TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE
ENGINEERING #23 **SPOKANE, WASHINGTON**
January, 2013

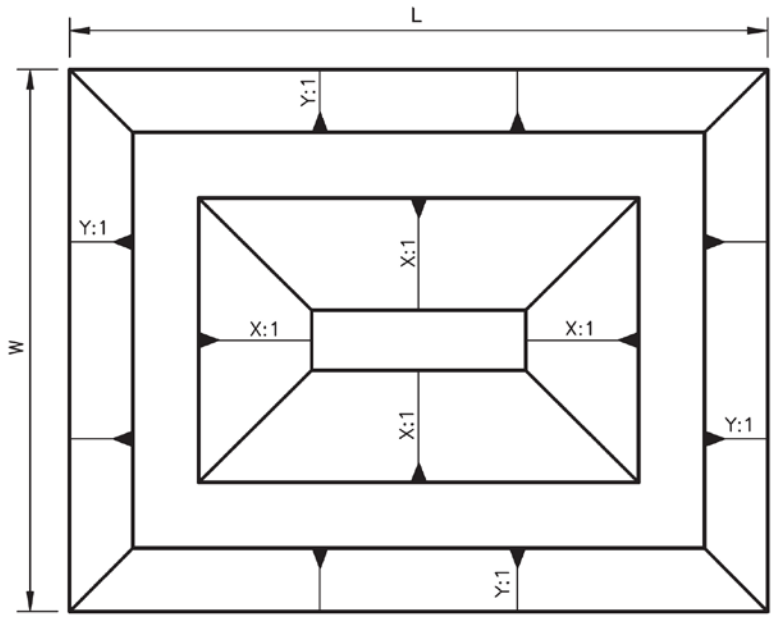
NRCS ASSESSMENT PROCEDURE

FOR

EXISTING WASTE STORAGE PONDS (WSP)

This Technical Note prescribes a consistent review and assessment process for assigning one of four rating categories and subcategories to a waste storage pond (WSP) according to observed factors that may contribute to the risk of contamination of water resources.

The NRCS assessment should not be construed to provide **ANY** regulatory certainty from State regulatory agencies. State of Washington laws and rules prohibit pollution of waters of the state, including ground water. The state requires a permit for discharge of wastewater to waters of the state. This document does not supersede these requirements.



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EXISTING WASTE STORAGE POND (WSP) ASSESSMENT PROCEDURE

INTRODUCTION

NRCS works with Dairy operators across Washington State to provide technical and financial assistance to further their effort in the implementation of practices that serve to protect water resources. Waste storage ponds (WSPs) encountered by NRCS staff, while providing assistance, may have been constructed to an outdated standard or constructed to no standard.

This technical note contains a site inventory and assessment procedure for evaluating existing WSPs. This procedure requires collecting existing WSP site information and conducting an assessment of the WSP and Site, to establish an overall assessment of a WSP according to observed factors that may contribute to the risk of water resources. The assessments in this technical note are qualitative in nature and are not intended to quantify seepage amounts occurring from existing WSP's.

BACKGROUND

Waste storage ponds (WSPs) are used in animal production agriculture for the purpose of containing liquid animal waste until such time that the waste can be utilized as a soil nutrient amendment for crop production. The Washington State Department of Agriculture (WSDA) is assigned the responsibility of statewide inspection and enforcement of Dairy facilities. If WSDA identifies a water quality concern, the operator is directed to NRCS and/or the local Conservation District (CD) for technical assistance. On a voluntary basis, NRCS and/or the CD collaborate with the Dairy operator to address the identified water quality concerns.

A WSP is a common component of a Dairy waste management system. Most often the existing WSP structure condition and performance is unknown. Information is needed in order to develop technically sound comprehensive nutrient management plan alternatives for the dairy operation. This technical note provides a standardized procedure for completing a assessment of, and recommendations for existing WSP's.

PROCEDURE

Through this procedure, NRCS personnel will establish an overall assessment category of a WSP according to observed factors that may contribute to the risk of water resource degradation. NRCS personnel will assign one of four rating categories and corresponding subcategory.

This Technical Note describes a three phase procedure that must be completed in order to assign an overall rating category to an existing WSP. Phase 1 consists of documenting the existing WSP and physical site features and includes a series of forms listed in the table below. Phase 2 documents whether the WSP complies with NRCS practice standard criteria. Phase 3 consists of assessment procedures.

The series of forms have been developed for conducting the assessment of the:

- Existing WSP
- Site
- The combined WSP/Site

Phases 1 and 2 must be completed before conducting Phase 3.

Table 1. Overview of Phase 1, 2 and 3 activities

Phase	Form	Name	Subparts
1	**SSIF**	WSP Site and Structure Inventory Forms	1. General Site Information Form 2. Site Soils Form 3. Site Attributes Form 4. Structure Attributes Form 5. Structure Condition Form 6. Operation and Maintenance Form 7. Structure Modification Form
2	**PSCRF**	Practice Standard Compliance Report Form	None
3	**AF**	Assessment Forms	1. Site Assessment Form 2. Structure Assessment Form 3. Overall Assessment Form

PHASE 1 – WSP SITE AND STRUCTURE INVENTORIES

*WSP Site and Structure Inventory Forms (**SSIF**)*

Purpose: These forms document the current WSP site and structure conditions.

1. General Site Information: This form is used to document the general information regarding the existing WSP (e.g.: landowner, Address, Location, etc.). General weather and field surface conditions are documented as the accuracy of the data collection effort may be hampered depending on these conditions.
2. Site Soils Form: This form is used to inventory and record the natural ground site soil properties and water table conditions.
3. Site Attributes Form: This form is used to collect and document the WSP site information.
4. Structure Attributes Form: This form is used to document the physical characteristics of the existing WSP. Information collected for this step include a measure of the; embankment height, side slopes, top width, pond depth, etc. It may be necessary to utilize survey equipment to gather this information. The review person should document how the data was collected so that the users of the information can determine if further data collection would be needed in the future.
5. Structure Condition Form: This form is used for the “Near Full” or “Near Empty” condition to document waste storage pond observations made during a site visit such as; erosion, liner and embankment condition.
6. Operation and Maintenance Inventory Form: This form is used for the “Near Full” or “Near Empty” condition to document waste storage pond O&M activities and the resulting effectiveness. Document whether or not there are minor or major repair needs.
7. Structure Modification Form: This form is used to document modifications that have been made to the WSP either through visual inspection or conversation with the operator.

PHASE 2 – PRACTICE STANDARD COMPLIANCE

*Practice Standard Compliance Report Form (**PSCRF**)*

Purpose: This form is used to compare the existing WSP or the most recent structure modification against NRCS criteria in place at the time of construction. The current NRCS design criteria for this practice is found in the NRCS Practice Standard 313-Waste Storage Facility. The preceding standard for this practice was the NRCS Practice Standard 425 - Waste Storage Pond. A table listing critical changes to the NRCS Practice Standard design criteria for all of the pertinent revisions is located in Appendix 1.

When completing the form, document whether or not the WSP is performing in accordance with NRCS practice standard in place at the time of construction.

PHASE 3 – ASSESSMENT

*Assessment Forms (**AF**)*

Purpose: These series of forms are used to complete the Site, Structure and Overall assessments.

1. Site Assessment Form: The Site Assessment takes into consideration the existing saturated hydraulic conductivity, presence of wells, distance to the nearest body of water, EPA Region 10 sole source aquifer designations and the WSDA Aquifer Susceptibility Maps. Risk ratings of "Low", "Medium" or "High" are assigned and are defined as:

   "Low Risk" - Located in an area that is highly unlikely to have water resources affected by the WSP.

   "Medium Risk" - Located in an area that may have water resources that could be affected by the WSP, however the site could be modified to protect water resources.

   "High Risk" - Located in an area where water resources are highly vulnerable to contamination and the site cannot be easily modified to protect water resources.

2. Structure Assessment Form: The Structure Assessment takes into account compliance with the NRCS practice standard in place at the time of construction and the inherent associated risk to the protection of water resources. Risk ratings of "Low", "Medium" or "High" are assigned and are defined as:

   "Low Risk" - Waste Storage Pond complies with the NRCS practice standard in use at the time when constructed.

   "Medium Risk" - Waste Storage Pond complies with the NRCS practice standard in use at the time when constructed, however there are minor corrective actions necessary in order to restore the WSP to full functionality.

   "**High Risk"** - Waste Storage Pond does not comply with the NRCS practice standard in use at the time when constructed. Major corrective actions are necessary in order to restore the WSP to full functionality.

3. Overall Assessment Form: The Overall Assessment takes into account the Site and Structure assessment. There are four Categories with subcategories that are defined as:

   Category 1A - NRCS recommends utilizing the WSP for the purpose of waste storage.

   Category 1B - NRCS recommends utilizing the WSP for the purpose of waste storage, however the site may benefit from additional practices to reduce discharge potential in the situation of a structure failure.

   Category 2A - NRCS recommends utilizing the WSP for the purpose of waste storage, however the site would benefit from additional practices to reduce discharge potential in the situation of a structure failure.

   Category 2B - NRCS recommends discontinued use of the WSP for the purpose of waste storage until minor repairs and/or improvements have been completed in accordance with the NRCS practice standard in place at the time of construction and the site may benefit from additional practices to reduce discharge potential in the situation of a structure failure.

   Category 2C - NRCS recommends discontinued use of the WSP for the purpose of waste storage until minor repairs and/or improvements have been completed in accordance with the NRCS practice standard in place at the time of construction.

   Category 3A - NRCS recommends discontinued use of the WSP for the purpose of waste storage until major repairs or possible replacement of the existing WSP meeting the current NRCS Conservation Practice Standard – 313, Waste Storage Facility.

   Category 3B - NRCS recommends discontinued use of the WSP for the purpose of waste storage until major repairs or possible replacement of the existing WSP meeting the current NRCS Conservation Practice Standard – 313, Waste Storage Facility and the site may benefit from additional practices to reduce discharge potential in the situation of a structure failure.

   Category 3C - NRCS recommends discontinued use of the WSP for the purpose of waste storage until minor repairs and/or improvements have been completed for the waste storage pond structure and the site would benefit from additional practices to reduce discharge potential in the situation of a structure failure with structure relocation being considered.

   Category 4 - NRCS recommends discontinued use of the WSP for the purpose of waste storage until major repairs or possible replacement of the existing WSP meeting the current NRCS Conservation Practice Standard – 313, Waste Storage Facility and the site would benefit from additional practices to reduce discharge potential in the situation of a structure failure with structure relocation being considered.

OTHER CONSIDERATIONS/ CRITERIA

An existing WSP that stores more than 10 acre-feet above the ground surface must also be evaluated in accordance with the Washington Department of Ecology (DOE), Dam Safety Office (DSO) regulatory requirements. The DOE Dam Safety Office schedule regular review and inspection of jurisdictional WSP projects focused on configuring the WSP to survive suitable design floods and earthquakes. The DSO does not evaluate the adequacy of jurisdictional WSP's in meeting ground water quality performance requirements.

This Technical Note does not evaluate compliance with WA DOE Dam Safety criteria. If the WSP is a state regulated structure the DSO criteria will need to be met in addition to NRCS criteria.

REFERENCES:

1. "Earthen Manure Storage Seepage: A Study of Five Typical Sites," Prepared by: Principal investigator, Bill MacMillan with Study Summary by, Robert Borg and Peter Llewellyn, Agri-Facts, Practical Information for Alberta's Agriculture Industry, July 2001, Agdex 729-1

2. "Seepage Evaluation of Older Swine Lagoons in North Carolina," By R.L. Huffman, 2004 American Society of Agricultural Engineers, Vol. 47(5): pp 1507-1512.

3. "Measurement of Seepage from Earthen Waste Storage Structures in Iowa", T.D. Glanville, J.L. Baker, S.W. Melvin and M.M. Agua, 1999, Department of Agricultural & Biosystems Engineering, Iowa State University, Ames, Iowa 50011

4. DISCUSSION OF "Literature Review and Model (COMET) for Colloid/Metals and Transport in Porous Media", By W. B. Mills, S. Liu, and F.K. Fong, Groundwater, March-April 1991 issue, v. 29, no. 2, pp 199-208.

5. "Geologic and Ground Water Considerations," Chapter 7, Agricultural Waste Management Field Handbook, National Engineering Handbook (NEH),Part 657.07, Natural Resources Conservation Service, June, 1999.

6. "Agricultural Waste Management System Component Design," Chapter 10, Agricultural Waste Management Field Handbook, Amendment 31, National Engineering Handbook (NEH),Part 657.07, Natural Resources Conservation Service, August 2009.

7. "Design and Construction Guidelines for Impoundments Lined with Clay or Amendment-treated Soil," Appendix 10D, Agricultural Waste Management Field Handbook, Amendment 31, National Engineering Handbook (NEH),Part 657.07, Natural Resources Conservation Service, August 2009.

8. "Ground Water/Surface Water Interactions and Quality of Discharging Ground Water in Streams of the Lower Nooksack River Basin, Whatcom County, Washington", Stephen E. Cox, USGS; William Simonds, USGS; Llyn Doremus, Nooksack Indian Tribe, et. al. Scientific Investigations Report 2005-5255, U.S. Department of the Interior, U.S. Geological Survey.

9. "Liquid Animal Waste System Operation & Inspection Guide", Alabama Cooperative Extension System, BSEN – 01C4 (REV JUN 03), By Ted W. Tyson, P.E., C.I.D., Extension Biosystems Engineer & Professor, Auburn University.

10. "Guidance for the Evaluation of Existing Storage Structures", Michigan Department of Environmental Quality, Water Bureau, December 2, 2005.

11. "Subsurface Investigations for Waste Storage Facilities", 04/22/2009, Michigan NRCS, Animal Waste Management website. http://www.mi.nrcs.usda.gov/technical/engineering/animal_waste.html

12. "An AEM Tool for the Evaluation of Un-Designed Waste Storage Facilities", Agricultural Environmental Management, New York State, Soil & Water Conservation Committee, Department of Agriculture and Markets.

13. “Evaluation of Existing Waste Storage Facilities”, William Reck PE, Darren Hickman PE, William Boyd PE, USDA-NRCS National Technical Service Center(s), 2006.

14. “Water Quality Indicator Tools”, Water Quality Technical Note 1, Washington State NRCS, July 2000.

15. “Waste Storage Facility, Conservation Practice Standard, Code 313”, USDA-NRCS, Washington State.

16. EPA Region 10 Sole Source Aquifer Maps, http://yosemite.epa.gov/r10/water.nsf/Sole+Source+Aquifers/ssamaps

SITE AND STRUCTURE INVENTORY FORMS (SSIF)

INSTRUCTIONS: The Site and Structure Inventory Forms are used to document the existing condition, physical features, evidence of operation / maintenance activities and the physical attributes of the WSP. The information collected through this process is used to complete the assessments for an existing WSP.

GENERAL SITE INFORMATION FORM:

Step 1: Document the landowner/farm name, address and the specific WSP location.

Step 2: Check the appropriate box for the review being completed, "WSP is near FULL or "WSP is near EMPTY".

Step 3: Complete the climatic condition section. This data is very important as it conveys the limitations present during the inventory process.

SITE SOILS FORM:

The Site Soils Form is used to document the existing WSP Site Soils. If there are different site soil types, it may be necessary to complete multiple reports.

SITE ATTRIBUTES FORM:

Information is either measured in the field, from maps, appendices of this technical note or from other previously completed forms of this technical note.

STRUCTURE ATTRIBUTES FORM:

Information is measured during the site visit or gathered from as-built documents. Provide comments pertinent to the site or structure for consideration during the assessment phase.

STRUCTURE CONDITION FORM:

Responses are either yes, no or N/A. The form was set up to address the Full or Empty condition, some of the questions may not apply depending on which condition is being evaluated.

INSTRUCTIONS: (Continued)

OPERATION AND MAINTENANCE INVENTORY FORM:

Read each question and provide the appropriate response. Responses are either yes, no or N/A. The form was set up to address the Full or Empty condition, some of the questions may not apply depending on which condition is being evaluated.

WSP - MODIFICATIONS:

All WSP modifications shall be documented and an impact assessment shall be included.

SIGNATURE BLOCK:

The technically responsible staff person completing the forms shall print and sign their name. The Engineering Job Approval Authority for PS 313, “Design” will be included when completed by NRCS staff.

SITE AND STRUCTURE INVENTORY FORMS (SSIF)

GENERAL SITE INFORMATION FORM

LANDOWNER/FARM NAME: _____

ADDRESS:_____ STATE:_____ ZIP: _____

WSP LOCATION: Sec _____ T ____ R ____ **(or)** Lat _____ Long _____

NRCS JOB CLASS: _____

CHECK REVIEW CONDITION BELOW:

☐ WSP is FULL (Typically late winter or early spring)

☐ WSP is near EMPTY (Typically late summer or early fall)

MANURE/ EFFLUENT LEVEL and Other Observations: _____

_____

TODAY: Liquid Level BELOW Top of Embankment or Spillway Elevation: _____ FT.

CLIMATIC CONDITIONS	
Weather:	Temperature:
Soil Surface Conditions (circle all that apply): Dry / Moist / Wet / Saturated / Standing Water/ Frozen/ Snow Covered	
Additional Information:	

SITE AND STRUCTURE INVENTORY FORMS (SSIF)

SITE SOILS FORM

INSTRUCTIONS: The Site Soils Report Form is used to document the existing WSP Site Soils. If there are different site soil types within the footprint of the structure or nearby it may be necessary to complete multiple reports.

Step 1: The landowner/farm name, address as well at the specific WSP location shall be documented.

Note: Attaching a soils map with the WSP location for documentation purposes is recommended.

Step 2: The soil type and soil profile propertied are retrieved from the NRCS Web Soil Survey (WSS). Aerial photos may also be used to document the surface water section of the site soils report.

It will be necessary to document the USCS classification for soils below the pond bottom surface. If there are two or more soil permeability rate values below the pond bottom surface, it is recommended to use the greatest permeability rate.

Step 3: Upon conducting a site visit it is recommended to verify any data obtained electronically when at the site. This is completed by digging soil pits or using a hand held soil auger.

SITE SOILS COMMENTS / NOTES

SITE AND STRUCTURE INVENTORY FORMS (SSIF)

Site Soils Report

Dominant Soil Type

Soil Survey Area Name

Map Unit Symbol

Map Unit Name

Soil Profile

Top Depth (in)	Bottom Depth (in)	Unified Soil Classification	K_{sat} low (μm/sec)	K_{sat} high (μm/sec)

Maximum Hydraulic conductivity (K_{sat}) below WSP bottom surface (μm/sec)

Depth to water table (in)

SITE AND STRUCTURE INVENTORY FORMS (SSIF)

WSP - SITE ATTRIBUTES FORM	
SITE INVENTORY QUESTIONS	**RESPONSE**
1. Saturated Hydraulic Conductivity (K_{sat}) of the Existing WSP site soils below the WSP surface **(Refer to SSRF)**	
2. Distance from the nearest edge of WSP to the nearest groundwater water supply wells	
a. Depth to groundwater source if distance is less than 100 feet from the nearest edge of the WSP. **(Refer to DOE well log data sheet or estimate from the landowner)**	
3. Distance from nearest toe of WSP to nearest surface water flow or body	
a. If distance is less than 300 feet is there a natural secondary barrier or containment dike between the WSP and the Surface water of concern?	
4. WSP located within an EPA Region 10 Sole Source Aquifer or Source Area? **(Refer to Appendix 3 for Regional Map. For more detailed maps visit EPA Region 10 website at:** http://yosemite.epa.gov/r10/water.nsf/Sole+Source+Aquifers/ssamaps)	(Circle One) **Yes / No**
5. WSDA Aquifer Susceptibility Rating? **(Refer to Appendix 2 for State Map.)**	(Circle One) **Very Low** **Low** **Medium** **High**

SITE AND STRUCTURE INVENTORY FORMS (SSIF)

WSP - STRUCTURE ATTRIBUTES FORM	
WSP STRUCTURE ATTRIBUTES	**NOTES**
1. WSP - Inside Top – Average Width (ft)	
2. WSP - Inside Top – Average Length (ft)	
3. WSP Storage Capacity (cu ft)	
4. Embankment - Inside SS (X:1)	
5. Embankment - Outside SS (Y:1)	
6. Embankment – Top Width (ft)	
7. Combined Side Slope (Outside SS + Inside SS)	
8. Embankment – Maximum Fill Height (ft)	
9. Maximum Excavation Depth (ft)	
10. Total Pond Depth (ft)	
11. Liner Type and Thickness (in)	
12. Inlet Type and Location	
13. WSP Interior-Outlet Ramp Slope (z:1)	
14. Distance to Nearest Well / Water Depth in well(ft)	
15. Failure Impacts; Farm Building, Homes, Roads, Water Course	
16. Emptying Feature is provided to protect against accidental release. (yes/no) If yes please describe in the note section.	
17. Distance to Nearest Home/Dwelling (ft)	
18. Distance to Nearest Water Course (ft)	
WSP – STRUCTURE COMMENTS / NOTES	

SITE AND STRUCTURE INVENTORY FORMS (SSIF)

WSP - STRUCTURE CONDITION FORM

If any boxes checked **"YES"**; make notes of items for concern, possible extent of damage, identify options to repair, stabilize or address in the **REPORT** section.

	SITE INVENTORY QUESTIONS	YES	NO	NA
Liner	Liner type: None / Compacted Clay / Flexible Membrane / Bentonite Amendment **(Circle One)**			
	Evidence of liner slumps, bulges, boils, or whales?			
	If applicable; Are perimeter drain(s) plugged or blocked?			
Embankment – Crest, Exterior Slope and Toe[1]	Evidence of cracks in embankment soils?			
	Damp, soft, or slumping areas?			
	Evidence of seepage on the embankment slope?			
	Evidence of seepage around pipes through berm?			
	Evidence of differential (uneven) settlement?			
	Evidence of seepage at the toe of the embankment?			
	Evidence of sand boils on the slope, along the toe or near the toe?			
WSP – Interior Surface	Interior erosion due to wave action?			
	Interior erosion from rainfall?			

[1] Complete inventory questions appropriate to structure, *if no embankment, as in a pit pond, show NA*.

NOTES:

SITE AND STRUCTURE INVENTORY FORMS (SSIF)

WSP - OPERATION AND MAINTENANCE INVENTORY FORM

If any boxes checked **"YES"**; make notes of location and identify O & M task to improve management in **REPORT** section.

SITE INVENTORY QUESTIONS		YES	NO	NA
Embankment – Crest, Exterior Slope and Toe[1]	Damage from burrowing animals?			
	Evidence of overtopping of embankment?			
	Evidence of soil erosion or gully on embankment?			
	Pond transfer pipe/structure is obstructed?			
	Presence of trees or woody vegetation?			
	Waste storage pond access is not fenced and properly marked? If not required for structure then n/a.			
WSP Interior/Liner	Interior erosion in vicinity of waste inlet structure?			
	Interior erosion near agitation equipment access points?			
	General erosion of liner material?			
	Damaged liner material (holes, tears, seams)?			
Waste Transfer	Any pumps or transfer pipes are not functional?			
	Any recycling pumps or transfer pipes are not functional?			
Odor	Downwind odor from WSP is strong or unbearable?			

[1] Complete inventory questions appropriate to structure, *if no embankment, as in a pit pond, show NA*.

NOTES:

STRUCTURE and O&M CONDITION CONCERNS	YES	NO
Was any abnormal condition or practice observed that requires corrective action (If yes then answer 1 and 2 below):		
1. Minor repair or change in practice would bring the WSP into compliance with accepted practice.		
2. Major repair or change in practice would bring the WSP into compliance with accepted practice.		

SITE AND STRUCTURE INVENTORY FORMS (SSIF)

WSP - STRUCTURE MODIFICATION FORM				
			Yes	**No**
HAS THE WSP BEEN STRUCTURALLY MODIFIED? ***(If "Yes" complete 1 through 5 below)***				
1	Was the WSP modification designed by a qualified individual?			
	Date design of modification			
	Designer (If applicable)			
2	Date of modification construction			
3	Description of structural modification:			
	Did the modification meet the NRCS practice standard in place at the time of construction?			
4	Describe impact of the modification on structural integrity:			
5	Describe impact of the modification on storage depth and storage volume:			

WSP Inventory Completed by			
Name:		JAA	
Signature:		Date:	

PRACTICE STANDARD COMPLIANCE REPORT FORM (PSCRF)

INSTRUCTIONS: The Practice Standard Compliance Report Form compares the WSP inventory data to the benchmark condition.

PRACTICE STANDARD COMPLIANCE REPORT FORM:

Step 1: Document the landowner/farm name, address as well at the specific WSP location.

Step 2: Fill in all fields if applicable otherwise place N/A.

Step 3: Complete the physical attributes table for “Current Conditions” by copying forward information from the “WSP Physical Attributes Table”.

Step 4: Complete the NRCS Practice Standard Criteria section referring to Appendix 1, NRCS practice standard criteria for WSP’s. Place the relative NRCS criteria based on the year the WSP was constructed or when the last modification was completed. If the WSP was constructed prior to 1979, then the 1979 criteria shall apply.

SIGNATURE BLOCK:

The technically responsible staff person completing the forms shall print and sign their name. The Engineering Job Approval Authority for PS 313, “Design” will be included when completed by NRCS staff.

PRACTICE STANDARD COMPLIANCE REPORT FORM (PSCRF)

WSP PRACTICE STANDARD COMPLIANCE REPORT FORM

LANDOWNER/FARM NAME: _____

ADDRESS:_____ STATE:_____ ZIP: _____

WSP LOCATION: Sec _____ T _____ R _____ **(or)** Lat _____ Long _____

DATE ORIGINAL WASTE STORAGE POND or MODIFICATION COMPLETED: _____

NRCS Practice Standard 313 Compliance Check

PHYSICAL WSP ATTRIBUTES	CURRENT CONDITIONS	NRCS Practice Standard criteria[1]	Complies NRCS Practice Standard Criteria? (Circle One)
1. Embankment height. (Ref SSIF 7/10 – 8.0)			Yes - No - N/A
2. Failure of WSP would result in damages limited to farm buildings, ag-land, or country roads. (Ref SSIF 7/10 - 15.0)			Yes - No - N/A
3. WSP embankment elevation above 25 yr. floodplain. (Estimated)			Yes - No - N/A
4. Inlet permanent and resists; corrosion, plugging, freeze damage and is UV protected. (Ref SSIF 7/10 - 12.0)			Yes - No - N/A
5. Emptying features are provided and are protected against erosion and accidental release. (Ref SSIF 7/10 - 16.0)			Yes - No - N/A
6. Slurry or solid storage ramp slope. (Ref SSIF 7/10 – 13.0)			Yes - No - N/A
7. Fencing necessary for protection of humans and livestock. (Ref SSIF 9/10)			Yes - No - N/A
8. WSP embankment protected against erosion. (Ref SSIF 8/10 & 9/10)			Yes - No - N/A
9. Separation distance from WSP bottom and SHGWT. (Ref SSIF 5/10)			Yes - No - N/A
10. Liner. (Ref SSIF 8/10 & 9/10)			Yes - No - N/A
11. Liner type (Ref PS 521). (Ref SSIF 8/10)			Yes - No - N/A
12. If no liner, foundation soils permeability. (Ref SSIF 5/10)			Yes - No - N/A

[1] Appendix 1: Refer to the NRCS practice standard design criteria by date of adoption for current and archived NRCS practice standards used for Waste Storage Pond design and construction in WA State.

PRACTICE STANDARD COMPLIANCE REPORT FORM

NRCS Practice Standard 313 Compliance Check (***Continued***)			
PHYSICAL WSP ATTRIBUTES	**CURRENT CONDITIONS**	**NRCS Practice Standard criteria[2]**	**Complies NRCS Practice Standard Criteria?**
13. Embankment inside side slope. (Ref SSIF 7/10 – 4.0)			Yes - No - N/A
14. Embankment outside side slope. (Ref SSIF 7/10 – 5.0)			Yes - No - N/A
15. Combined embankment side slope. (Ref SSIF 7/10 – 7.0)			Yes - No - N/A
16. WSP above ground volumetric storage. (Estimated)			Yes - No - N/A
17. Minimum distance to dwellings. (Ref SSIF 7/10 – 17.0)			Yes - No - N/A
18. Embankment top width. (Ref SSIF 7/10 – 6.0)			Yes - No - N/A
19. Minimum distance to water well. (Ref SSIF 7/10 – 14.0)			Yes - No - N/A
20. Minimum distance to water course. (Ref SSIF 7/10 – 18.0)			Yes - No - N/A

Compliance Check Results	YES	NO
Does the WSP comply with NRCS practice standards at the time of construction or modification?		

WSP Compliance Review Completed by (Print): _____ JAA: _____

Signature _____Date:_____

[2] Appendix 1: Refer to the NRCS practice standard design criteria by date of adoption for current and archived NRCS practice standards used for Waste Storage Pond design and construction in WA State.

WSP ASSESSMENT FORMS (AF)

INSTRUCTIONS: The assessment forms provide a standardized procedure for assigning a category that ranks a WSP according to observed factors that may contribute to the risk of degradation to water resources.

SITE ASSESSMENT FORM:

The information that is utilized for the Site Assessment is the completed data located on the Site and Structure Inventory Form.

Step 1: Carefully read each question and check corresponding box.

Step 2: Record the score points in the right hand column for each question.

Step 3: Total the score points and assign the corresponding risk rating.

STRUCTURE ASSESSMENT FORM:

The information that is utilized for the Structure Assessment is the completed data located on the Site and Structure Inventory Form and the Practice Standard Compliance Report Form.

Step 1: Carefully read each question and check corresponding box.

Step 2: Record the score points in the right hand column for each question.

Step 3: Total the score points and assign the corresponding risk rating.

OVERALL ASSESSMENT FORM:

The Overall Assessment Form is completed utilizing the results on the Site and Structure Assessment Forms.

Step 1: On the "Risk Probability Matrix for Water Resource Degradation" plot the "Site Risk" rating and the "Structure Risk" rating.

Step 2: Circle the resulting combined risk factor on the matrix.

Step 3: From the Risk Probability Matrix for Groundwater Degradation check the corresponding box to document recommended actions for the Existing Waste Storage Pond.

SIGNATURE BLOCK:

The technically responsible staff person completing the forms shall print and sign their name. The Engineering Job Approval Authority for PS 313, "Design" will be included when completed by NRCS staff.

WSP ASSESSMENT FORMS

SITE ASSESSMENT FORM				
Consideration	**Categories (Check appropriate box for each consideration and record points in the right hand column)**			**Score**
Saturated Hydraulic Conductivity (K_{sat}) of the soils below the WSP bottom surface	Less than 2 μm/sec	Between 2 and 20 μm/sec	Greater than 20 μm/sec	
	☐ **0 points**	☐ **1 points**	☐ **3 points**	
Shallow (< 145 feet deep) groundwater water supply wells within 100 feet of the nearest edge of the WSP	No	Yes, but it **is** technically feasible to decommission or relocate the shallow groundwater well	Yes, but it **is not** technically feasible to decommission or relocate the shallow groundwater well	
	☐ **0 points**	☐ **1 points**	☐ **3 points**	
Distance from the nearest surface water flow or body to the toe of the WSP	Greater than 300 ft	Less than 300 ft. but technically feasible to construct a secondary barrier or containment dike between the WSP and the surface water of concern.	Less than 300 ft. but not technically feasible to construct a secondary barrier or containment dike between the WSP and the surface water of concern.	
	☐ **0 points**	☐ **1 points**	☐ **3 points**	
Location with respect to an EPA Region 10 Sole Source Aquifer or Source Area **and** Medium to High Aquifer Susceptibility according to the WSDA Aquifer Susceptibility Map	Not located in either	Located in one, but not the other	Located in both.	
	☐ **0 points**	☐ **3 points**	☐ **6 points**	
			Total Score	
			Risk	

Total Score	**Risk Rating**
2 points or less =	**Low Risk**
3 to 5 points =	**Medium Risk**
6 points or more =	**High Risk**

WSP ASSESSMENT FORMS

STRUCTURE ASSESSMENT FORM				
Consideration	**Categories (Check appropriate box for each consideration and record points in the right hand column)**			**Score**
WSP complies with NRCS practice standard criteria (PSCRF 3/3)	Yes		No	
	☐ **0 points**	**N/A**	☐ **6 points**	
Earthen structural condition questions (SSIF 8/10)	All questions answered "NO" or "NA"	One or more of the questions answered "YES"; repairs require **minor** restoration effort[1].	One or more of the questions answered "YES"; repairs require **major** restoration effort[2].	
	☐ **0 points**	☐ **3 points**	☐ **6 points**	
Operation and maintenance questions (SSIF 9/10)	All questions answered "NO" or "NA"	One or more of the questions answered "YES"; repairs require **minor** restoration effort[1].	One or more of the questions answered "YES"; repairs require **major** restoration effort[2].	
	☐ **0 points**	☐ **2 points**	☐ **4 points**	
Structural modifications	Constructed in accordance with NRCS practice standard criteria	Not constructed in accordance with NRCS practice standard criteria in place at the time; repairs require **minor** restoration effort[1].	Not constructed in accordance with NRCS practice standard criteria in place at the time; repairs require **major** restoration effort[2].	
	☐ **0 points**	☐ **3 points**	☐ **6 points**	
			Total Score	
			Risk Rating	

Total Score	**Risk Rating**
2 points or less =	**Low Risk**
3 to 5 points =	**Medium Risk**
6 points or more =	**High Risk**

1. Minor restoration effort – Restorative activities can be completed without significant disturbance to the WSP.

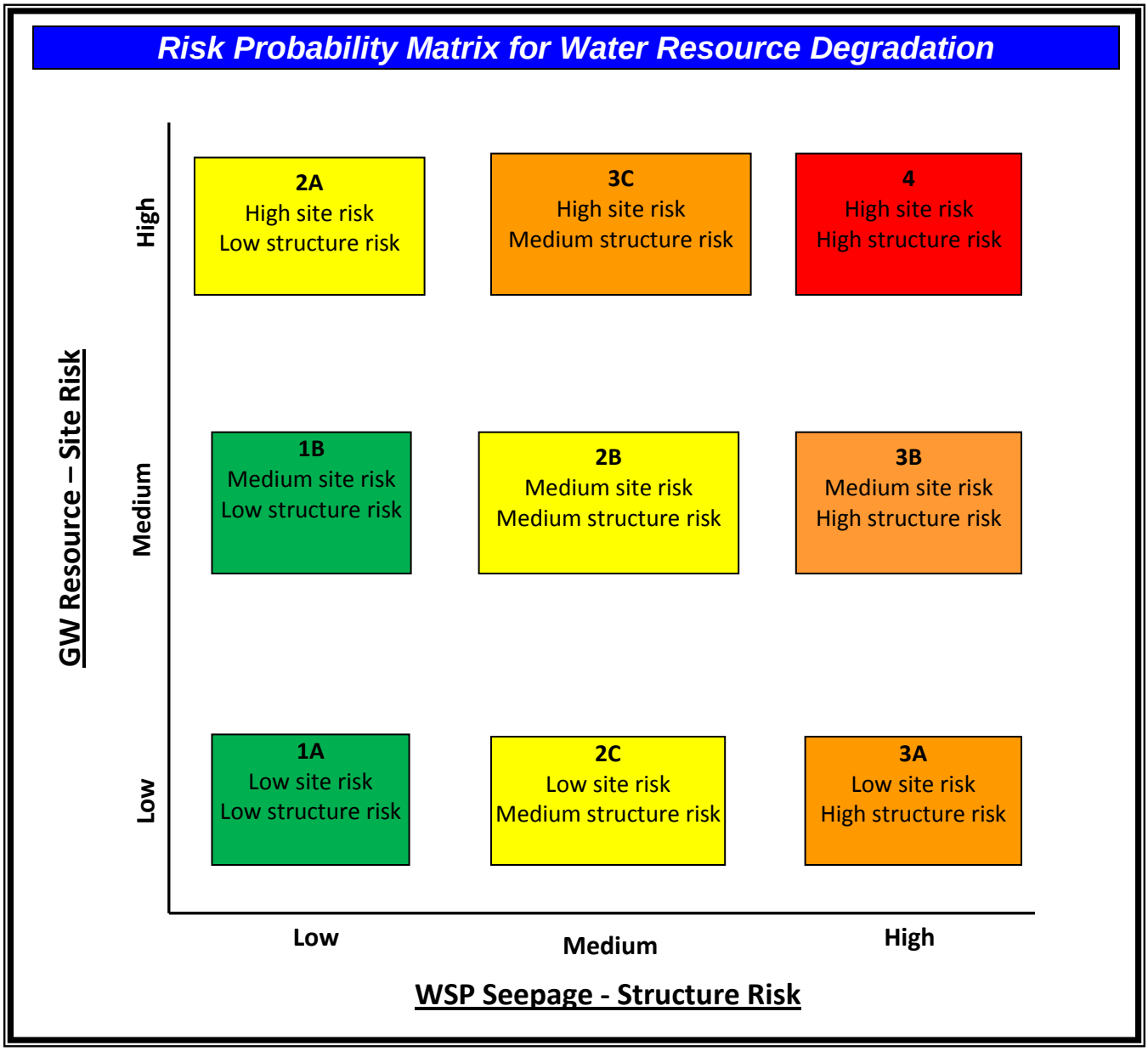
2. Major restoration effort – Restorative activities cannot be completed without significant disturbance to the WSP.

WSP ASSESSMENT FORMS

OVERALL ASSESSMENT FORM

Instructions: On the "Risk Probability Matrix for Water Resource Degradation" plot the following factors and circle the resulting combined risk factor on the matrix.

1. ***Ground Water Resource - Site Risk*** on the Y axis
2. ***WSP Seepage - Structure Risk*** on the X axis



WSP ASSESSMENT FORMS

Instructions: From the Risk Probability Matrix for Water Resource Degradation check the corresponding box to document recommended actions for the existing Waste Storage Pond.

Category 1

	A	B
☐	Low site risk Low structure risk	Medium site risk Low structure risk

Category 1A - NRCS recommends utilizing the WSP for the purposes of waste storage.

Category 1B - NRCS recommends utilizing the WSP for the purposes of waste storage, however the site may benefit from additional practices to reduce discharge potential in the situation of a structure failure.

Category 2

	A	B	C
☐	High site risk Low structure risk	Medium site risk Medium structure	Low site risk Medium structure risk

Category 2A - NRCS recommends utilizing the WSP for the purposes of waste storage, however the site would benefit from additional practices to reduce discharge potential in the situation of a structure failure.

Category 2B - NRCS recommends discontinued use of the WSP for the purposes of waste storage until minor repairs and/or improvements have been completed in accordance with the NRCS practice standard in place at the time of construction and the site may benefit from additional practices to reduce discharge potential in the situation of a structure failure.

Category 2C - NRCS recommends discontinued use of the WSP for the purposes of waste storage until minor repairs and/or improvements have been completed in accordance with the NRCS practice standard in place at the time of construction.

CONTINUED NEXT PAGE

WSP ASSESSMENT FORMS

CONTINUED FROM PREVIOUS PAGE

Category 3

	A	B	C
☐	Low site risk High structure risk	Medium site risk High structure risk	High site risk Medium structure

Category 3A - NRCS recommends discontinued use of the WSP for the purposes of waste storage until major repairs or possible replacement of the existing WSP meeting the current NRCS Conservation Practice Standard – 313, Waste Storage Facility.

Category 3B - NRCS recommends discontinued use of the WSP for the purposes of waste storage until major repairs or possible replacement of the existing WSP meeting the current NRCS Conservation Practice Standard – 313, Waste Storage Facility and the site may benefit from additional practices to reduce discharge potential in the situation of a structure failure.

Category 3C - NRCS recommends discontinued use of the WSP for the purposes of waste storage until minor repairs and/or improvements have been completed for the waste storage pond structure and the site would benefit from additional practices to reduce discharge potential in the situation of a structure failure with structure relocation being considered.

Category 4

☐	High site risk High structure risk

Category 4 - NRCS recommends discontinued use of the WSP for the purposes of waste storage until major repairs or possible replacement of the existing WSP meeting the current NRCS Conservation Practice Standard – 313, Waste Storage Facility and the site would benefit from additional practices to reduce discharge potential in the situation of a structure failure with structure relocation being considered.

SIGNATURE BLOCK

THE WSP INTEGRITY ASSESSMENT REPORT WAS COMPLETED BY:

Evaluating Personnel: _____ **Date:** _____

Agency: _____

PS 313 Assigned Job Approval Authority for "WSP Review Assessment": _____

Appendix 1

WSP Practice Standard Criteria Reference Documents

Table outline for – NRCS Practice Standard Criteria Revisions and WA State Supplements

Waste Storage Pond, PS-425, Dated: 1979 -1994

Waste Storage Facility, PS-313, Dated 2000 - Current

Washington State NRCS REVISION and Supplement Dates:

- April 1979 -
- February 1987 – State Supplement
- January 1994 – State Supplement
- February 2000
- June 2001
- December 2004

Earth pond construction dimension criteria for all WSP practices and all revisions: April 1979 to December 2004

Practice Standard Code/Name	PS 425 Waste Storage pond			PS 313 Waste Storage Facility		
Release Date	1979, April			2000, February	2001, June	2004, December
Supplement Release Date		1987, February	1994, January			
1. Embankment Height.	35 feet or Less	35 feet or Less	35 feet or Less	35 feet or Less	35 feet or Less	35 feet or Less
2. Failure of WSP would result in damages limited to farm buildings, Ag-Land, or country roads.	N/A	N/A	N/A	Yes	Yes	Yes
3. WSP Embankment Elevation above Floodplain?	25 Yr	25 Yr	25 Yr	25 Yr	25 Yr	25 Yr
4. Inlet permanent and resists; corrosion, plugging, freeze damage and is UV protected?	Yes	Yes	Yes	Yes	Yes	Yes
5. Emptying features are provided and are protected against erosion and accidental release?	Yes	Yes	Yes	Yes	Yes	Yes
6. Liquid Storage Ramp slope.	4:1	4:1	4:1	4:1	4:1	4:1
7. If the WSP creates a safety hazard fencing is necessary for protection of Humans and livestock.	Yes	Yes	Yes	Yes	Yes	Yes
8. WSP Embankment protected against erosion.	Yes	Yes	Yes	Yes	Yes	Yes
9. Separation distance from WSP Bottom and SHGWT.	0 Inches	6 inches	6 inches	24 inches	24 inches	24 inches
10. Liner	Only if Self Sealing is not anticipated	Required for all foundation material, except glacial till, when closer than 300 feet to a domestic well.	Required for all WSP's	Required for all WSP's	Required for all WSP's if wetted surface permeability rate is less than $1x10^{-6}$ cm/s	Required for all WSP's if wetted surface permeability rate is less than $1x10^{-6}$ cm/s

Earth pond construction dimension criteria for all WSP practices and all revisions: April 1979 to December 2004

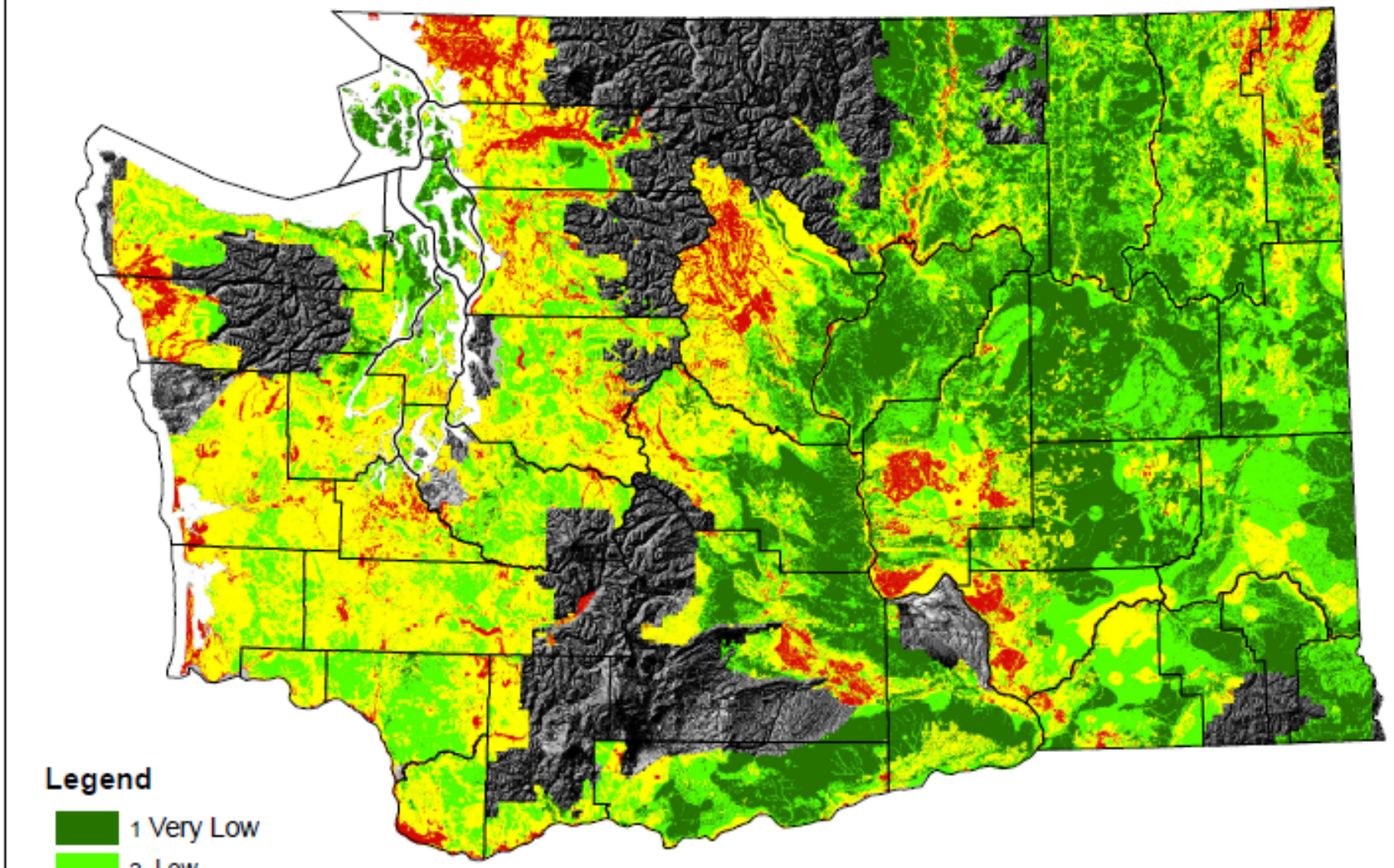
Practice Standard Code/Name	PS 425 Waste Storage pond			PS 313 Waste Storage Facility		
Release Date	1979, April			2000, February	2001, June	2004, December
Supplement Release Date		1987, February	1994, January			
11. Liner type (Ref PS 521)	If Required	Minimum Requirements GM – 12" thick GC – 9" thick SM – 12" thick SC – 9" thick ML – 12" thick CL – 6" thick CH – 6" thick	12" Minimum thickness & soils requirement GM-w/20% fines GC-w/20% fines SM-w/20% fines SC-w/20% fines (or Amended) ML MH CL CH	12" Minimum thickness & soils requirement GM-w/20% fines GC-w/20% fines SM-w/20% fines SC-w/20% fines (or Amended) ML MH CL CH	12" Minimum thickness & soils requirement of permeability rate is less than $1x10^{-6}$ cm/s	12" Minimum thickness & soils requirement of permeability rate is less than $1x10^{-6}$ cm/s
12. If no liner, foundation soils permeability.	Low to Moderate	Low to Moderate	Must be equivalent to liner requirement	Must be equivalent to liner requirement	Must be equivalent to liner requirement	Must be equivalent to liner requirement
13. Maximum operating level marker	N/A	N/A	N/A	N/A	Yes	Yes
14. Embankment Top Width (minimum)	8 feet	8 feet	8 feet	8 feet	Embankment Height / Width 15' or Less / 8' 15'-20' / 10' 20'-25' / 12' 25'-30' / 14' 30'-35' / 15'	Embankment Height / Width 15' or Less / 8' 15'-20' / 10' 20'-25' / 12' 25'-30' / 14' 30'-35' / 15'
15. Embankment Inside Side Slope	N/A	N/A	N/A	No Steeper Than 2:1	No Steeper Than 2:1	No Steeper Than 2:1
16. Embankment Outside Side Slope	N/A	N/A	N/A	No Steeper Than 2:1	No Steeper Than 2:1	No Steeper Than 2:1
17. Combined Embankment Side Slope (minimum)	5:1	5:1	5:1	5:1	5:1	5:1
18. WSP Above Ground Volumetric Storage[3]	If over 10 ac-ft above ground storage refer to DOE Dam Safety Criteria	If over 10 ac-ft above ground storage refer to DOE Dam Safety Criteria	If over 10 ac-ft above ground storage refer to DOE Dam Safety Criteria	If over 10 ac-ft above ground storage refer to DOE Dam Safety Criteria	If over 10 ac-ft above ground storage refer to DOE Dam Safety Criteria	If over 10 ac-ft above ground storage refer to DOE Dam Safety Criteria
19. Minimum Distance to Dwellings	100 feet	100 feet	100 feet	N/A	N/A	N/A
20. Minimum Distance to water well	N/A	100 ft., 200 ft. for unconfined aquifers	300 feet	300 feet	300 feet	100 feet
21. Minimum distance to water course	N/A	25 feet	25 feet	N/A	N/A	N/A

[3] The storage threshold is the theoretical volume contained in the WSP with the fluid level at the top of the embankment, not at the operating level.

Appendix 2

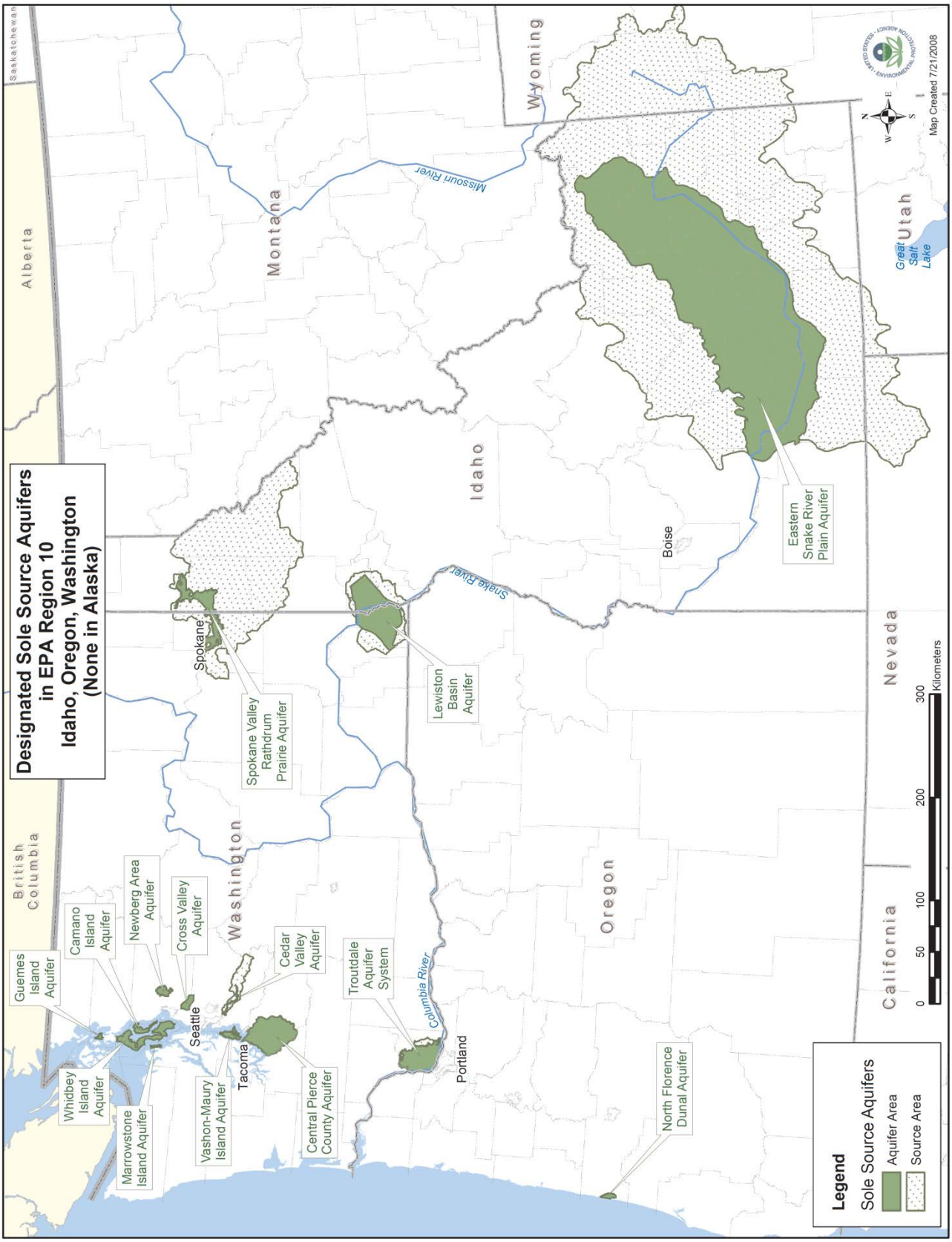
WSDA Aquifer Susceptibility Map

Aquifer Susceptability Map - Washington State 2011



Appendix 3

Designated Sole Source Aquifer Map for EPA Region 10


Designated Sole Source Aquifers
in EPA Region 10
Idaho, Oregon, Washington
(None in Alaska)
Saskatchewan
Alberta
British Columbia
Montana
Wyoming
Idaho
Washington
Oregon
Nevada
California
Utah
Missouri River
Snake River
Columbia River
Great Salt Lake
Boise
Spokane
Seattle
Tacoma
Portland
Eastern Snake River Plain Aquifer
Lewiston Basin Aquifer
Spokane Valley Rathdrum Prairie Aquifer
Guemes Island Aquifer
Camano Island Aquifer
Newberg Area Aquifer
Cross Valley Aquifer
Cedar Valley Aquifer
Troutdale Aquifer System
Whidbey Island Aquifer
Marrowstone Island Aquifer
Vashon-Maury Island Aquifer
Central Pierce County Aquifer
North Florence Dunal Aquifer
Legend
Sole Source Aquifers
Aquifer Area
Source Area
0
50
100
200
300
Kilometers
Map Created 7/21/2008

Appendix 4

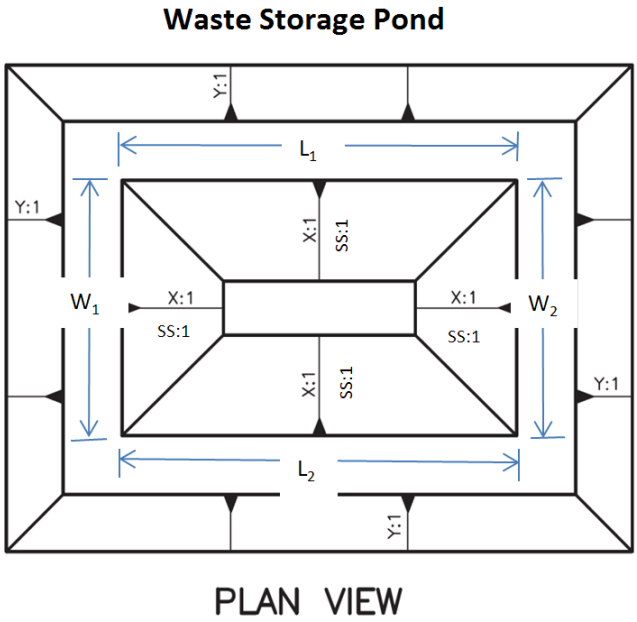
WSP Volume Estimating Spreadsheet

INSTRUCTIONS

A spreadsheet has been developed to calculate the estimated volume of a square or rectangular WSP.

SPREADSHEET INPUTS

The spreadsheet requires six inputs in order to compute the approximate volume of the WSP.



PLAN VIEW

L1 and L2 are Top of Pond dimensions as shown in feet.

W1 and W2 are Top of Pond dimensions as shown in feet.

h = Depth of WSP measured from crest to pond bottom surface in feet.

SS = Internal side slope of WSP.

h_{out} = Depth of WSP above ground measured from crest to lowest outside toe in feet

SPREADSHEET COMPUTATIONS

The spreadsheet computes the volume utilizing the prismoidal formula. All formula variables can be computed from the inputs and the intermediate results are shown in the output window of the spreadsheet.

$$V = h/6\ (A_t + 4M + A_b)$$

Where:

V - Volume of the truncated pyramid
h - WSP Depth (Crest to Bottom)
A_t - Top Surface Area, WSP Crest
M - Cross Section Area, Mid-Depth
A_b - Bottom Surface Area, WSP Base
h_{out} - Depth of pond above ground from lowest outside toe to top of crest
$V_{ab\text{-}gnd}$ - Volume stored above ground
SS - Internal Sideslope of the WSP
L_1 and L_2 are Top of Pond dimensions as shown
W_1 and W_2 are Top of Pond dimensions as shown

SPREADSHEET OUTPUTS

The spreadsheet provides a quick assessment of the estimated WSP volume. Three examples are provided for review.

See Example #1: The user inputs the information that is captured during the SSIF forms. The volume is computed and displayed in the output window. The estimated volume can be used to populate the "WSP Structure Attributes" field for waste storage capacity on SSIF page 7/10.

See Example #2: The user inputs the information that is captured during the SSIF forms. The volume is computed and displayed in the output window. The estimated volume can be used to populate the "WSP Structure Attributes" field for waste storage capacity on SSIF page 7/10.

In addition, a note is displayed when the computed volume is greater than 10 ac-ft. If the above ground storage is greater than 10 ac-ft, the WA State Dam Safety Office has regulatory authority over the facility and the State Dam Safety Standards prevail. NRCS Technical Note 23 does not determine compliance with WA State regulated dams.

See Example #3: The user inputs the information that is captured during the SSIF forms. In this case the volume cannot be computed or displayed in the output window. If the computed length or width of the bottom of the pond is less than zero (0), the results in the intermediate computation field for l or w reports "n.g.". Either a different method will need to be utilized to compute the volume or the depth may be in error. It is recommended to verify that all of the input fields are correct.

Example 1: Determine the estimated WSP volume

Computation Sheet

WA NRCS-ENG-Computation

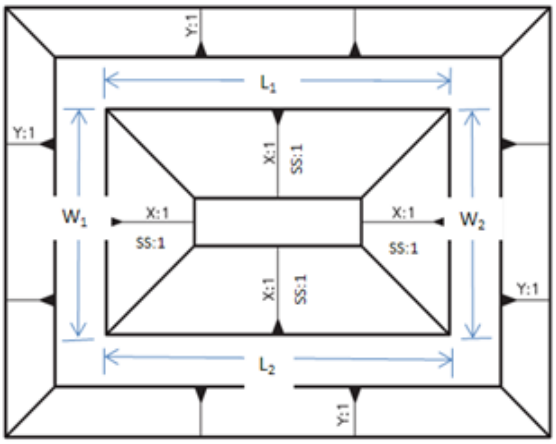
U.S. Department of Agriculture
Natural Resources Conservation Service

State	Project			
Washington	Example #1			
By	**Date**	**Checked By**	**Date**	**Job No.**
NRCS	1/4/2013			
Subject				**Sheet** ____ of ____
Estimated WSP Prismoidal Volume				

Volume of a Truncated Pyramid Prism with a Rectangular Base

with two parallel polygonal bases joined to one another by straight edges

Waste Storage Pond



PLAN VIEW

$$V = h/6\,(A_t + 4M + A_b)$$

Where:

V - Volume of the truncated pyramid
h - WSP Depth (Crest to Bottom)
A_t - Top Surface Area, WSP Crest
M - Cross Section Area, Mid-Depth
A_b - Bottom Surface Area, WSP Base
h_{out} - Depth of pond above ground from lowest outside toe to top of crest
$V_{ab\text{-}gnd}$ - Volume stored above ground
SS - Internal Sideslope of the WSP
L_1 and L_2 are Top of Pond dimensions as shown
W_1 and W_2 are Top of Pond dimensions as shown

Definitions	Inputs		
ft. = Feet	$L_{side\ 1}$ =	210	ft.
s.f. = Square Feet	$L_{side\ 2}$ =	185	ft.
c.f. = Cubic Feet	$W_{side\ 1}$ =	100	ft.
a.f. = Acre-Feet	$W_{side\ 2}$ =	125	ft.
n.g. = Results are No Good	h =	11	ft.
	SS =	2.5	
	h_{out} =	5	

Data Input Field

Outputs			
Intermediate Computations		Estimated WSP Volume	
A_t =	22,219 s.f.	$V = h/6\,(A_t + 4M + A_b)$	
M =	14,450 s.f.		
A_b =	8,194 s.f.	V_{total} = 161,723	c.f.
$M_{ab\text{-}gnd}$ =	18,500 s.f.	V_{total} = 3.7	a.f.
$A_{b\ ab\text{-}gnd}$ =	15,094 s.f.	and	
		$V_{ab\text{-}gnd}$ = 92,760	c.f.
		$V_{ab\text{-}gnd}$ = 2.1	a.f.

Pond Storage Volume

Above Ground Pond Storage Volume

Example 2: Determine the estimated WSP volume

Computation Sheet

WA NRCS-ENG-Computation

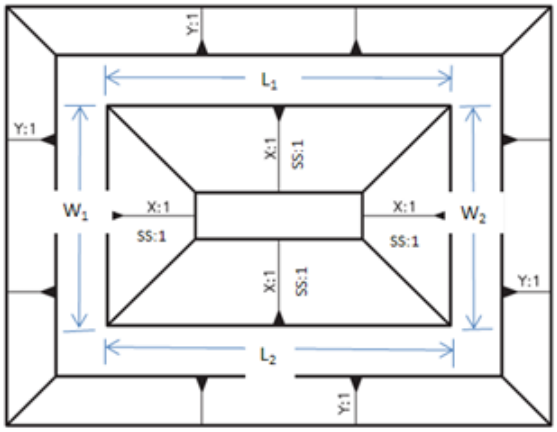
U.S. Department of Agriculture
Natural Resources Conservation Service

State	Project			
Washington	Example #2			
By	**Date**	**Checked By**	**Date**	**Job No.**
NRCS	1/4/2013			
Subject				**Sheet** ____ of ____
Estimated WSP Prismoidal Volume				

Volume of a Truncated Pyramid Prism with a Rectangular Base

with two parallel polygonal bases joined to one another by straight edges

Waste Storage Pond



PLAN VIEW

$$V = h/6\,(A_t + 4M + A_b)$$

Where:

V - Volume of the truncated pyramid
h - WSP Depth (Crest to Bottom)
A_t - Top Surface Area, WSP Crest
M - Cross Section Area, Mid-Depth
A_b - Bottom Surface Area, WSP Base
h_{out} - Depth of pond above ground from lowest outside toe to top of crest
$V_{ab\text{-}gnd}$ - Volume stored above ground
SS - Internal Sideslope of the WSP
L_1 and L_2 are Top of Pond dimensions as shown
W_1 and W_2 are Top of Pond dimensions as shown

Definitions	Inputs		
ft. = Feet	$L_{side\ 1}$ =	300	ft.
s.f. = Square Feet	$L_{side\ 2}$ =	325	ft.
c.f. = Cubic Feet	$W_{side\ 1}$ =	250	ft.
a.f. = Acre-Feet	$W_{side\ 2}$ =	200	ft.
n.g. = Results are No Good	h =	15	ft.
	SS =	2.5	
	h_{out} =	7.5	

Data Input Field

Outputs	
Intermediate Computations	Estimated WSP Volume
A_t = 70,313 s.f.	$V = h/6\,(A_t + 4M + A_b)$
M = 51,563 s.f.	
A_b = 35,625 s.f.	V_{total} = 780,469 c.f.
$M_{ab\text{-}gnd}$ = 60,586 s.f.	V_{total} = 17.9 a.f.
$A_{b\ ab\text{-}gnd}$ = 51,563 s.f.	and
	$V_{ab\text{-}gnd}$ = 455,273 c.f.
	$V_{ab\text{-}gnd}$ = 10.5 a.f.
	NOTE: Exceeds 10 Acre-Feet stored above ground

Pond Storage Volume

This notification is displayed when the above ground volume is greater than 10 ac-ft

Example 3: Determine the estimated WSP volume

Computation Sheet

WA NRCS-ENG-Computation

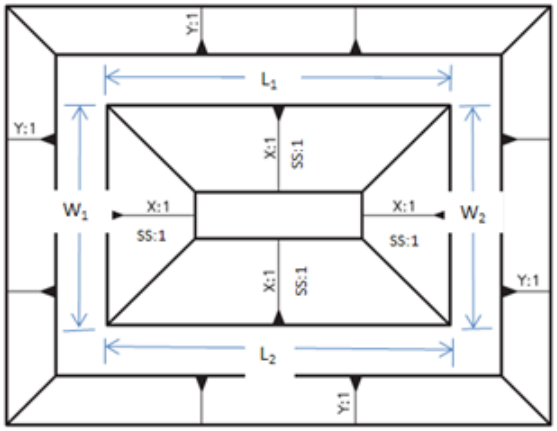
U.S. Department of Agriculture
Natural Resources Conservation Service

State	Project			
Washington	Example #3			
By	**Date**	**Checked By**	**Date**	**Job No.**
NRCS	1/4/2013			
Subject				**Sheet** ____ of ____
Estimated WSP Prismoidal Volume				

Volume of a Truncated Pyramid Prism with a Rectangular Base

with two parallel polygonal bases joined to one another by straight edges

Waste Storage Pond



PLAN VIEW

$$V = h/6\,(A_t + 4M + A_b)$$

Where:

V - Volume of the truncated pyramid
h - WSP Depth (Crest to Bottom)
A_t - Top Surface Area, WSP Crest
M - Cross Section Area, Mid-Depth
A_b - Bottom Surface Area, WSP Base
h_{out} - Depth of pond above ground from lowest outside toe to top of crest
$V_{ab\text{-}gnd}$ - Volume stored above ground
SS - Internal Sideslope of the WSP
L_1 and L_2 are Top of Pond dimensions as shown
W_1 and W_2 are Top of Pond dimensions as shown

Data Input Field

Definitions	Inputs		
ft. = Feet	$L_{side\ 1}$ =	100	ft.
s.f. = Square Feet	$L_{side\ 2}$ =	90	ft.
c.f. = Cubic Feet	$W_{side\ 1}$ =	50	ft.
a.f. = Acre-Feet	$W_{side\ 2}$ =	50	ft.
n.g. = Results are No Good	h =	9	ft.
	SS =	3	
	h_{out} =	4	

Outputs

Intermediate Computations		Estimated WSP Volume		
A_t =	4,750 s.f.	$V = h/6\,(A_t + 4M + A_b)$		
M =	1,564 s.f.			
A_b =	n.g. s.f.	V_{total} =	n.g.	c.f.
$M_{ab\text{-}gnd}$ =	3,154 s.f.	V_{total} =	n.g.	a.f.
$A_{b\ ab\text{-}gnd}$ =	1,846 s.f.	and		
		$V_{ab\text{-}gnd}$ =	12,808	c.f.
		$V_{ab\text{-}gnd}$ =	0.3	a.f.

Output field displays "n.g." when the pond bottom length or width is <0 ft.