Final Geo-technical Analysis dated 2/26/10 of draft TSCA Permit

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

IN THE MATTER OF:	
Clinton Landfill, Incorporated Illinois Route 51 South, Rural Route Number 2 Box 216L, Clinton, Illinois 61727	**CHEMICAL WASTE LANDFILL APPROVAL TO DISPOSE OF POLYCHLORINATED BIPHENYLS ISSUED PURSUANT TO 40 CFR 761.75**
corporate address	
Clinton Landfill, Incorporated, 4700 North Sterling Avenue, Peoria, Illinois 61612-9071	
PERMITTEE	

Abstract

On October 19, 2007, Clinton Landfill Incorporated (CLI) submitted an application to U.S. EPA for approval to dispose of PCB remediation waste in a proposed Chemical Waste Unit (CWU) of Clinton Landfill #3. Based on what was presented in the application and on EPA's investigations, the existing authority to dispose of PCB Bulk Product Waste under TSCA should be extended to include PCB remediation waste.

Protection of Groundwater

The level of protection existing at the site and in CWU design is very high. Risks have ben evaluated with regard to groundwater, surface water, air, construction and monitoring. At this time, no pathways or potential pathways of exposure can be found. The level of protection for drinking water resources is so high that risk estimates are subjective. Because the potential pathways of concern are so contrived, an approach was developed to simply communicate protectiveness.

Protectiveness was taken as the sum of liners, geochemical/hydrological assumptions and distance to groundwater. The standard unit of measure under TSCA is a 30 mil synthetic

liner or 4 feet of natural clay soil meeting certain requirements. The guiding assumption used is that every protective member creates a 10 fold reduction in concentration. Therefore, it was determined that any "conservative assumption" that has the force of a 10 fold reduction is equivalent to a liner.

Using this approach on the results of modeling contaminant transfer across the underlying 3 foot clay pad/liner, the Mohamet Aquifer groundwater can be said to be protected from vanishingly low concentrations of PCBs by the equivalent of 50 to 60 geomembranes. The shallow Glasford Aquifer sands are protected by the equivalent of 15-20 geomembranes.

Time of transport studies using an advective absorptive model show that even under worst case scenarios of high PCB level leachate resting directly upon clay, it would take about 1000 years for PCB fluid at a concentration of 500 ppm to be found at a concentration of 0.1×10^{-32} mg/ml at a depth of two feet. At the three foot mark the concentration of PCBs is reported as zero although a few molecules might move all three feet.

Flow modeling was conducted for all reportable sand units. Most modeling is based on use of available water elevation information from on-site and off-site published data. The results show the most "vulnerable" sands, those in the Upper Glasford, are uniformly safe and isolated although in some cases though they are near or even cross-cut by the landfill itself. The Upper Glasford sands are used onsite for monitoring and review of that data shows there are no wells downstream of the cell.

The site, a Large Area Clay Pan, counts for about 2/3 of the overall protectiveness. That percentage is reliable because drilling shows the clay is continuous vertically and horizontally and the pan can be shown to be hydraulically intact at least on-site.

The clay pan extends offsite and makes up a major regional confining unit that seems able to hold a constant regional artesian elevation. The capacity of a confine an aquifer with a uniform slope is a good indicator the clay pan is intact. The clay pan is the capping member of a large natural artesian system that covers many counties, including most of DeWitt County.

The pan extends 170 ft. below the base of the proposed cell and extends for 10's of miles around the landfill and has received much scientific investigation. The pan is made up mostly of clay and hardpan clay interspersed with sand. Surface water infiltration is low, deep vertical permeability is low but horizontal permeability is present. However, the seams are thin and are not productive enough to be aquifer class. Nevertheless, the shallow seams are used locally and they are safe.

Investigation of water resources within the clay pan shows shallow groundwater exposure pathways via the Glasford Formation are not complete. Wells that draw from the Glasford are not downstream of the CWU. Compilation of water sands and wells over an area of about 25-36 square miles and development of a Geographic Information System (see Figure 1…to be completed) shows the direction of groundwater seepage is toward Salt Creek and because the landfill is relatively close to Salt Creek but above it by several feet, there is virtually no risk that anyone can accidently try and develop water resources that will be at risk. The shallow sands effectively outcrop at the edge of the valley so there is no continuity. There is, however with a strong likelihood of intermittent seepage breakouts along the slopes and in "dry" gullies along Salt Creek Valley, but water in those sands is monitored before it gets out.

Seepage in the Upper Glasford units around the landfill is always toward Salt Creek and given the elevation of the floor of Salt Creek Valley, the same is likely true south of Salt Creek. Wells south of Salt Creek are not "downstream" of the landfill because the direction of seepage is always toward the creek, but northward. The base of Salt Creek Valley appears to be the top of the Lower Glasford and so is a hydrogeologic barrier to all flow in the Upper Glasford Formation (see figure ….....tbd). It may be a barrier to flow in some sand units of the Lower Glasford but Lower Glasford water may also be influenced by surface water in Salt Creek and it may be influenced by deep water seepage from the Mahomet.

Groundwater in the Lower Glasford is a host to about 20 wells (see Figure …tbd). It is less well known but because the Mahomet water pressure stands at approximately 605-610 feet MSL, there is a chance wells in the Lower Glasford and deeper are recharged from the Mahomet (see fig…..). Although direction of groundwater flow is not considered a protective factor, the issue of artesian recharge to Lower Glasford located at 605 feet MSL is favorable.

A third issue concerns the surface water pathway via erosion. The long term integrity of the landfill itself is expected to be high but because the landfill is built out over slopes that lead to Salt Creek Valley, there are hypothetical reasons to be concerned that Salt Creek could eventually erode those slopes and cause the landfill (see fig…..tbd google).

Given the 280-300 feet of gentle slope that protects the cell from the uncertainties of stream flow on the floor of Salt Creek Valley, roughly the 500 year flood elevation, and given that the floor of the CWU will be at the same elevation of Salt Creek Valley and given the 1200 feet of valley floor that protects the slope from an underfit stream, there is reason to believe that the CWU will outlast Clay Pan #1. If so, it will become a stable isolated erosional remnant protected by an oversized cap which, depending on cap

characteristics, could allow the cell to stand 50-100 ft above the underlying Clay Pan #2 and dominate the countryside in the far future.

END OF ABSTRACT

BEGINNING OF UNORGANIZED TECHNICAL MATERIAL

Protectiveness of Groundwater

Evaluating the protectiveness of the CWU itself, monitoring and the site upon which it is located can be done by counting real liners, accounting for conservative assumptions by assigning one membrane-equivalent for each order-of-magnitude assumption, and using regulations where possible. Ignoring complications as much as possible suggests that

the Mohamet Aquifer groundwater 170 feet below the cell is protected from PCBs in the landfill by the equivalent of 25-30 geomembranes. Furthermore, any hypothetical wells drawing from the Mohamet Aquifer right at the landfill itself are not only protected by the hypothetical 25-30 liners but they are protected by time and motion. Because the Aquifer is artesian and the direction of groundwater is up, not down for the last 100-140 feet, the pathway segment is both incomplete and slow. The basis of the pathway determination is that for such a path to be considered complete, all the rules of how groundwater and PCBs move would have to be ignored. Conservatively assuming that there is a path anyway, contaminant movement along the path would be slow, time-of-travel would be on the order of thousands of years.

Particle tracking

Taking a widely quoted groundwater parameter, permeability, using it as a velocity for time of travel estimates and assuming that the hypothetical velocity of water would be the speed of a PCB molecule moving downward, it would still take roughly 2000 years to go 170 feet to the Mahomet. That would also conservatively ignore a number of known protective measures not otherwise considered above. Such measures include thin sand seams that divert and dilute and organic soil that traps PCBs. Once a particle makes it to the Mohamet, bedrock topography indicates that the Mohamet Aquifer flow splits a mile east of the landfill and that the particle would be diverted again. Because water table, rock type and bedrock topography indicate that deep aquifer flow in the Mohamet Sand

below the CWU could flow in several directions, a PCB particle could flow west in the Kenny Valley branch of the Mohamet Aquifer.

Gullies

Evaluation of the style of erosion indicates that Salt Creek is an underfit stream that is not widening its valley. The main threat to the slopes of Salt Creek Valley is by the widespread development of gullies throughout the drainage system. There is extensive gully formation in the area around the CWU. Drilling results indicate that the gullies are following sand bodies. They develop where groundwater can breach the surface and speed up erosion. Evaluation of gullies and sand bodies on site shows that the CWU is to be built where shallow sand zones are relatively thin or missing. Interpretation of the consequences of the specifics of the particular cell's siting show that construction of a CWU will block shallow groundwater flow and prevent its reaching the surface in a groundwater "shadow" downstream of the cell. Other cells, if constructed will do the same. If not constructed, groundwater cutoff walls down to the elevation of the deepest sand that provides groundwater seepage to the surface will cure the problem.

TECHNICAL BACKGROUND INFORMATION FOR TSCA DECISIONMAKING

The location of Clinton Landfill #3 is approved for disposal by, DeWitt County and a certificate was issued on October 17, 2002 pertaining to 268.804 acres of which approximately 157 acres will be used for cell construction.

CLI has a modified RCRA Subtitle D disposal license for Landfill #3 and is operating under that license. Recent modifications address PCB disposal. There have been no changes to CLI's current authorization to dispose of PCB Bulk Product Waste. The license has always allowed for such waste to be co-mingled and disposed within CLI's municipal solid waste cells at any concentration, subject to TSCA compatibility testing. The license is now modified to authorize disposal of PCB Remediation Waste in a new cell subject to TSCA approval. The new cell, a Chemical Waste Unit, is to be built as a separate, hydraulically isolated cell located within the perimeter of Clinton Landfill #3.

On August 21, 2008, U.S. EPA requested further information concerning the October 19,

2007 TSCA application and issued a Notice of Deficiency on January 6, 2009. On March 2, 2009, EPA received a response to both requests. Final review of the application, the responses, together with coordination with the Illinois Environmental Protection Agency and independent work by U.S. EPA fully addresses the technical deficiencies. U.S. EPA received supplementary geologic and groundwater information from the State of Illinois and from other sources that supports the findings described below.

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FINDINGS:

The Permittee seeks authorization to dispose of what is termed PCB Remediation Waste under TSCA and will place the material in a specially constructed cell, to be located at and immediately adjacent to its MSW landfill in Clinton, Illinois. The CWU and the MSW Landfills are regulated by the State of Illinois under the RCRA Subtitle D Solid Waste disposal program for the Clinton Landfill #3 facility.

LOCATION:

The authorization concerns 22.6 acres to be constructed in the S ½ of the SW ¼ of the SW ¼ of Section 11 and the N ½ of the NW ¼ of the NW ¼ of Section 14, Township 19 North, Range 2 East of the Third Principal Meridian. It is 2 miles south of Clinton on State Route 51, in DeWitt County, Illinois. The site meets TSCA requirements for land disposal. Synthetic membrane liners will be used in the CWU in addition to what is found at the site even though hydrologic and geologic conditions meet TSCA soil requirements.

Site protectiveness-Failure Mode Analysis

The most significant aspect of the disposal of PCBs is its location. Engineering protectiveness is important but given the long term care requirements for landfilling, it cannot be the primary factor. The site meets TSCA requirements for location.

Under TSCA the site must either be in relatively impermeable formations such as a large area clay pan or it must be protected by artificial liners of some sort, clay, plastic or a mix of the two.

Studies from the applicant and the State of Illinois Geological Survey and the U.S. Geological Survey together with the State of Illinois Water Survey show that the site is suitable to host a multiply-lined excavation to be filled with soil from remediation

activity in addition to its authorization for special waste under state license and its authorization for disposal of bulk product TSCA waste. It is to be capped upon completion with an intermediate earthen cap, by MSW waste and finally by a synthetic membrane and granular soil cap.

Failure mode analysis indicates the site is sufficiently protective of drinking water. Pathways of exposure via groundwater do not exist and cannot be made to exist except by taking liberties with reality on a scale of thousands of years. More rational lines of exposure include the risks from long term erosion and re-introduction of the material to surface water. Air-born pathways of exposure for PCBs do exist but only during special circumstances what will not be allowed onsite.

Previous examples include cleanup of Willow Run, Michigan where there was on-site solidification of hundreds of thousands of cubic yards of pond bottoms, mixed municipal/industrial wastewater sludge and river bed material mixed with PCBs that consistently ran thousands of ppm PCBs. After review of other normal PCB commercial disposal sites, the pathways of PCB migration have rarely been shown to extend far enough beyond a landfill's perimeter to constitute a measurable exposure to anyone offsite.

Examination of drinking water wells in the area show none are at risk now or in the future. Review of aquifers, aquifer flow patterns and drinking water use patterns show the no downstream users. All sites of potential risk were found to be protected by substantial natural barriers to flow. The landfill will have a substantial moat around it resting on an earthen barrier approximately 350-750 feet wide at the base and 50 feet above the nearby valley. The barrier will be set back some 1000 feet from the posted 500 year flood elevation. There is no scenario that will lead that lined basin to become a groundwater threat. The only possible threat has to do with surface erosion and the long term viability of any structure to survive for 10,000 years. At this time erosion is not a realistic threat for thousands of years and protective measures can be put in place that will extend that time frame past the point of reasonable geological predictability.

Site Geology-Relatively Impermeable Large Area Clay Pan

The site consists of many layers of clay with occasional interclay sands, silts, peats and ancient soils. The CWU is enclosed by what is called Clay Pan #1 and rests on another informal unit, Clay Pan #2. Clay Pan #1 is effectively the uppermost soil unit on site.

i) Clay Pan #1 is thick, large and extends continuously northward from the

CWU to the city of Clinton and extends east and west from the CWU for at least 2 miles.

ii) Although Clay Pan #1 is large, the CWU sits near an edge where the pan is eroded down. South of the CWU, Clay Pan #1 slopes down to Salt Creek. The upper part of the slope is filled and built up with recompacted clay creating a level berm/stormwater control structure.

iii) Erosional slopes extend from the CWU about 1000 feet southward before being terminated by Salt Creek. The erosion exposes the pan to inspection however, the dry wooded swales making up the rolling erosional slope do not reveal springs but they do reveal outcropping sand seams.

iv) Beneath Clay Pan #1, Clay Pan #2 can be found extending throughout DeWitt County. Though not exposed at the surface, drilling results indicate the hardness of the deep pan protects Glasford aquifers and controls both surface drainages and base flow in the area. Creeks and valleys around the facility are comparatively wide and flat bottomed as if they all effectively rest on the hard impermeable top of Clay Pan #2.

v) Drilling indicates the top of Pan #2 is at 650-655 feet. The elevation of nearby Salt Creek valley at 640 to 650 feet is similar. The near coincidence of the two elevations suggests Pan #2 may be relatively effective at resisting infiltration and erosion compared to Clay Pan #1.

Site Geology: SOIL 40 CFR 761.75(b)(1):

The site meets TSCA geological criteria for soil. The site is located in a thick, relatively impermeable formation, a large-area clay pan that is more protective than 4 feet of clay pad with a permeability less than 1 x 10-7 cm/sec, a LL > 30 and a PI >15. The soil making up the clay pan meets criteria for thickness and permeability but not for liquid limit and plastic index. The soil is an inorganic clay loam that is can be relatively silty and stiff. If needed, the soil can and will be made sufficiently plastic for all earthworks by appropriate soil moisture control.

The large area clay pan is an intact aquitard/aquiclude. The clay pan at the site is thick, confines many water bearing units at the site but allows for considerable horizontal seepage and exchange with surface water along local drainages. Analysis of USDA Farm Service Agency and Digital Globe imagery of Sept. 16, 2006 for Texas Township and adjacent areas

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shows no signs of large scale fracture features that cross the site. Large scale fracture permeability is not evident on site on the basis of landform assessment imagery. Fracturing of the clay pan does not appear likely to interfere with laboratory based permeability data. Permeability parameters are therefore considered useful as is and need not be discounted to be safe. The clay pan does show signs of water penetration. Over the course of thousands of years it is permeable and has been oxidized and leached. It shows the effects to a depth of 20 feet but is resistant to infiltration and serves as a runoff area. Where the topography is flat, water ponds for weeks to months and can be a nuisance. The formations at the site meet TSCA requirements for a relatively impermeable large area clay pan. Because the soil technical requirements are met by synthetic membrane liners, the natural protectiveness of the soils provides a significant additional level of protection above and beyond that provided by membrane construction and design.

The site features:

A) Relatively impermeable geological formations,

The Clay Pans are the most impermeable formations in the area. There are significant permeable units between the Clay Pans but the CWU was located where exploratory drilling showed permeable units are thin or missing. Any, silts, sands and organic soil found during construction will be removed and backfilled with recompacted clay pan soil. Although the upper 10 feet of Clay Pan #1 is weathered and is not necessarily fully intact, it resists infiltration well enough to be. Local storm water ponding is so common that special measures have to be taken. Offsite, the flat-laying clay-loam soil results in soft muddy farm fields so frequently that drain tile systems have been installed. Surface water recharge via fractures or infiltration to shallow clay-bound water-bearing sand seams appears negligible. Drilling results and excavation shows the deep clay till from 10-20 feet is leached and altered. It appears the standing water has partly transformed the clay till into a semi-plastic and even more water resistant material.

B) A Large Area Clay Pan;

The MSW-CWU Landfill is immediately surrounded and underlain by a Large Area Clay Pan consisting of at least two geological formations each of which is a clay pan hosting one or more clay members. The Large Area Clay Pan is fully protective of drinking water resources. Each of the two clay pans making up the Large Area Clay Pan is larger than the CWU and host both water bearing sand zones and minor aquifers. Each clay pan is a significant

barrier to vertical infiltration but they allow horizontal seepage through sand zones.

Geology

The upper clay pan hosts shallow rarely used water-sands and near surface aquifers not hydrologically relevant to groundwater at the CWU.

For the purposes of The Approval, the contact between the upper and lower clay pans hosts the uppermost aquifer the Roxana Silt of Wisconsin age. It is shallow and not sufficiently protected from the surface for use as a drinking water resource. It is a rarely used minor aquifer.

The lower clay pan hosts deeper, locally thin, protected water-sands and aquifers of the Glasford Formation of Illinoian age. The Glasford Formation provides water to numerous domestic wells within a 2 mile radius of the landfill.

Recharge to the Roxana Silt, seems likely to come from infiltration into the unit from Coon Creek, a minor surface drainage located a mile northwest of the CWU. The creek flows across the upper clay pan and the Roxana Silt below it potentially providing recharge for groundwater flow in all permeable units including the Roxana Silt, all of which flow toward Salt Creek.

i. *Clay Pan #1 is a weathered and leached sheet of Tiskilwa Clay till member of the Wedron Formation. It is dissected by local drainages and is capped by Peoria Silt. Infiltration into the pan is slow and partial. There is a brownish oxidized soil for 10 feet and gley, a sticky grey leached clay to a depth of 20 feet. Signs of fracture permeability are not present on site and the clay pan resists infiltration well enough for a "perched" sandy aquifer, Weldon Springs Aquifer to be maintained atop it. The Weldon Springs Aquifer is a late glacial stringer sand associate with Peoria Loess. It captures and stores sufficient amounts of water from rainfall and ephemeral runoff to provide a steady source of water for Weldon Springs Natural Area.*

ii. *Clay Pan #2 is a massive large-area feature that extends over many counties. It has long been relied upon to protect the Mahomet Aquifer from such things as sewage treatment plants and unlined landfills as well as industrial and agricultural activities.*

C) A soil pad 3 to 4 feet thick meeting permeability and plasticity requirements;

The proposed cell will have a soil pad consisting of natural low permeability clay (the Berry Clay). It will be filled and contoured. It will be the smooth surface upon which the primary geosynthetic membrane liners will rest but the soil pad will not meet plasticity parameters.

Background

i) Excavation for the cell will cut through Clay Pan #1. Less desirable silt and silty organic soil seams found within and between the two clay pans such as Robein organic soil and loess member units of the Athens Sub-episode of the Wisconsin Age will be removed. The cell will rest on a pad built upon Berry Clay found at the top of Clay Pan #2. The Berry Clay has good engineering properties and is a favored unit for the foundation. The pad will be contoured with select Tiskilwa clay and will have a finished permeability less than 1 x 10-7 cm/sec.

ii) The Berry Clay, a sticky compressed gumbotil Sangamonian-Age gley formed during inter-glacial weathering of the Sangamon episode, pre-Wisconsin Roxana Silt and post Illinoian Glasford Formation. It has high natural moisture content and is more plastic than other clays. It retains high natural moisture content. Because it is found within the zone of permanently high moisture, it maintains favorable plastic qualities.

D) A smooth rock-free surface;

The secondary geomembrane will be placed directly upon a prepared surface consisting of recompacted clay pad that merges with contoured Berry Clay-gumbotil. The surface will be made smooth so that the membrane will not be damaged by stray rock fragments.

E) Permeability less than 1 x 10-7 cm/sec;

(i) Although a lined landfill, as proposed, would meet TSCA requirements located on soil of virtually any permeability, testing clay in each pan

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consistently shows vertical permeability parameters are equal to or less than 1 x 10-7 cm/sec. and horizontal permeability in the clay would be equivalent. However, sands and silts are found within the pan. They are thin enough to not affect the overall vertical permeability. Impermeable zones dominate and cause widespread artesian conditions.

(ii) The permeability of sand seams is only significant with regard to recharge of wells such as from proposed surface water recharge from Coon Creek and discharges such as at springs or seepage breakouts.

Background

(iii) Soil permeability is a minimum technical requirement and is intended for design of an unlined disposal facility built on a relatively thin clay soil or recompacted clay pad. The proposed site is not such a location. The physical characteristics and geologic history of the large area clay pan combined with an investigation of groundwater flow within it shows it is protective of all drinking water resources within the Large Area Clay Pan and in the Mahomet Aquifer below it.

F) Liquid Limit < 30%;

The Large Area Clay Pan consists of a loamy clay soil. The soil does not meet the TSCA index parameter used for selection of high plastic soil but it can be made to be sufficiently plastic for use in making a water-tight recompacted clay pad. The soil to be used contains a high content of expandable clay, particularly below 20-30 feet where it is leached and gray. The Tiskilwa silty clay can be very sticky and plastic; its high silt content does not detract from its usability or protectiveness. Project-based criteria for soil-moisture and density can make the final product meet standards for resistance to infiltration.

Geological/Soil Engineering Background

The liquid limit is an index property for selection of soil favorable for earthwork. With the soil moisture controls proposed for construction, the clay soil and clay till can be made to perform as needed. In addition, gleys such as the Berry Clay unit into which the cell is to be keyed, are naturally favorable for cell construction. The Berry

clay is below the climatically active zone and is stable. It will not dry out, crack or change permeability. The Berry Clay and the recompacted clay pad are particularly well protected because they are so close to the Roxana Silt, a good source of moisture. Because soil moisture will remain high indefinitely in the aquifer, the recompacted clay pad and the Berry Clay can be expected to exhibit favorable engineering properties such as self sealing.

G) Plasticity Index < 15

Loamy clay soil found in the Large Area Clay Pan holds water well and can be made workable. While the soil does not meet TSCA Plasticity Index parameters for material selection, the Tiskilwa silty clay material is acceptable for use in construction of engineered recompacted clay pads for containment and for use as a sub-base as-is.

Geological/Soil Engineering Background

The clay plasticity index test shows it is a non plastic inorganic soil. It contains too much silt for optimum construction workability; however, the clay can be made sufficiently workable by moisture control.

SYNTHETIC MEMBRANE LINER 40 CFR 761.75(b)(2):

The installation of a 30 mil thick membrane liner will satisfy the TSCA requirement to provide a permeability that is equa1 to or less than TSCA soil parameters. The proposed containment liner system for the CWU using three 60 mil high density polyethylene geosynthetic membranes with an intermediate bentonite composite as listed in the application of October 2007 or its equivalent upon approval satisfies TSCA requirements

HYDROLOGICAL CONDITIONS 40 CFR 761.75 (b)(3):

The requirements are met.

A) the bottom of the landfill liner system is at least 50 feet from the historical high water table the bottom of the facility is not in a flood plain, shoreland or groundwater recharge area,

B) there is no hydraulic connection between the site and standing or flowing surface water,

C) the clay pans will be effective at protecting all aquifers. There is no reason to believe there is a meaningful hydraulic connection between the surface and the Glasford Aquifers or the Mahomet Aquifer,

Drinking Water Protection

D) *The Weldon Springs Aquifer found offsite is situated on top of the Large Area Clay Pan approximately a mile from and topographically above the CWU. There is no hydraulic connection between the landfill site and Weldon Springs.* Weldon Springs water is protected, it is at an elevation that is higher than the CWU and is independent of it,

E) Clay Pan wells, water produced from the Wedron and Glasford Formation are naturally protected by clay, distance and flow-direction so that no wells could be found that draw from below the CWU,

F) Water wells producing from the clay pans are not in the path of groundwater flow from below the site.

G) The closest clay pan wells that draw from sand units near the landfill are at a distance of at least 3000 feet and are not downstream.

H) The path groundwater next to the CWU takes will not lead to a drinking water well screen.

I) Mohamet Aquifer wells are all naturally protected by many clay layers, artesian conditions, 170 feet silty clay till, organic soils, distance and flow direction.

J) Wells are vulnerable to seepage from low quality water units unless they are fully cased and sealed off, casing and grouting of any such well offers sufficient protection.

K) The extent of natural and engineered barriers, monitoring, artesian conditions and the character of groundwater usage in the area ensures that there will be no impact on drinking water resources as a result of PCB disposal,

i) There is little avenue by which drinking water might become jeopardized, The site is runoff area typified by storm water ponding runoff.

ii) The site is not part of a groundwater recharge area. It rests on a regional barrier to surface water infiltration. The barrier is effectively a hydrogeologic cap over the whole of Texas Township and beyond. The barrier retains water, supports ponds and impedes natural drainage. Where not leached it is a relatively high organic content clay loam soil. The natural clay subsoil and parent clay pan material is much denser, thicker and much less subject to

infiltration than surface soils. At depth it is a leached sticky clay with a high percentage of "bentonite-like" expandable clay minerals, such as illite and smectite/mixed-layered clays.

Hydrological Background

iii) *there are no drinking water wells in the path of groundwater from around the CWU,*

iv) *water resources from within the Large Area Clay Pan aquifers are isolated from each other,*

v) *water tables in the clay pan's individual sand units are at different elevations,*

vi) *the permeability, the integrity of the clay and the high hydraulic gradient between water-bearing units indicates vertical flow is restricted,*

vii) *because vertical flow of water is insignificant, contaminant transport is expected to be low and water resources in and below the clay pan system will be protected,*

viii) *the most prominent water resource in the area, Weldon Springs, is not related to the CWU; Weldon Springs is a nearby perched water-table aquifer that is protected by its elevation, stratigraphically above the clay pan,*

ix) *the first potentially groundwater-bearing unit found onsite, the Roxana Silt, is protected by Clay Pan #1; hosting several domestic water wells it may produce drinking water but is within 25-35 feet of the surface and does not always meet minimum depth requirements of at least 30 feet,*

x) *A thin unit, the Upper Radnor Till Sand, is located 2 feet below part of the CWU's recompacted Clay Pad; it is penetrated by the lowest sump. The sand is vulnerable to contamination at the sump because the hydraulic head will be relatively high but all sand within 20 feet of a sump will be removed and backfilled with clay,*

xi) *the next significant unit, the Lower Radnor Till Sand, is a minor drinking water aquifer the closest well being at distances of over 3000 feet from the CWU, the well and the unit are protected:*

(a) the unit is being monitored by onsite monitoring wells,

(b) the unit is deeper than 30 feet so wells meet minimum depth requirement for drinking water wells,

(c) the closest well producing from the unit is 3100 feet cross gradient from the CWU,

(d) 3100 feet greatly exceeds potential setback requirements under worst case considerations,

(e) wells producing from the unit are not down gradient of the landfill,

(f) the Lower Radnor Till Sand is expected to be patchy, discontinuous and crosscut by Salt Creek, so over distances of 1000's of feet, wells screened at the same elevation are not necessarily interrelated,

(g) the sand is not present beneath all of the landfill, where found, it is 18-20 feet below the lowest synthetic membrane.

FLOOD PROTECTION: 40 CFR 761.75(b)(4):

(4)(i) Below the 100 year floodwater elevation: The CWU is not located below the 100 year flood water elevation.

(4)(ii) Above the 100 year floodwater elevation: Federal Emergency Flood protection maps show it rests above the 100 year floodwater elevation on an upland prairie platform located above Salt Creek Valley terraces. The site is subject to storm water flooding because the site is so flat, however plans show diversion and holding structures will be built to control all water from a 24 hour 100 year storm.

Background

i) The CWU does not contribute to surface water drainage. Surface water has been controlled by dikes and retention ponds so there is no surface water runoff from the disposal site. Water that falls upon TSCA regulated material will be contained within the CWU and handled as leachate. The CWU and the site is designed and will be constructed so that the there is no discharge of PCBs or uncontrolled contact water. All water will be discharged under the terms of the Clean Water Act.

ii) Existing contact water storage capacity and control structures for discharge of non contact storm water satisfy Illinois State NPDES discharge permit conditions.

5. TOPOGRAPHY 40 CFR 761.75(b)(5): The CWU is located on the remains of a Wisconsin Age glacial till at the edge of what is now a dissected prairie terrace. The CWU extends south onto forested slope land with low to moderate relief. The southern facing slopes of the CWU constitute the sidewalls of Salt Creek Valley. The slopes are stable and show no signs of landslides or slumping.

Background

Slope stability modeling for the expected waste in the cell, the liners and the clay layers below it show the whole structure will be stable against landslides or slumping under all expectable conditions, static and seismic, within the scope of seismic evidence available, at least 250 years; and it will resist erosion to the limit of geological predictability for the area, on the order of at least thousands of years.

A) Gullies seen along the south and east side of the CWU are the result of intermittent seepage from sand layers within Clay Pan #1. The seepage temporarily softens soil slopes and leads to storm related erosion in otherwise dry gullies. Drilling shows gullies around the CWU are being eroded in the direction of the thickest sand are not controlled by structural weaknesses in the clay pans. The CWU appears to be located where the underlying sands are minimized and the long term potential for erosion has been minimized. The forces of erosion that are observable now will diminish. Each new cell will interfere and block seepage that leads to gully formation.

B) Parts of the CWU are expected to intersect Upper Radnor Till Sand at 650 feet MSL and the Roxana Silt at an elevation of 663 feet MSL. Those sands will be excavated and blocked by clay.

C) The south slope includes a fragment of a pre-existing topography that stands out in bold relief. It is comparatively resistant to erosion and is large enough for an unimproved jeep trail. It is a short ridge/hog back like feature capped by protective Peoria Sands. The ridge protects part of the CWU from erosion. Natural armoring decreased erosion significantly and shows how landfill designs can be expected to perform.

D) Geotechnical slope stability modeling for loaded landfills under static and under dynamic conditions shows the site including the landfill and adjacent slopes are

stable showing a factor of safety greater than 1.3 for static conditions during and after construction and that earthquake activity will not create an unreasonable risk of release of PCBs.

E) Reports of geological inspections for earthquake related clastic dikes conducted along terraces of Salt Creek adjacent to the CWU show none are present and that local ground motions from seismic activity are low and are consistent with lateral accelerations used in dynamic stability modeling.

F) The landfill rests on two clay pans, the upper being dissected and the lower acting as the base of surface water flow. The remnants of Clay Pan #1 still visible at the surface, approximately 40-50 feet thick, constitute most of the vertical relief present locally. Salt Creek Valley appears to be cut down to an elevation that corresponds to the top of the next major unit down, Clay Pan #2. Clay Pan #2, an older and deeper unit appears to erode more slowly. It is not dissected by surface drainages in the area but controls it.

6) MONITORING SYSTEMS 761.75(b)(6)

6(i) Water Sampling :

A) Background groundwater sampling has been conducted and PCBs were not detected. Quarterly data for the following units was taken for 2 years and submitted with the application:

1) Roxana Silt (Sangamonian interglacial unit, part of Wedron Group),
2) Lower Radnor Till Sand (Upper Glasford Formation),
3) Organic soil (correlative with Roby Silt Member of Glasford Formation),

B) Salt Creek, a surface watercourse, is not subject to contact water runoff from the CWU. Salt Creek has not been designated for monitoring by the Regional Administrator.

C) Closure and post-closure surface water sampling requirements will be determined upon initiation of closure.

Technical Background

i) Groundwater monitoring wells and leak detection systems built into the liners are in position to test groundwater before it leaves the disposal site.

ii) The only surface water present on site is from intermittent storm water runoff. That runoff is controlled by a catchment system. Contact and non-contact water are divided by berms and settlement basins so that no sampling is needed beyond that required under the Clean Water Act; clean water act permit discharge permits are based on demonstrating that only non contact water will be discharged to the Salt River

6(ii) Groundwater Monitoring Wells:

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A) Underlying earth materials are not homogenous, and uniformly sloping in one direction; Groundwater monitoring will include more than three wells. TSCA requirements for groundwater monitoring are satisfied by installation of the following monitoring wells in accordance with the Illinois State Municipal Solid Waste Landfill Permit No. 2005-070-LF as modified January 8, 2010 including:

i) Wells now installed:

Roxana:			G 08R	G 09R	G 10R	G 11R	G 12 R
Lower Radnor:	G 1M		G 08M	G 09M	G 10M	G 11M	G 12 M
Organic Soil:	G 01D	G 02D	G 08D	G 09D	G 10D	G 11D	G 12D

ii) Wells to be installed under TSCA for the CWU:

Roxana Silt (R)			G07R	G39R	G40R	G47R	G48R	G49R	G50R	G51R	G52R	G58R	G59R
Upper Radnor (S)			G07S								G52S		
Lower Radnor (M)		G05M		G39M	G40M	G47M	G48M	G49M		G51M	G52M	G58M	
Organic Soil (D)	G03D		G07D	G39D	G40D	G47D	G48D	G49D	G50D	G51, D	G52D	G58D	G59D

B) All monitoring wells are cased to prevent percolation of surface water from entering the well and are capped to control access.

C) All monitoring well locations applicable to the CWU listed in the RCRA Subtitle D license modification added or related to Phase 2 monitoring for the CWU are also TSCA monitoring well locations. Sampling requirements and sampling frequencies are identical.

Groundwater Monitoring Background

i) The upper three water bearing units, found on site are being monitored by a perimeter monitoring system.

ii) The perimeter monitoring system consists of monitoring wells spaced at 100-200 feet around the perimeter of the cell.

iii) well spacing was designed to detect a contaminant plume from the landfill.

v) clay below the CWU resists and blocks PCB movement,

vi) the Lower Radnor Till Sand Aquifer and deeper units of the Glasford Formation are separated by 18 feet of clay and is not subject to contamination,

vii) The landfill meets groundwater monitoring requirements set forth by the State of Illinois under the RCRA Subtitle D program,

7) LEACHATE COLLECTION 40 CFR 761.75(b)(7) includes: A primary leachate collection and a secondary leachate collection system is planned that will be separate from the adjacent MSW facilities. The construction of a secondary leachate collection system exceeds TSCA requirements. The synthetic membrane liners allows for efficient leachate control. The leachate collection system will be monitored monthly for quantity and physicochemical characteristics. Monitoring water level in sumps and chemical analysis of leachate volumes removed prior to disposal according to applicable regulations is sufficient.

8) CHEMICAL WASTE LANDFILL OPERATIONS 40 CFR 761.75(b)(8) include:

a) Placement of waste:

i) inspection of waste material for conformance with TSCA 40 CFR 761 including but not limited to the ban on TSCA liquids in landfills;

ii) placement of PCB wastes;

b) Operational Plan: developed and approved, including

i) use of a coordinate system to record the location of PCB waste;

ii) inspection of the CWU=s integrity, groundwater monitoring in the vicinity of the CWU, analysis of water extracted from the Leachate Collection System and the Leak Detection Collection and Removal System (LDCRS);

iii) maintenance of manifest records in accordance with the PCB regulations and State rules;

iv) Solidification of incidental PCB waste that fails the paint filter test within the cell,

v) The CWU will be operated with safety features which act to prevent releases, or spills to water, soils, or other cells as specified in the Conditions of Approval. The Permittee has provided the Agency with a description of its worker training program. This program is designed to ensure compliance with applicable safety and health requirements and regulations. The training program, as described, encompasses safety, record keeping, sampling and analysis;

vi) operational procedures for using, inspecting, repairing, decontaminating and replacing equipment used to identify, monitor, track, transport, dispose, and confine PCBs; and

vii) spill prevention, cleanup and emergency response procedures.

9) SUPPORTING FACILITIES 40 CFR 761.75(b)(9)(i) include:

(i) Fence:

A 6 Foot Woven mesh fence or equivalent…to be placed around the CWU,

(ii) Roads:

Roads, when constructed will be maintained to prevent track-out of waste,

(iii) Spill prevention & windblown material:

All waste is covered at the end of each day.

10) OTHER INFORMATION 40 CFR 761.75{c}(2): found necessary to determine whether a chemical waste landfill should be approved and technical footnotes:

Water Use

A) Review of groundwater use in the area shows that there are users of groundwater within a 2 mile radius but in no case has any well been found in a location where it is or can be influenced by the CWU

B) A detailed review was conducted for wells within a one mile radius around the CWU. Well databases from the State of Illinois Geological Survey, Water Survey and Department of Public Health show most wells are protected by full depth casing. Those not listed as fully cased had been test borings, abandoned wells or wells to be closed and did not need evaluation. Five wells were found whose use and construction history could not be determined. Wells 10-5, 10-6, 10-10, 10-12, and 14-2 were evaluated for potential exposure pathways. Wells 10-5, 10-10, and 14-2 draw from the heavily protected Mahomet Aquifer. Wells 10-5, 10-10 and 14-2 draw from a part of the aquifer that is downgradient of the CWU. Mohamet Aquifer water flowing under the landfill is fully protected.

C) The other two wells, 10-6 and 10-12 draw from an elevation of approximately 635 feet, a depth that is below the base of the CWU and is equivalent to the elevation of the base of Salt Creek Valley. No well stood in the path of groundwater that had been in contact with the CWU or drill holes around it.

Supplemental Geological Comments

D) Clay Pan #2 has been studied offsite and publications are readily available from the State of Illinois and the U.S. Geological Survey that illustrate the situation. Checking information presented by the applicant shows that what U.S. EPA calls Clay Pan #2 actually consists of units from a previous glacial event of Illinoian age and possibly pre-Illinoian age. For the purposes of the TSCA approval, Clay Pan #2 overlies and isolates the Mahomet Aquifer sands of the Middle Banner member of the Pre-Illinoian Banner Formation from an even earlier period.

E) The large area clay pan is a composite of relatively uniform silty and sandy clay layers. The few thin silt and fine sand seams that break the uniformity of the clay pan do not change known hydrologic site conditions

F) Clay Pan #2 is thicker and even more compressed than Clay Pan #1. It is "bedrock" in construction terms for the project. Being older and deeper it has been loaded more and over a longer period. Drilling penetration rates and lab tests show a consistent and significant increase in shear strength in Clay Pan #2. Subsurface exploration is soon terminated upon encountering the harder material.

G) Clay Pan #1, Clay Pan #2 and the interface between them host thin silt, sand and black organic units, can produce useable water even though they are considered relatively impermeable. Vertical permeability is generally low. Horizontal permeability is generally low. There are some zones within the soil sequence that have sufficient permeability and lateral extent to produce useable water, mostly for domestic needs but there are several commercial wells that produce from within the Clay Pans.

H) Some wells are set in and draw from the Roxana Silt and from a deeper unit the Organic Soil, possibly a Farmdale substage unit located between Radnor and Vandalia Tills. The black organic units appear to be remains of ancient bogs stratigraphically positioned between clay pans #1 and #2 and between till members of Clay Pan #2. The aquifer units are typically found at the top and bottom of each clay pan member unit.

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I) Water level measurements in borings show the silt zones are hydrostatically independent. Monitoring wells set in the more prominent units show individual sand layers vary in thickness and elevation but that water in the sand is sufficiently interconnected for water table maps to show a gradient that shows an influence by the land surface. The gradient indicates that groundwater flow within Clay Pan #1, the boundary silt and the upper part of Clay Pan #2 is largely toward Salt Creek.

J) Clay Pan #2, although widespread, the older and deeper clay units of Clay Pan #2 are not visible at the surface. However, geologic interpretation of special core holes drilled by the U.S. Geological Survey, and by many other parties over the years provides sufficient information to rely upon. There are approximately 3,500 wells and logs available from all across DeWitt, Piatt and Northern Macon County. That information together with borings and wells spaced around the CWU provide extensive knowledge of the area. Clay Pan #2 consists of two separate geologic formations, 3-5 individual clay till units and several thin sand bodies, some of which produce enough water for domestic and in one case commercial use. The units of interest are in the Upper Glasford member of the Glasford Formation. They include Radnor Till, Vandalia Till and 3-4 included sand units described below. Minor amounts of water are available from sands in the Upper Glasford, the Lower Glasford and below.

K) Water sands below the Roxana Silt some of which are identified as Glasford Formation sands and minor aquifers of Clay Pan #2 are relatively thinned around the facility based on information from published state and federal geological reports. One Glasford aquifer unit, the Lower Radnor Sand is the "Sentinel Sand" for groundwater monitoring. The closest well that draws from a unit at approximately same elevation as the Sentinel Zone is located approximately 3100 feet away from the edge of the CWU. That well and others which draw from near the 636-643 foot elevation of the Lower Radnor sand are safe. They are not in any projected path of flow from around the CWU. Wells are cross-gradient or up-gradient of the CWU or both. Although apparently stratigraphically close, drinking water is not necessarily being drawn from units that connect to the Sentinel Zone or to other Glasford units close to the CWU. The close well, for example, draws from 629-637ft MSL approximately 5-6 feet deeper than the 635-644 ft range of the top and bottom of the Lower Radnor sand. Without dye tracing for instance, there is no way to know that two points so far apart are truly connected. The well could be drawing from the "Organic Soil" unit found between the Radnor Clay Till Member and a lower unit of the Glasford Formation, the Vandalia Clay Till Member. The Organic Soil unit is thin and discontinuous. It was modeled by the State of Illinois and was demonstrated to be

even more resistant to contaminant migration than the Lower Radnor Till Sand.

L) Glasford Formation, the Upper Members of the Banner Formation and other unidentified units in the stratigraphic section make a total distance of approximately 170 feet from base of cell to the top the Mohamet Aquifer, the most important major water resource in the area. That distance to the Mohamet Aquifer is much more than the 50 foot depth to the historic high water table in TSCA regulations.

i) The clay material is relatively impermeable. Testing to a depth of approximately 25 feet below the CWU liner was done to certify the permeability of the clay to be less than 1 x 10^{-7} cm/sec.

ii) Although the 2-3 foot thick silty Lower Radnor sand exists at a depth of about 25 feet below the CWU, testing of conclusions clay to a depth of about 60 feet below the liner shows permeabilities are consistently less than 1 x 10-7 cm/sec. Such results together with consistent elevations and correlation of marker clays, sands, silts and organic material in drill hole measurements indicates that the undisturbed clay immediately under the CWU is part of a much thicker wide spread and known geological sequence making up a large area clay pan under TSCA extending all the way to the Mahomet Aquifer found approximately 170 feet below the cell.

Geochemical Background

M) HYDROGEOCHEMICAL CHARACTERISTICS: of the clay pan are favorable and protect human health and the environment at the CWU and over Clintonia and Texas Townships. The clay pan shows there is a color change in the soil from yellow/brown to a uniform gray at about 10-20 feet below ground surface. The color change signals the bottom of the oxidized zone and indicates that infiltration of plain rainwater over thousands of years is so low that it has not consumed the carbon content of the soil.

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N) GROUNDWATER MODELLING: Results show that given the clay pan, liners, monitoring systems and expectable leachate character under the waste acceptance plan there is no unreasonable risk of harm to human health and the environment by release of PCBs. Three models and one database were used

i) LEACHATE CHEMISTRY DATABASE: Official EPA records of leachate chemistry from PCB and PCB Hazardous Waste landfills used by

Clinton Landfill Inc. show that the chemistry of the working leachate at the CWU should have PCB concentrations that are generally below the level of routine analytical detection, 0.01 ppm and that they will rarely show levels above 1 ppm.

ii) Model #1 "MIGRATE": Used by the applicant for a Groundwater Impact Assessment for the MSW cell.

iii) Model #2 "MEMO": used by applicant's consultant Shaw Environmental Inc., replacing "PLUME" by PDC Technical Services Inc., resulting in a closer spacing, the applicant determined the size of a hypothetical plume that could come from the MSW facility showing that a well spacing of less than 200 feet will be sufficient to detect the release of a most likely constituent at any well.

iv) Model #3 "POLLUTE": Used by Shaw Environmental Inc. applicant's consultant to show that the migration of PCBs is stopped by the carbon content of the recompacted clay liner. The natural carbon content of gray clay will stop the seepage of PCBs. For example, the three feet of recompacted clay liner present around the CWU will absorb all PCBs in contaminated leachate for over 1000 years.

Groundwater Modeling Background

iv) Potential vertical contaminant transport paths from the base of the lowest synthetic membrane liner to the Lower Till Sand and Organic Soil units and then using horizontal paths have been modeled as a part of a Groundwater Impact Assessment included in the TSCA application. The assessment was a two dimensional advective adsorptive model requiring much data. It is not required under TSCA but it was part of the RCRA Subtitle D modification. EPA did not review or certify the results but finds they can be used in a general way.

v) A more simplified, conservative one dimensional assessment of chemical absorption was requested for comparison. The results provided in the application and the response to request used worst possible case assumptions such as:

(1) that such liquids at such concentrations could exist at all after placement in the landfill,

(2) chemical absorption modeling shows the clay will retain all PCBs within the 3-5 foot thick Berry clay/ clay pad.

(3) the Lower Radnor Aquifer 18-20 feet below the landfill has been modeled as if the overlying clay and liners did not exist.

(4) Conservative and generalized advective adsorptive modeling conducted as part of a Groundwater Impact Assessment required by the State of Illinois shows that chemicals cannot effectively migrate to the perimeter of the facility at meaningful concentrations for over 100 years.

(5) Absorptive modeling shows the PCBs cannot escape the clay pad for thousands of years.

Historical Background

N) HISTORY OF USE: The clay pan has historically been deemed locally to be good enough so that municipal drinking water for the town of Clinton can safely be drawn from wells in the Mahomet Aquifer only a mile or so downhill from nearby sewage disposal ponds.

Natural Resource Background

O) RESOURCE UNITS: offsite within a 2 mile radius there are no indications that water resources are at risk from contamination by PCBs as a result of disposal activity at the CWU. The area is within a 10 mile groundwater resource protection zone of the town of Clinton, but the terms of resource protection have to do with usage, management of pressure and water depletion, the resource is not vulnerable to contamination from surface activity. Coal resources are reported but there are no indications planned utilization within a mile radius of the facility

(1) Water Units:

(a) Clay Pan water-bearing units, permeable parts of the Glasford Formation and Wedron Group generally produce insignificant water although there are sand bodies capable of producing water in quantities suitable for domestic purposes. They have been reported

offsite side or up-gradient of the CWU…such as wells around Wedron State Park and near Coon Creek. Other Clay Pan wells in the vicinity of the CWU are protected by Salt Creek Valley, a hydrologic barrier.

(b) The Mahomet Aquifer, 170 feet below the CWU, is usually a significant water resource but bedrock mapping indicates that the aquifer is locally thinned by half under the CWU and appears missing or very thin in wells as close as a mile away. Mohamet Aquifer production from wells under the landfill or anywhere else on the unnamed bedrock high around the landfill may be affected.

(c) The uppermost hard rock unit, thought to be Millersville Limestone of Pennsylvanian age, is part of the coal bearing Bond Formation, it is not a water resource. Easy access to the Mahomet Aquifer water usually found overlying it renders local bedrock aquifers undesirable.

(2) Coal Units:

(a) State of Illinois reports indicate that coal-bearing units with a net coal thickness of as much as 10 to 15 feet exist deep below the landfill but are not described as being economically attractive in the foreseeable future.

(b) The Springfield #5 coal is reportedly present in the Texas Township in general, is estimated as 42-60 inches thick approximately 550 feet below ground surface. Coal would not be open to leasing in the vicinity of the landfill

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WAIVER

EPA waives no requirements under TSCA 761.75