Illinois, Kansas has established a tiered investigation, but consisting of two phases. During the initial phase, regional and local geological and hydrogeological information is collected via a documentation review that is confirmed with a single boring located near the center of the facility. This information is compiled and submitted to the State for review and comment with regards to the scope of work for the second phase. With the State's input and approval, a second intrusive investigation phase is conducted. The regulations do not establish a minimum boring quantity, but require one placed at the topographic high, and one placed at the topographic low of the site. The regulations indicated that the investigation should include sufficient quantity of data points to adequately characterize local geologic and hydrogeologic conditions at the site.

2.5.5 Minnesota

The Minnesota regulations pertaining to soil and hydrogeological investigations are typically located within Minnesota Rules Chapter 7035.2815 Subpart 3 (**Appendix E.5**). Minnesota regulations require that a hydrogeological investigation be conducted "to define the hydrogeologic conditions at the facility". The regulations establish a dual-phased investigation process. During the initial phase, regional and local geologic and hydrogeologic conditions are assessed via a documentation review. The second phase generally consists of a hydrogeological investigation conducted to assess local geologic and hydrogeologic conditions

with the advancement of borings and installation of piezometers and monitoring wells. The regulations provide the following guidance for minimal boring requirements:

<u>Size of the Site (acres)</u>	<u>Number of Borings</u>
0-10	15
10-20	1 additional boring per additional acre
20	25
20-40	1 additional boring per additional 2 acres
40	35
More than more	1 additional boring per additional 4 acres

The findings and conclusion of each phase are to be presented within a report that is submitted to the State along with a work plan for additional investigation tasks deemed appropriate. The State's review and approval is required prior to advancing to subsequent phases. The regulations also contain guidance related to field methodologies, data collection and analysis and reporting requirements.

2.5.6 Missouri

The Missouri regulations pertaining to soil and hydrogeological investigations are typically located within Title 10 Code of State Regulations, Division 80, Chapter 2 (15) and Appendix 1 (**Appendix E.6**). The Missouri regulations require an applicant to obtain geologic and hydrogeologic site approval prior to obtaining a permit to construct and operate a MSWLF facility. The approval process involves the following steps:

- Obtain preliminary site approval through the Division of Geology and Land Survey Geological Survey Program (based on preliminary documentation review conducted by the State);
- A "Qualified Groundwater Scientist" must meet with the Division of Geology to discuss site conditions;
- Submit a work plan for a "detailed surface and subsurface geological and hydrogeological investigation" for approval;
- Perform the investigation and present findings and conclusions to the State for geologic and hydrogeologic site approval.

The regulations incorporate a document entitled "Guidance for Conducting and Reporting Detailed Geologic and Hydrogeologic Investigations at a Proposed Solid-Waste Disposal Area". The document contains detailed minimal standards for proposing, conducting, and presenting the geologic and hydrogeologic investigation. Generally, the guidance indicates that 1 boring should be advanced for every two acres to a depth of 25 ft below the anticipated disposal area sub-grade base or to competent bedrock.

2.5.7 *Nebraska*

The Nebraska regulations pertaining to soil and hydrogeological investigations are typically located within Title 132, Chapter 3, Section 002.02 (**Appendix E.7**). The Nebraska regulations state that the application submitted for MSWLF development should include a description of “Soil and bedrock to a depth adequate to allow evaluation of the water quality protection provided by soil and bedrock” and “Ground water condition, including groundwater flow below and adjacent to the proposed facility, with an appraisal of the effect of the facility on groundwater and surface water”. The regulations do not specifically establish geologic and hydrogeologic investigation requirements.

2.5.8 *Wisconsin*

The Wisconsin regulations pertaining to soil and hydrogeological investigations are typically located within Wisconsin Administrative Code Chapters NR 512.09 (**Appendix E.8**). The Wisconsin regulations indicate that a “geotechnical investigation” should be conducted to define subsurface conditions. The regulations establish minimal quantity of borings, piezometers and monitoring wells. The system is based upon the acreage of the fill area and accounts for both coarse and fine-grained soil environments, as follows:

<u>Acreage</u>	<u>Borings (Coarse/Fine)</u>	<u>Piezometers (Coarse/Fine)</u>	<u>Wells (Coarse/Fine)</u>
Initial 5 or less	10/10	2/4	5/5
Additional 5 or less	2/2	0/0	1/1
Additional 10 or less	0/0	1/2	0/0

The regulations generally indicate that the borings should be advanced 25 ft below the anticipated sub-base of the unit. The regulations also contain guidance regarding field methodologies, data collection and analysis and reporting requirements.

2.5.9 *Comparison Summary*

Shaw completed a comparison of Iowa’s proposed soil and hydrogeological investigation regulations to those enacted by the Federal government, Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin. While each of the reviewed regulatory frameworks requires investigation of subsurface conditions at MSWLF facilities, the quantity and detail of procedural requirements (e.g., quantity of borings, boring depths, field and sampling methodologies, reporting requirements, etc.) to which the investigation should be conducted vary from minimal to extensive. It is Shaw’s opinion that Iowa’s proposed requirements represent neither extreme.

2.6 *Alternative Liner Systems*

2.6.1 *Federal*

Federal guidelines pertaining to alternate liner systems are typically located within 40 CFR Parts 258.40(a)-(c) (**Appendix F.1**). The regulations establish an approved composite liner design, consisting of a 30-mil flexible membrane liner (FML) or 60-mil if utilizing high density polyethylene (HDPE) overlying a 2-ft compacted soil layer with a maximum hydraulic conductivity of 1×10^{-7} cm/s. While the Federal regulations do not include specific alternative liner designs, the regulations generally state that the Director of an approved State may approve alternate MSWLF designs so long as the design ensures that groundwater impacts potentially originating from landfilling activities do not exceed pre-established concentration values within the uppermost aquifer at the relevant point of compliance. When considering alternate designs, the Federal guidelines establish various site-specific characteristics that the Director must consider.

2.6.2 *Iowa*

The proposed Iowa MSWLF regulations pertaining to alternative liner systems are typically located within 567 IAC Chapter 113.7(5) (**Appendix F.2**). The proposed regulations establish an approved composite liner design consisting of a 30-mil FML (60-mil if HDPE) overlying a 2-ft compacted soil layer with a maximum hydraulic conductivity of 1×10^{-7} cm/s. In addition to a composite liner design, the proposed Iowa regulations contain language that provides the applicant the opportunity to utilize an approved alternate liner system consisting of compacted soil. In accordance with Federal guidance, the proposed regulations generally indicate that approved alternative liner systems should be designed and constructed so as to ensure that pre-established groundwater quality standards are not exceeded at the relevant point of compliance. The proposed alternative liner system should be evaluated by the Department with the consideration of various factors regarding the site and surrounding area.

2.6.3 *Illinois*

The Illinois regulations pertaining to alternative liner systems are typically located within Title 35 Illinois Administrative Code Section 811.306 (**Appendix F.3**). The Illinois regulations establish a standard compacted soil liner with a minimum thickness of 5 ft and a maximum hydraulic conductivity of 1×10^{-7} cm/s. Alternate liner designs should not be less than 5 ft in thickness unless an FML is utilized. In such cases, a 60-mil FML should overlie a minimum 3-ft compacted soil layer with a maximum hydraulic conductivity of 1×10^{-7} cm/s.

2.6.4 *Kansas*

The Kansas regulations pertaining to alternative liner systems are typically located within Kansas Administrative Regulations 28-29-104(e) (**Appendix F.4**). The Kansas regulations establish a standard composite liner design that should consist of a 30-mil geomembrane (60-mil if HDPE) overlying a 2-ft compacted soil layer with a maximum hydraulic conductivity of

1×10^{-7} cm/s. The Kansas regulations also provide the applicant the opportunity to utilize an approved alternate liner system. The regulations generally indicate that approved alternative liner systems should be designed and constructed so as to ensure that pre-established groundwater quality standards are not exceeded at the relevant point of compliance, and the alternative liner system should be approved by the Department with the consideration of various factors regarding the site and surrounding area. The Kansas regulations further state that alternative liner systems are considered and approved only when the proposed technology has been successfully implemented in at least one other similar application and the methods for ensuring quality control during construction can be readily implemented.

2.6.5 Minnesota

The Minnesota regulations pertaining to alternative liner systems are typically located within Minnesota Rules Chapter 7035.2815 Subpart 7 (**Appendix F.5**). The regulations indicate that the approved standard composite liner system design should consist of a 30-mil reinforced FML (60-mil if not reinforced) overlying a 4-ft compacted soil layer with a hydraulic conductivity no greater than 1×10^{-7} cm/s. The Minnesota regulations only briefly address proposed alternate liner systems, indicating that they may be approved based on the State's evaluation of the proposed system to "control leachate migration, meet performance standards, and protect human health and the environment".

2.6.6 Missouri

The Missouri regulations pertaining to liner systems are typically located within Title 10 Code of State Regulations, Division 80, Chapter 3(10) (**Appendix F.6**). The Missouri regulations establish an approved standard composite liner system design consisting of a 30-mil FML (60-mil if HDPE) overlying a 2-ft compacted soil layer with a maximum hydraulic conductivity of 1×10^{-7} cm/s. The Missouri regulations do not appear to address alternate liner systems.

2.6.7 Nebraska

The Nebraska regulations pertaining to alternative liner systems are typically located within Title 132, Chapter 3, Section 003.04A of the Nebraska Department of Environmental Quality Rules and Regulations (**Appendix F.7**). The Nebraska regulations establish an approved composite liner system design consists of a 30-mil FML (60-mil if HDPE) overlying a 2-ft compacted soil layer with a maximum hydraulic conductivity of 1×10^{-7} cm/s. Approved alternative liner systems should be designed and constructed so as to ensure that pre-established groundwater quality standards are not exceeded at the relevant point of compliance, and the alternative liner system should be approved by the Department with the consideration of various factors regarding the site and surrounding area.

2.6.8 Wisconsin

The Wisconsin regulations pertaining to alternative liner systems are typically located within Wisconsin Administrative Code Chapters NR 504.06 (**Appendix F.8**). The Wisconsin

regulations establish an approved composite liner design that consists of a 60-mil geomembrane overlying a 4-ft compacted soil layer with a maximum hydraulic conductivity of 1×10^{-7} cm/s. The Wisconsin regulations also approve an alternate compacted soil liner system. The regulations indicate the liner should consist of 5 ft of compacted materials that achieve a hydraulic conductivity no greater than 1×10^{-7} cm/s.

2.6.9 Comparison Summary

Shaw completed a comparison of Iowa's proposed alternate liner system regulations to those enacted by the Federal government, Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin. With the exception of Missouri, each of the entities compared during this analysis allow for approval and utilization of alternate liner systems. The comparison of both standard and alternate liner system regulations are summarized below.

Liner System Designs		
Comparison Entity	Standard Liner Design	Possible Alternate Liner Designs
Federal	30-mil FML (60-mil if HDPE) overlying 2-ft compacted soil ($<1 \times 10^{-7}$ cm/s)	Allowable, must ensure pre-established groundwater quality standards are not exceeded at the relevant point of compliance
Iowa (proposed)	30-mil FML (60-mil if HDPE) overlying 2-ft compacted soil ($<1 \times 10^{-7}$ cm/s)	Allowable, must ensure pre-established groundwater quality standards are not exceeded at the relevant point of compliance
Illinois	5-ft compacted soil ($<1 \times 10^{-7}$ cm/s)	60-mil FML overlying 3-ft compacted soil ($<1 \times 10^{-7}$ cm/s)
Kansas	30-mil FML (60-mil if HDPE) overlying 2-ft compacted soil ($<1 \times 10^{-7}$ cm/s)	Allowable, must ensure pre-established groundwater quality standards are not exceeded at the relevant point of compliance
Minnesota	30-mil reinforced FML (60-mil if not reinforced) overlying 4-ft compacted soil (1×10^{-7} cm/s)	Allowable, design must adequately control leachate, meet performance standards, and protects human health and the environment.
Missouri	30-mil FML (60-mil if HDPE) overlying 2-ft compacted soil ($<1 \times 10^{-7}$ cm/s)	Alternate liner system designs do not appear to be addressed
Nebraska	30-mil FML (60-mil if HDPE) overlying 2-ft compacted soil ($<1 \times 10^{-7}$ cm/s)	Allowable, must ensure pre-established groundwater quality standards are not exceeded at the relevant point of compliance
Wisconsin	60-mil FML overlying 4-ft compacted soil (1×10^{-7} cm/s)	5 ft compacted soil that achieves a hydraulic conductivity no greater than 1×10^{-7} cm/s.

With the exception of Illinois and Wisconsin, a majority of the State regulations (including Iowa's proposed regulations) contain generalized language, thus allowing a degree of flexibility with regard to the alternate liner system.

2.7 Surface Water Monitoring

2.7.1 Federal

Federal guidelines pertaining to surface water are typically located within 40 CFR Parts 258.27 (**Appendix F.1**). The Federal regulations do not establish specific surface water sampling requirements. Rather, the guidelines generally indicate that no facility should discharge pollutants to waters of the United States in accordance with the requirements of the Clean Water Act including, but not limited to the National Pollutant Discharge Elimination System requirements.

2.7.2 Iowa

The proposed Iowa MSWLF regulations pertaining to surface water are typically located within 567 IAC Chapters 113.10(1)"a" and 113.10(3) (**Appendix F.2**). In addition to containing language that generally mirrors the Federal guidelines, the proposed Iowa regulations generally indicate that the Department may require the implementation of a surface water sampling program if there is evidence that surface water has, or may be impacted by facility operations. The regulations provide further guidance with regards to the establishment of surface water monitoring points and surface water sampling.

2.7.3 Illinois

The Illinois regulations pertaining to surface water are typically located within Title 35 Illinois Administrative Code Section 811.102(e)-(f) (**Appendix F.3**). Illinois regulations contain language that generally mirrors the Federal guidance, requiring compliance with the Clean Water Act. Surface water sampling requirements are not addressed by Illinois' MSWLF regulations.

2.7.4 Kansas

The Kansas regulations pertaining to surface water are typically located within Kansas Administrative Regulations 28-29-108(j) (**Appendix F.4**). The Kansas MSWLF regulations do not contain specific requirements with regard to surface water monitoring, but do contain language that generally mirrors the Federal guidance requiring compliance with the Clean Water Act.

2.7.5 Minnesota

The Minnesota regulations pertaining to surface water are typically located within Minnesota Rules Chapter 7035.2565 Subpart 1 and 7035.2815 Subpart 4(E), Subpart 10 and Subpart 14 (**Appendix F.5**). The Minnesota regulations indicate that "solid waste management facilities should be located, designed, constructed and operated to...prevent pollution of...surface water". Similar to the relevant point of compliance that applies to groundwater, the State maintains the

authority to establish a surface water point of compliance if there is a potential for groundwater to discharge to surface water and negatively impact its quality. The regulations provide guidance for the establishment of surface water monitoring systems and surface water sampling.

2.7.6 Missouri

The Missouri regulations pertaining to surface water are typically located within Title 10 Code of State Regulations, Division 80, Chapter 3 (8) (**Appendix F.6**). The Missouri regulations do not contain specific requirements with regard to surface water monitoring. However, it is stated that “the location, design, construction, and operation of the sanitary landfill shall minimize environmental hazards and shall conform to the applicable ground and surface water quality standards and requirements”, later referencing the Missouri Clean Water Law.

2.7.7 Nebraska

The Nebraska regulations pertaining to surface water are typically located within Title 132, Chapter 3, Section 004.08 of the Nebraska Department of Environmental Quality Rules and Regulations (**Appendix F.7**). The Nebraska regulations do not contain specific requirements with regard to surface water monitoring. Rather, the regulations mirror the language of the Federal guidelines, requiring compliance with the Clean Water Act.

2.7.8 Wisconsin

The Wisconsin regulations pertaining to surface water are typically located within Wisconsin Administrative Code Chapters NR 507.23 (**Appendix F.8**). The Wisconsin regulations indicate that the State reserves the right to require the monitoring of surface water (e.g., stormwater runoff, leachate seeps, sumps, sedimentation ponds, wetlands, stormwater discharges, etc.). The regulations indicate that the sampling should be performed in accordance with plans approved by the State and that the sampling points should be surveyed, marked and documented.

2.7.9 Comparison Summary

Shaw completed a comparison of Iowa's proposed surface water sampling regulations to those enacted by the Federal government, Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin. A majority of the MSWLF regulatory frameworks address surface water quality by generally indicating that compliance with the Clean Water Act and the National Pollutant Discharge Elimination System should be maintained. While most do not contain specific surface water sampling requirements, the regulations of Iowa (proposed), Minnesota, and Wisconsin contain language that preserves the right of the State to mandate a surface water sampling program and further establish surface water monitoring methodology requirements.

2.8 Waste to Groundwater Separation

2.8.1 Federal

The Federal guidelines do not contain language pertaining to the separation distance from the bottom of waste to the top of groundwater.

2.8.2 Iowa

The proposed Iowa MSWLF regulations pertaining to the separation distance from the bottom of waste to the top of groundwater are typically located within 567 IAC Chapters 113.6(2) (Appendix H.2). The proposed Iowa regulations require the base of the MSWLF unit to be situated so as to maintain a 5 ft minimum distance from the high groundwater elevation. The regulations indicate that the distance should be measured and maintained, and that “artificial means of lowering the high water table are acceptable”.

2.8.3 Illinois

Illinois regulations do not require a separation distance from the bottom of waste to the top of groundwater. In fact, many facilities are located below the water table, known as inward gradient landfills. Groundwater impact assessments are conducted utilizing site and chemical-specific parameters to demonstrate groundwater quality at the relevant point of compliance.

2.8.4 Kansas

Kansas regulations do not require a separation distance from the bottom of waste to the top of groundwater for MSWLF facilities. However, Kansas Administrative Regulations 28-29-302(g) (Appendix H.4), pertaining to construction and demolition debris landfills, indicates that the minimum distance of 5 ft should be maintained from the lowest point of the unit to the high groundwater elevation. The regulations require that the minimum distance should be maintained via naturally-occurring conditions. It should be noted that liner system standards for construction and demolition debris facilities may not be equivalent to those required for MSW facilities.

2.8.5 Minnesota

Minnesota maintains separate regulatory frameworks for mixed municipal solid waste and industrial waste landfills. Minnesota’s MSWLF regulations do not appear to require a separation distance; however, Minnesota Rules Chapter 7035.1700(B) (Appendix H.5), pertaining to industrial solid waste land disposal facilities, indicates that a minimum distance of 5 ft should be maintained from the lowest point of the unit to the high groundwater elevation. It should be noted that liner system standards for industrial solid waste facilities may not be equivalent to those required for MSW facilities.

2.8.6 Missouri

The Missouri regulations pertaining to the separation distance from the bottom of waste to the top of groundwater are typically located within Title 10 Code of State Regulations, Division 80, Chapter 3(8)(B)(1)(C) (**Appendix H.6**). The Missouri regulations do not establish a specific separation distance, but require the applicant to propose a “separation between the lowest point of the lowest cell and the predicted maximum water table elevation”.

2.8.7 Nebraska

The Nebraska regulations pertaining to the separation distance from the bottom of waste to the top of groundwater are typically located within Title 132, Chapter 3, Section 002.01B and Chapter 5 Section 002.01 of the Nebraska Department of Environmental Quality Rules and Regulations (**Appendix H.7**). The Nebraska regulations do not establish a specific separation distance for MSWLF facilities, but require that one be proposed.

For construction and demolition debris facilities, the regulations indicate that a 10-ft minimum separation distance should be maintained between the lowest cell and the predicted maximum water table elevation. It should be noted that liner system standards for construction and demolition debris facilities may not be equivalent to those required for MSW facilities.

2.8.8 Wisconsin

The Wisconsin regulations pertaining to the separation distance from the bottom of waste to the top of groundwater are typically located within Wisconsin Administrative Code Chapters NR 504.06(2)(b) and NR 504.06(4). (**Appendix H.8**). The Wisconsin regulations generally indicate that a separation distance of 10 ft should be maintained between the bottom of the liner and the high groundwater table “except for zone-of-saturation facilities”. Zone-of-saturation facilities are constructed with composite liners where the base grade is located below the groundwater surface in fine-grained soil environments.

2.8.9 Comparison Summary

Shaw completed a comparison of Iowa’s proposed waste to groundwater separation distance regulations to those enacted by the Federal government, Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin. Of the MSWLF regulatory frameworks reviewed, the proposed Iowa regulations are the only to establish a specific separation distance for MSWLFs, while Missouri and Nebraska generally imply one should exist. For all practical purposes, separation distance requirements for other States tend to pertain to construction/demolition debris or industrial waste landfills or those constructed with non-composite liners.

2.9 *Basic Disposal Operation*

2.9.1 *Federal*

Federal guidelines pertaining to basic MSWLF disposal operation are typically located within 40 CFR Parts 258.20 - 258.29 (**Appendix I.1**). The Federal regulations do not contain language addressing specific operational methods regarding site surveying, waste placement and fill progression phasing; however the regulations do contain the operating criteria summarized below:

- Take measures to prevent the receipt of hazardous waste (inspections, training, etc.);
- Cover disposed solid waste by either 6 in of soil or an approved alternate material on a daily basis;
- Prevent/control onsite disease vectors (e.g., rodents, flies, mosquitoes, or other animals or insects capable of transmitting disease to humans);
- Monitor and control explosive gas concentrations;
- Maintain compliance with State and Federal regulations under the Clean Air Act and conditionally prohibit open burning;
- Provide adequate stormwater run-on and run-off controls to withstand the 24-hour, 25-year storm;
- Prevent nonpoint discharge of pollutants to waters of the United States in accordance with the Clean Water Act;
- Conditionally prevent the disposal of bulk or non-containerized liquids; and
- Record and retain a facility operating record.

2.9.2 *Iowa*

The proposed Iowa regulations pertaining to basic MSWLF disposal operation are typically located within 567 IAC Chapter 113.8(2) (**Appendix I.2**). The proposed Iowa regulations contain basic operational requirements generally described below:

- Ongoing site surveys are necessary to establish and maintain facility and waste unit boundaries and monitor both horizontal and vertical fill progression;
- The first lift of waste should be placed so as to not damage the leachate collection and liner systems and should be 4 ft in thickness prior to December 31st;

- Filling should progress in a fashion that does not present risk of slope-failure or differential settlement, control stormwater run-on and run-off, etc.
- The working face area should be minimized and maintained at an acceptable slope;
- Appropriate measures should be taken to reduce blown litter, dust, mud, etc.;
- Appropriate cover types (daily, intermediate, or final) should be maintained over disposed waste as indicated;
- Leachate seeps should be addressed in a timely fashion;
- Leachate recirculation may occur in a controlled fashion upon Department approval; and
- Differential settlement that may occur should be re-graded so as to not interfere with designed stormwater management systems.

2.9.3 Illinois

The Illinois regulations pertaining to basic MSWLF disposal operation are typically located within Title 35 Illinois Administrative Code Section 811.104 – 811.107 (**Appendix I.3**). Similar to the proposed Iowa regulations, Illinois language establishes minimum operational requirements associated with site surveying, waste placement, daily cover, fill progression phasing, and general site aesthetics.

2.9.4 Kansas

The Kansas regulations pertaining to basic MSWLF disposal operation are typically located within Kansas Administrative Regulations 28-29-108 (**Appendix I.4**). The Kansas regulations largely address the minimum federal guidelines summarized above, but do contain operational requirements pertaining to site surveying, waste placement, fill progression and fill progression phasing. Overall, the Kansas disposal operation requirements appear to be generally consistent with those proposed by Iowa.

2.9.5 Minnesota

The Minnesota regulations pertaining to basic MSWLF disposal operation are typically located within Minnesota Rules Chapter 7035.2815 Subpart 6 (A)–(B) and Subpart 13 (**Appendix I.5**). The Minnesota regulations address site surveying, waste placement, fill progression phasing, and daily and intermediate cover.

2.9.6 Missouri

The Missouri regulations pertaining to basic MSWLF disposal operation are typically located within Title 10 Code of State Regulations, Division 80, Chapter 3 (7) and Chapter 3(15)-(19) (**Appendix I.6**). The Missouri regulations establish minimum requirements pertaining to

surveying controls, daily cover, filling operations, fill progression phasing and general site aesthetics.

2.9.7 Nebraska

The Nebraska regulations pertaining to basic MSWLF disposal operation are typically located within Title 132, Chapter 3, Section 004 of the Nebraska Department of Environmental Quality Rules and Regulations (**Appendix I.7**). The Nebraska regulations generally mirror the minimum requirements of the Federal guidelines, and establish other basic operating requirements including general site aesthetics, waste placement, and compaction. The Nebraska regulations do not appear to contain specific survey control requirements.

2.9.8 Wisconsin

The Wisconsin regulations pertaining to basic MSWLF disposal operation are typically located within Wisconsin Administrative Code Chapter NR 500.05(6)(g) and NR 506. (**Appendix I.8**). The Wisconsin regulations contain the minimum operational requirements specified by the Federal guidelines and establish guidance with regard to waste placement and waste-type acceptance. The regulations briefly indicate that a landfill survey grid should be established utilizing monuments and a datum and coordinate system that are acceptable to the State.

2.9.9 Comparison Summary

Shaw completed a comparison of Iowa's proposed basic MSWLF disposal operation regulations to those enacted by the Federal government, Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin. A majority of the reviewed MSWLF regulations contain basic operation requirements including ongoing surveying, waste placement, fill progression phasing, and general site aesthetics. It is Shaw's opinion the basic operating requirements contained within Iowa's proposed MSWLF regulations are generally consistent with those of the Federal government and the surrounding States included within this comparative analysis.

2.10 Final Covers

2.10.1 Federal

Federal guidelines pertaining to final cover thickness are typically located within 40 CFR Part 258.60(a) - (b) (**Appendix J.1**). The Federal regulations generally indicate that a final cover system should consist of an “infiltration layer” no less than 18 in of soil and an “erosion layer” consisting of no less than 6 in of soil capable of supporting vegetative growth. The overall hydraulic conductivity of the final cover should be less than or equal to the permeability of the liner system, but no greater than 1×10^{-5} cm/s. The regulations further indicate that the Director of an approved State can approve alternate final cover designs that consist of components that perform equivalently to the minimum criteria.

2.10.2 Iowa

The proposed Iowa MSWLF regulations pertaining to final cover thickness are typically located within 567 IAC Chapters 113.712(1)-(2) (**Appendix J.2**). The proposed Iowa regulations require the hydraulic conductivity of the final cover to be equal to or less than the liner system, but no greater than 1×10^{-7} cm/s and be constructed of a 24 in “infiltration layer” and a 24 in “erosion layer”. The maximum slope of the final cover must be between 5 and 25 percent. The regulations further indicate that alternate final cover designs can be considered for implementation should the components perform equivalently to the minimum criteria.

2.10.3 Illinois

The Illinois regulations pertaining to final cover thickness are typically located within Title 35 Illinois Administrative Code Section 811.314 (**Appendix J.3**). The Illinois regulations require the final cover system to generally consist of the following components (from bottom to top):

- ❑ A low permeability layer with a hydraulic conductivity no greater than that of the liner system not to exceed 1×10^{-7} cm/s. The low permeability layer should consist of one of either:
 - a 3-ft compacted soil layer or
 - a geomembrane overlying a 1-ft compacted soil layer.

- ❑ A final protective layer consisting of a 3-ft soil layer capable of supporting vegetative growth.

Alternate designs for the low permeability layer will be considered with adequate demonstration that equivalent or superior performance is achievable.

2.10.4 *Kansas*

The Kansas regulations pertaining to final cover thickness are typically located within Kansas Administrative Regulations 28-29-121(a)-(h) (**Appendix J.4**). The Kansas regulations require the final cover system to generally consist of the following components (bottom to top):

- ❑ A low permeability layer that is either:
 - A geomembrane underlain by an 18-in compacted soil layer with a hydraulic conductivity no greater than 1×10^{-5} cm/s if a composite liner system is present or
 - An 18-in compacted soil layer with a hydraulic conductivity equivalent to that of the non-composite liner system, but no greater than 1×10^{-5} cm/s.
- ❑ A final protective layer that is “as thick as the frost penetration depth” and is capable of supporting vegetative growth.

2.10.5 *Minnesota*

The Minnesota regulations pertaining to final cover thickness are typically located within Minnesota Rules Chapter 7035.2815 Subpart 6(D) (**Appendix J.5**). The Minnesota regulations indicate that a final cover system should be constructed to prevent the infiltration of at least 90% of precipitation and should generally consist of the following three components (bottom to top):

- ❑ A 24-in soil barrier layer or a 30-mil geomembrane with a hydraulic conductivity of no greater than 2×10^{-6} cm/s;
- ❑ A 6-in soil drainage layer; and
- ❑ An 18-in top layer that includes at least 6 in of soil capable of supporting vegetative growth.

The regulations further indicate that the slope of the final cover system should not exceed 20%.

2.10.6 *Missouri*

The Missouri regulations pertaining to final cover thickness are typically located within Title 10 Code of State Regulations, Division 80, Chapter 3(17)(C)(4) (**Appendix J.6**). The Missouri regulations indicate that the final cover system should generally consist of the following components (bottom to top):

- ❑ A 1-ft soil layer with a maximum hydraulic conductivity of 1×10^{-5} cm/s;

- ❑ A geomembrane liner;
- ❑ A drainage layer; and
- ❑ A 2-ft soil layer capable of sustaining vegetative growth.

2.10.7 Nebraska

The Nebraska regulations pertaining to final cover thickness are typically located within Title 132, Chapter 3, Section 005.01(A) – (B) of the Nebraska Department of Environmental Quality Rules and Regulations (**Appendix J.7**). The Nebraska regulations indicate that the final cover system should generally consist of an 18-in “infiltration layer” with a maximum hydraulic conductivity no greater than that of the liner system or 1×10^{-5} cm/s (whichever is less) and an 18-in “erosion layer” capable of sustaining vegetative growth. The regulations indicate that an alternate cover system design can be proposed provided that components perform equivalently to the minimum standards.

2.10.8 Wisconsin

The Wisconsin regulations pertaining to final cover thickness are typically located within Wisconsin Administrative Code Chapters NR 504.07. (**Appendix J.8**). The Wisconsin regulations require that the final cover system generally consist of the following components (bottom to top):

- ❑ A 6-in soil “grading layer” over the final waste elevation;
- ❑ A “capping layer” that may consist of 2 ft of compacted clay soil or a geosynthetic clay layer encapsulated between two geomembrane layers;
- ❑ A 40-mil geomembrane layer (relevant if utilizing a clay capping layer);
- ❑ A 2.5-ft “drainage and rooting layer” consisting of a 1-ft sand layer or a geosynthetic drain layer with a hydraulic conductivity no less than 1×10^{-3} cm/s. A 1.5-ft soil layer including a 6-in topsoil layer adequate for supporting vegetative growth should cover the drainage layer.

2.10.9 Comparison Summary

Shaw completed a comparison of Iowa’s proposed final cover thickness regulations to those enacted by the Federal government, Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin. Following is a summary of select parameters regarding the compared final cover system design regulations:

Final Cover System Design			
Comparison Entity	Required Components (Bottom to Top)	Maximum Hydraulic Conductivity (Overall Effectiveness)	Overall Final Cover Thickness
Federal	18-in Compacted Soil 6-in Erosion/Vegetative Layer	1×10^{-5} cm/s	2 ft
Iowa	24-in Compacted Soil 24-in Erosion/Vegetative Layer	1×10^{-7} cm/s	4 ft
Illinois	36-in Compacted Soil or Geomembrane overlying 12-in Compacted Soil 36-in Erosion/Vegetative Layer	1×10^{-7} cm/s	6 ft
Kansas	Geomembrane 18-in Compacted Soil Layer Final Protective Layer thick as frost line (~3ft)	1×10^{-5} cm/s	~4.5 ft
Minnesota	24-in Compacted Soil or Geomembrane 6-in Drainage Layer 18-in Erosion/Vegetative Layer	1×10^{-6} cm/s	4 ft
Missouri	12-in Compacted Soil Geomembrane Drainage Layer 24-in Erosion/Vegetative Layer	1×10^{-5} cm/s	>3 ft
Nebraska	18-in Compacted Soil 18-in Erosion/Vegetative Layer	1×10^{-5} cm/s	3 ft
Wisconsin	6-in "grading layer" 24-in Compacted Soil or Geosynthetic Clay Geomembrane 12-in Drainage Layer 18-in Erosion/Vegetative Layer	Not Specified	5 ft

Based on the results of this comparative analysis, Iowa's proposed final cover system requirements appear relatively similar to those specified by the other comparison states.

2.11 Quality Control and Assurance Programs

2.11.1 Federal

The Federal regulations do not contain requirements regarding the establishment of construction quality control and assurance programs.

2.11.2 Iowa

The proposed Iowa MSWLF regulations pertaining to construction quality control and assurance programs are typically located within 567 IAC Chapters 113.7(6) (**Appendix K.2**). The proposed Iowa regulations require MSWLFs to be “constructed under the supervision of a strict quality control and assurance program to ensure that MSWLF units are constructed as well or better” than the applicable requirements. The proposed regulations indicate that a professional engineer should be designated as the quality control and assurance officer and establish documentation and reporting requirements regarding the construction of the liner, leachate collection/drainage system and any other aspects required by the Department.

2.11.3 Illinois

The Illinois regulations pertaining to construction quality control and assurance programs are typically located within Title 35 Illinois Administrative Code Section 811.501 – 811.509 (**Appendix K.3**). The Illinois regulations establish minimum requirements of a construction quality assurance program that include inspection, sampling, and documentation requirements during the construction/installation of foundations and subbases, compacted earth liners, geomembranes, and leachate collection systems. The regulations require that the construction quality assurance officer should be a professional engineer.

2.11.4 Kansas

The Kansas regulations pertaining to construction quality control and assurance programs are typically located within Kansas Administrative Regulations 28-29-308(p)(1)(C) and 28-29-325(a)(9) (**Appendix K.4**). The Kansas regulations generally indicate that a construction quality assurance plan should be prepared that describes the measures taken to assure the construction quality of the stormwater management structures, construction/demolition contact water management systems, base elevations, final cover, and other components of the facility. The regulations indicate that the construction quality assurance plan should be “tailored” to the specific facility, and further indicate that the construction quality assurance plan should be certified by a professional engineer.

2.11.5 Minnesota

The Minnesota regulations pertaining to construction quality control and assurance programs are typically located within Minnesota Rules Chapter 7035.2815 Subpart 12 (**Appendix K.5**). The Minnesota regulations briefly address construction quality assurance programs, generally

indicating that one should be established and should address procedures and frequency of inspections and testing.

2.11.6 Missouri

The Missouri regulations pertaining to construction quality control and assurance programs are typically located within Title 10 Code of State Regulations, Division 80, Chapter 3(6) (**Appendix K.6**). The Missouri regulations establish requirements associated with the implementation of a construction assurance / quality control program during the construction, operation, and closure of a MSWLF. The requirements generally address the specifications for testing the liner and final cover and indicate that a professional engineer should review and approve all quality assurance / quality control reports.

2.11.7 Nebraska

The Nebraska regulations pertaining to construction quality control and assurance programs are typically located within Title 132, Chapter 3, Section 003.04(C) of the Nebraska Department of Environmental Quality Rules and Regulations (**Appendix K.7**). The Nebraska regulations briefly address construction quality assurance plans, indicating that one should be prepared that “assures adequate construction and testing of the containment system components as called for in design specifications in the facility plan”. The plan should be prepared and signed by a professional engineer.

2.11.8 Wisconsin

The Wisconsin regulations pertaining to construction quality control and assurance programs are typically located within Wisconsin Administrative Code Chapters NR 516 (**Appendix K.8**). The Wisconsin regulations establish detailed requirements associated with reporting during the construction of a MSWLF. Generally, the requirements address report preparation, testing, quality assurance, and certifying personnel during the preconstruction, construction and closure phases of a MSWLF.

2.11.9 Comparison Summary

Shaw completed a comparison of Iowa’s proposed construction quality control and assurance program regulations to those enacted by the Federal government, Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin. Although not addressed by the Federal guidelines, each of the comparison states requires a construction quality control and assurance program. The level of detail with regard to the specific requirements of quality control and assurance programs provided within the various regulations varies from “minimal” to “extensive”. It is Shaw’s opinion that Iowa’s proposed regulations can be described as “moderate”.

2.12 Field Permeability Testing of Liners

2.12.1 Federal

The Federal regulations do not contain requirements pertaining to the field permeability testing of liners.

2.12.2 Iowa

The proposed Iowa MSWLF regulations pertaining to field permeability testing of liners are typically located within 567 IAC Chapters 113.7(6)"b" (**Appendix L.2**). The proposed Iowa regulations require a minimum of one field density test be performed per 8-in lift per acre of compacted soil to correlate with laboratory hydraulic conductivity testing.

2.12.3 Illinois

The Illinois regulations pertaining to field permeability testing of liners are typically located within Title 35 Illinois Administrative Code Section 811.507 (**Appendix L.3**). The Illinois regulations generally require that a test liner be constructed of materials to be utilized during the construction of the full-scale liner. The regulations indicate that both field and laboratory tests, including hydraulic conductivity analysis, should be performed on materials from the test liner. The regulations indicate that full-scale liner construction should utilize equivalent materials and machinery, and that the density, water content, and permeability of each lift should be monitored. The regulations do not contain guidance with regard to the rate at which testing should be conducted.

2.12.4 Kansas

The Kansas regulations pertaining to field permeability testing of liners are typically located within Kansas Administrative Regulations 28-29-104(q)(1)(i) (**Appendix L.4**). The Kansas regulations do not specifically require field hydraulic conductivity tests, but indicate records should contain demonstration that the liner meets the applicable liner standards. The regulations do not contain guidance with regard to the rate at which testing should be conducted.

2.12.5 Minnesota

The Minnesota regulations pertaining to field permeability testing of liners are typically located within Minnesota Rules Chapter 7035.2815 Subpart 12(D) (**Appendix L.5**). In addition to laboratory analysis for other various engineering parameters, the Minnesota regulations require that field permeability and field moisture density be obtained on liners and final covers to assure the minimum standards are being met. The regulations do not contain guidance with regard to the rate at which testing should be conducted.

2.12.6 Missouri

The Missouri regulations pertaining to field permeability testing of liners are typically located within Title 10 Code of State Regulations, Division 80, Chapter 3 (10)(C) (**Appendix L.6**). Similar to the Illinois regulations, Missouri generally requires that a “test pad” be constructed to verify the adequacy of proposed construction and quality control procedures. The regulations indicate that at one field hydraulic conductivity test be performed and verified by two laboratory hydraulic conductivity tests. In addition, the regulations indicate that two test pits should be excavated into the test liner to investigate the “interlift bonding”.

2.12.7 Nebraska

The Nebraska regulations do not contain requirements pertaining to the field permeability testing of liners.

2.12.8 Wisconsin

The Wisconsin regulations do not contain requirements pertaining to the field permeability testing of liners.

2.12.9 Comparison Summary

Shaw completed a comparison of Iowa’s proposed regulations pertaining to field permeability testing of liners to those enacted by the Federal government, Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin. Field permeability testing is not specifically addressed by the Federal guidelines or the MSWLF regulations established by Kansas, Nebraska and Wisconsin. Missouri and Illinois both require the construction of test liners to perform in-situ and ex-situ analysis of various engineering properties. While the remaining States indicate that field permeability testing of the liner system should be performed, it appears that only the proposed Iowa regulations specify an analysis frequency.

3.0 Summary and Closing

Shaw has completed a comparative analysis of select portions of Iowa's MSWLF regulations proposed to be adopted into Iowa Administrative Code 567 Code 113. Utilizing compiled regulatory documentation available on the Department's website and conversation with industry contacts, the following twelve specified subject areas of the proposed regulations were compared to the Federal Guidance contained within Title 40 Code of Federal Regulations Part 258 (Subtitle D) and MSWLF regulations enacted by Illinois, Kansas, Minnesota, Missouri, Nebraska and Wisconsin.

1. Groundwater monitoring network and point of compliance location in reference to the waste management unit boundary for landfills designed with alternative liners.
2. Groundwater monitoring well spacing and relevant point of compliance distance.
3. Groundwater detection monitoring.
4. Leachate collection system design, with particular emphasis on drainage layer media.
5. Soil and hydrogeological investigation.
6. Design for alternative liners.
7. Surface water monitoring.
8. Separation distance from the bottom of waste to the groundwater surface.
9. Basic operating methods, including but not limited to: staking at the landfill, filling operations and covering wastes.
10. Final cover thickness.
11. Construction quality control and assurance programs.
12. Field permeability testing of liners, if any.

Based on the findings of the comparative analysis, it is the opinion of Shaw that Iowa's proposed MSWLF regulations pertaining to the aforementioned subject areas are generally consistent with Subtitle D and like regulations enacted by Illinois, Kansas, Minnesota, Missouri, Nebraska, and Wisconsin.