APPENDIX B

Provisional Criteria

APPENDIX B: PROVISIONAL CRITERIA

Introduction

Provisional criteria are those that have not been used, do not have a database to support their use, or are in the process of being developed, peer reviewed, and finalized. In some cases, provisional criteria are developed anticipating a future need, but no appropriate data are available. More information on criteria development is found in Chapter 3. Provisional criteria are not placed in a group (Appendix A) until they are finalized.

Criteria

D_V Criterion: Severity of Ozone Pollution	
Project Location	Score
moderate	1
serious	3
severe	5

Databases:
www.epa.gov/oar/oaqps/greenbk

References:
CFR Part 81 Clean Air Act. Http://www.epa.gov/airs/nonattn.html

References:

Definitions, Assumptions, Limitations, Uncertainties:

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┌──────────────────────────────────────────────────────────────────────┐
│              D_V Criterion: Employment [1] (% unemployed)              │
│                                                                        │
│   % unemployed                                    Score                │
│   ─────────────────────────────────────────────────────               │
│   ≤ State average                                   1                  │
│   State average-1.33 x State avg                    2                  │
│   1.34 x State avg-1.66 x State avg                 3                  │
│   1.67 x State avg- 2 x State avg                   4                  │
│   > 2 x the State avg                               5                  │
│                                                                        │
│   [1] Employment is measured by the percent of resident in an area    │
│   which are unemployed compared to the state average.                  │
│                                                                        │
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Databases:
Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:
U.S. EPA. 1995. Computer Assisted Environmental Justice Index Methodology. Office of Planning and Analysis, Enforcement Division, Region 6 EPA, Dallas, TX.[unpublished]

U.S. EPA. 1994. Executive Order 12898: "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations". 59 Federal Register Notice 7629 (1994).

U.S. EPA, Region 6, March 2000. Environmental Education Targeting Study: Border Report, Analysis of Counties Within the US/Mexico 100 Km Border Buffer, Gerald Carney, Office of Planning and Coordination, Dallas, TX 75202. [unpublished]

Definitions, Assumptions, Limitations, Uncertainties:
1.   Demographic data will be 2000 SF3 Census coverage. Data will change to year 2000 data the summer of 2001.
2.   The definition of "unemployed" is for persons 16 years old and older in a specific study area without jobs.
3.   The "Employment" analysis is a comparison to the state average and can be calculated for many different areas (block groups, tracts, counties, of radii around a point location). Region 6 EPA enforcement, education and health risk targeting demographic evaluations (i.e., age, income, ethnicity, education) are often for 0.56 and 4 mile radii.
4.   Employment in a study area is related to economic status. It is assumed that a high rate of unemployment is an indication of a depressed economic area and therefore a risk for environmental stress (environmental justice concerns).
5.   It is assumed that there are different social-economic factors specific to each Region 6 state which justifies using state averages for comparisons. Factors include: availability of

insurance and health care benefits for residents, education opportunities, public transportation systems, infrastructure stress related to language differences, state income tax, ethnic differences, employment rate, stability of industrial - business base, housing and utility costs, use of land, presence of rural and urban areas, availability of natural resources.

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┌─────────────────────────────────────────┐
│        Dᵥ Criterion: Age of Homes [1]     │
│                                           │
│   Year Home built               Score     │
│   1980-1999                       1        │
│   1970-1979                       2        │
│   1960-1969                       3        │
│   1950-1959                       4        │
│   1949 and earlier                5        │
│                                           │
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Databases:
Census 2000 Summary File 3 – (AR, LA, NM, OK, TX) / prepared by the U.S. Census Bureau, 2002.

References:
U.S. EPA. 1997. Lead-Based Paint Geographical Information System (June 23,1997 Draft). Region 6 EPA, Dallas, TX, Anna Treines, Compliance and Enforcement Division.[unpublished]

Definitions, Assumptions, Limitations, Uncertainties:
1. The housing age criteria is derived from a calculation of the Census block group percentage of older homes.
2. The age of homes score is calculated by multiplying a weighted factor for each age range by the percentage of homes in that range, then summing the range scores to arrive at a single score of 1 through 5. [{(% of homes built between 1980-1999) / 100} * 1] + [{(% 1970-79) / 100} * 2] + [{(% 1960-69) / 100} * 3] + [{(% 1950-59) / 100} * 4] +[{(% 1949 and earlier) / 100} * 5].
3. A cumulative ranking of all decades is given a weighted 1 to 5 ranking for all housing in a block group.
4. It is assumed that older homes are more likely to have a higher concentration of lead in paint and are more likely to have paint in deteriorated condition
5. The criteria is used in EPA Region 6 Lead-Based Paint Program for outreach to the home sales industry (The Real Estate Notification and Disclosure Rule, section 1018 of Title X). Data used in conjunction with income, age (children), and demographics.

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+-------------------------------------------------+
|   D_I Criterion: RCRA Permitted Units [1]       |
|                 at Facility                     |
|                                                 |
|   # permitted RCRA waste units      Score       |
|   0                                   1         |
|   1 or 2                              2         |
|   3                                   3         |
|   4                                   4         |
|   > 4                                 5         |
|                                                 |
|   [1] Waste disposal or storage process         |
|   requiring an EPA permit to operate.           |
+-------------------------------------------------+
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Databases:
RCRIS, Resource Conservation and Recovery Act of 1976, as amended.

References:

Definitions, Assumptions, Limitations, Uncertainties:
1.   Information self reported by regulated facility.
2.   Only units directly affecting groundwater are included.
3.   Units include waste piles, landfills, land application and surface impoundments.
4.   All units are assumed to be operating.
5.   Waste stored for greater than 90 days.
6.   The greater the number of permitted units, the greater the potential for environmental impacts.

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<table>
<tr><td colspan="2">D_I Criterion: RCRA Hazardous Waste Disposal</td></tr>
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lbs of waste/day	Score
0 - 100	1
101 - 1,000	3
>1,000	5

Databases:
RCRIS, Resource Conservation and Recovery Act of 1976, as amended.

References:

Definitions, Assumptions, Limitations, Uncertainties:
1.   Information supplied by facility. All waste is considered equally hazardous whether waste is listed or meets constituent definition.
2.   The criterion numbers represent an average calculated annually by the facility.
3.   This criterion does not take into account toxicity.
4.   Disposal actions include the use of landfills, land application, surface impoundments, injection wells, and ocean dumping.
5.   Waste is assumed to be properly and adequately disposed of in an permitted location.
6.   The greater the amount of waste disposed, the greater the chance for potential environmental impact.
7.   Hazardous waste definitions, including disposal regulations are as defined in RCRA.

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│        D_I Criterion: Water Design Flow Data  │
│                                               │
│   NPDES Design Flow data (gal/day)    Score   │
│   ≤ 1,000,000                           1     │
│   1,000,001-2,500,000                   2     │
│   2,500,001- 5,000,000                  3     │
│   5,000,001-10,000,000                  4     │
│   >10,000,000                           5     │
│                                               │
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References:
U.S. EPA, 1999. SNC Tracker, URL:http//intranet.epa.gov/oeca/oc/eptdd/teb/sncgloss.html.
Washington, D.C. 20460, from PCS (Permit Compliance System)

Definitions, Assumptions, Limitations, Uncertainties:
1.   NPDES (National Pollutant Discharge Elimination System) CWA permits
2.   Design flow from an NPDES facility is the permitted waste stream effluent for the site.
3.   It is assumed that if the design flow amount is relatively high, there is more potential for environmental harm.
4.   Receiving stream flow capacities are not directly considered in the criteria. Stream flow is a separate watershed vulnerability criteria.   Design Flow and Stream Flow criteria may be used together to assess stream loading.
5.   Specifics concerning the waste being released are not considered.

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┌─────────────────────────────────────┐
│         D_I Criterion: Density of     │
│       National Historical Places      │
│                                       │
│   Number within 4 mi          Score   │
│   ≤ 2                            1     │
│   3                             2     │
│   4                             3     │
│   5                             4     │
│   > 5                           5     │
│                                       │
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Databases:
National Register of Historical Sites

References:

Definitions, Assumptions, Limitations, Uncertainties:
1. The more National Historic Places in a watershed subunit, the greater the potential for negative impacts.
2. Four mile radius is used to be comparable with other Region 6 risk index analyses (e.g. Human Health Risk Index, Environmental Justice Index).
3. The majority of National Historical Places are assumed to be in the same watershed, but there is the possibility that managed lands can be in different HUCs.
4. The number of five managed lands in a five mile radius was chosen by considering the size of the facilities (0.25-1 mi. sq.), desirable distance between the projects (2 miles), typical size of the 11 digit HUC, and the impacts of the managed lands on the watershed.

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<table>
<tr><th colspan="2">D_I Criterion: Proximity of National Historical Places</th></tr>
</table>

Number within 2mi radius	Score
> 2	1
1.5-2	2
1-1.5	3
0.5-1	4
< 0.5	5

Databases:
National Register of Historical Sites

References:

Definitions, Assumptions, Limitations, Uncertainties:
1.   The closer the proximity of historic sites, the greater the potential for negative environmental impact to the watershed subunit.
2.   The majority of historic sites are assumed to be in the same watershed, but there is the possibility that managed lands can be in different HUCs.

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D_I Criterion: Proximity of National Historical Places	

Number within 2mi radius	Score
> 2	1
1.5-2	2
1-1.5	3
0.5-1	4
< 0.5	5

Databases:
National Register of Historical Sites

References:

Definitions, Assumptions, Limitations, Uncertainties:
1.   The closer the proximity of historic sites, the greater the potential for negative environmental impact to the watershed subunit.
2.   The majority of historic sites are assumed to be in the same watershed, but there is the possibility that managed lands can be in different HUCs.

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D$_I$ Criterion: **Environmental Assessment**

	Score
Independent assessment/s performed	1
Self assessment/s performed	3
No Environmental assessment/s performed	5

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Databases
FEDPLAN: (PGMT) Environmental Program Management Costs

References:

Definitions, Assumptions, Limitations, Uncertainties:
1.   An environmental assessment is a review or audit of the organizations environmental system which may include current compliance status with applicable environmental laws.
2.   An independent assessment is an environmental assessment conducted by personnel independent of the area/s being assessed.
3.   A self assessment is an environmental assessment conducted by personnel which are affiliated with the area/s being assessed.
4.   The result of any self or independent environmental assessments benefits the facility by establishing baseline conditions and/or results in corrective actions. Environmental assessments does not include those conducted under the National Environmental Policy Act (NEPA) for proposed Federal actions. Time frame for consideration is limited to the last five years.
5.   The degree of benefit is not measured by this indicator. The impacted media are unknown without further analyses.
6.   Corrective action follow-through is an uncertainty.

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D$_I$ Criterion: **Pollution Prevention**

Activity (within last 2 years)	Score
Pollution Prevention Plan and > 4 of the listed activities	1
Pollution Prevention Plan + 4 of the listed activities	2
Pollution Prevention Plan + 3 of the listed activities	3
Pollution Prevention Plan only	4
No Pollution Prevention activities	5

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Databases:
Data from facility.

References:

Definitions, Assumptions, Limitations, Uncertainties:
1. Acceptable Pollution Prevention activities include: establishing a Pollution Prevention Plan, source reduction, waste treatment, recycling, training of personnel or partnership with other entities for pollution prevention activities, and recognition or award for pollution prevention activities.
2. Pollution Prevention is any practice that (1) reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and (2) reduces the hazardous to public health and the environment associated with the release of such substances, pollutants, or contaminants.
3. Recycling is defined as a series of activities by which materials that are no longer useful to the generator are collected, sorted, processed, and converted into raw materials and used in the production of new products.
4. Treatment is defines as any method, technique, or process designated to change the physical, or biological character or composition of any hazardous waste so as to neutralize such waste, or to render non-hazardous.

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│                                               │
│  D_I Criterion: Model Energy Code (MEC)       │
│                                               │
│  % over MEC Guidelines            Score       │
│  >25%                               1         │
│   21-25%                            2         │
│   11-20%                            3         │
│    5-10%                            4         │
│  < 5%                               5         │
│                                               │
│                                               │
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Databases:
Information from facility.

References:
E.O. 12843 Procurement Requirements and Policies for Federal Agencies for Ozone-Depleting Substances (April 23, 1993)

E.O. 12844 Federal Use of Alternative Fueled Vehicles (April 21,1993)

E.O. 12845 Requiring Agencies to Pursue Energy-Efficient Computer Equipment (April 21, 1993)

E.O. 12873 Federal Acquisition, Recycling and Waste Prevention (October 20,1993)

E.O. 12902 Energy Efficiency and Water Conversation at Federal Facilities (March 8, 1994)

Energy Policy Act of 1992

Climate Change Action Plan (CCAP)

Definitions, Assumptions, Limitations, Uncertainties:
1.   The use of energy efficient practices in the construction of buildings are to follow Model Energy Code for both Residential and Commercial buildings in all Federal facilities. In following these guidelines software is used as an easy check for compliance. The Model Energy Code includes new construction as well as renovation.
2.   Many levels of Energy efficiency are possible. For instance the use of 12 SEER HVAC systems, tinted and spectrally select low emissivity glazing for glass, attic ventilation to reduce heat build-up, perimeter of slab foundation insulation, use of   high R sheathing, use of radiant barriers on sidewalls and in attic, placement of duct and mechanical equipment of conditioned space. All of these will improve energy efficiency of a

structure.
3. The ultimate goal is a 70 percent reduction in energy consumption to receive the highest rating.
4. Energy Policy Act of 1992 (EPAct) authorizes DOE, Department of Commerce and US EPA and other Federal agencies to work in tandem to reduce the energy consumption of appliances, set standards of efficiency, promote new technologies and reduce pollution through increased efficiency. The EPAct provides for mandatory standards as well as voluntary development and adoption of housing standards, commercial building code standards and labeling of a select group of consumer products.
5. E.O 12843 directs federal agencies and facilities to change procurement policies to reduce the use of ozone depleting substances earlier than Montreal Protocol phase-out schedules. A reduction of ozone depleting includes less use of a substance such as R-22 and elimination of CFC-11 and 12.
6. E.O. 12844 places the federal government in a leadership role in the demand for and use of alternative fueled vehicles.
7. E.O. 12845 encourage market transformation through increased purchase of energy-efficient computer products that save money and reduce pollution.
8. E.O. 12873 directs executive agencies to increase the purchase of 1) products containing recovered materials and 2)environmentally preferable products. The order also encourages agencies to intensify their recycling and waste prevention activities.
9. E.O. 12902 encourages increased use of energy and water saving-saving products in federal facilities. Purchasing of products in the top of the market for energy and water efficiency leads to large savings on annual utility bills.
10. Climate Change Action Plan (CCAP) promotes voluntary partnerships to reduce and prevent pollution through cost effective practices that conserve energy and waste. Federal facilities are asked to implement energy efficiency practices and waste reduction practices by taking advantage of energy saving practices such as 1) the use of energy efficient construction practices and technologies, 2) energy efficient office equipment, 3) energy efficient appliances, 4) recycling of glass, aluminum, steel, office paper, and newspaper, 5) reuse of landscape (yard) wastes.
11. Percent over MEC guidelines values will be rounded to the nearest integer.

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$\boxed{\begin{array}{l} \textbf{D}_\textbf{I} \textbf{ Criterion}\text{: } \textbf{Energy Efficient} \\ \qquad\qquad \textbf{Office Equipment} \\[1em] \underline{\text{\% Facility Upgrade}} \qquad \underline{\text{Score }} \\ \text{>40\%} \qquad\qquad\qquad\quad 1 \\ \ \text{31-40\%} \qquad\qquad\qquad 2 \\ \ \text{21-30\%} \qquad\qquad\qquad 3 \\ \ \text{11-20\%} \qquad\qquad\qquad 4 \\ \underline{<}\ \text{10\%} \qquad\qquad\qquad\quad 5 \end{array}}$

Databases:
Information from facility.

References:
See D_I Criterion Model Energy Code(MEC).

Definitions, Assumptions, Limitations, Uncertainties:
1.   This criterion measures the percentage of your facility that has upgraded to energy efficient office equipment, operating as it was intended.
2.   Energy Efficient Office Equipment includes Copy Machines, Facsimile Machines, Computers, Computer Monitors, Scanners, Printers.
3.   Percent facility upgrade values will be rounded to the nearest integer.

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┌─────────────────────────────────────────────┐
│         D_I Criterion: Energy Efficient (EE)  │
│                  Appliances                    │
│                                                │
│  % improvement on the EE scale    Score       │
│  > 80%                              1          │
│  61-80%                             2          │
│  41-60%                             3          │
│  21-40%                             4          │
│  ≤ 20%                              5          │
│                                                │
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Databases:
Information from facility.

References:
See D_I Criterion Model Energy Code(MEC).

Definitions, Assumptions, Limitations, Uncertainties:
1.   Residential and commercial appliances include Refrigerators, Dishwashers, Washing Machines, and Room Air-conditioners.
2.   In replacing these appliances life cycle issues should be taken into consideration. As an example, a cheaper price tag on a room air conditioner that may cost $400 may end up costing in excess of $2000 to operate over a ten year period. Similarly a $600 room air conditioner with similar cooling capacity will consume $1200 over a ten period.
3.   Different appliances have different efficiency ratings.
4.   The benchmark can be found on Federal Trade Commission Energy Guide placed on every appliance by federal law. They are a guidepost (not necessarily actual) measure of its energy efficiency.
5.   Percent improvement on EE scale values will be rounded to the nearest integer.

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<table>
<tr><th colspan="2">D_I Criterion: Lighting System Upgrade</th></tr>
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D_I Criterion: **Lighting System Upgrade**	
% reduction in energy usage	Score
>25%	1
21-25%	2
16-20%	3
11-15%	4
$\leq 10\%$	5

Databases:
Information from facility.

References:
See D_I Criterion Model Energy Code(MEC).

Definitions, Assumptions, Limitations, Uncertainties:
1. Since the passage of EPAct, energy efficiency is being standardized on all appliances, consumer electronics, lighting products and mechanical systems.
2. Energy Star Buildings and Green Lights Program participants have demonstrated a reduction of 45 percent after renovating to Green Lights standards.
3. Percent reduction in energy usage values will be rounded to the nearest integer.

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D_I Criterion: Million Solar Roofs Initiative	
No. of solar products used	Score
≥ 5	1
4	2
2-3	3
1	4
0	5

Databases:
Information from facility.

References:
See D_I Criterion Model Energy Code(MEC).

Definitions, Assumptions, Limitations, Uncertainties:
1. Solar technologies include: solar hot water heaters, photovoltaic landscape lighting, photovoltaic street lighting, remote water pumping, and photovoltaic panels for power generation.
2. Solar Thermal Energy is a simple way to preheat air for boilers and furnace air-intakes and water for residential and commercial use. It is possible to achieve significant reductions in energy consumption for hot water.
3. Solar energy is a free source that has shown that it can routinely provide 70 percent of domestic and commercial hot water.
4. The design of solar thermal hot water systems are now built and tested in accordance with strict federal and industry standards. Recognizing this advance in ability to perform in both Canada as well as desert environments of the southwest.
5. Solar Photovoltaic Energy has seen tremendous reduction in price over the last ten years. Commercial sales of units as low as $4.50 per watt are now available. This makes photovoltaic installations economical for remote water pumping, street lighting, remote locations and new construction in areas where line extensions, excavation or other costs are high.
6. Solar photovoltaic energy can be store on batteries or distributed across the power grid to others. Solar photovoltaic technology is now capable of substantially offsetting the peak demand of energy thus providing greater cost saving in the commercial sector where peak demand charges during daylight hours are high.
7. Number of solar products used values will be rounded to the nearest integer.

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D$_I$ Criterion: Federal Energy Management Program	
% reduction from baseline	Score
>12%	1
10-12%	2
7- 9%	3
4- 6%	4
$\leq$ 3%	5

Databases:
Information from facility.

References:
See D$_I$ Criterion Model Energy Code(MEC).

Definitions, Assumptions, Limitations, Uncertainties:
1.   The Federal Energy Management Program (FEMP) is an Executive order which outlines the reduction of energy consumption by federal facilities by 30 percent in 2005 from 1985 levels, and 20 percent for industrial federal facilities by 2005 using 1990 as the baseline year.
2.   Percent reduction from baseline values will be rounded to the nearest integer.

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D_I Criterion: Proximity of Managed Lands	
Number within 2mi radius	Score
> 2	1
1.5-2	2
1-1.5	3
0.5-1	4
< 0.5	5

Databases:

References:

Definitions, Assumptions, Limitations, Uncertainties:
1. Managed lands include National Park Service Lands, National Forest Service Lands, U.S. Fish & Wildlife Service Lands, State Parks and Wildlife Areas, City Parks, County Parks, and other lands used for conservation/recreation. Managed lands also may include other large properties owned/managed by the Federal Government such as Military Bases, BLM Lands, and DOE Lands. Section 4f.....
2. The closer the proximity of managed lands, the greater the potential for negative environmental impact to the watershed subunit.
3. The majority of managed lands are assumed to be in the same watershed, but there is the possibility that managed lands can be in different HUCs.

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│                                                   │
│  D_I Criteria: Unregulated[1] CAFO[2] Facilities │
│                                                   │
│  % Unregulated CAFOs in HUC[3]      Score        │
│  < 20                                 1           │
│  20-29                                2           │
│  30-39                                3           │
│  40-50                                4           │
│  > 50                                 5           │
│                                                   │
│  [1] facilities not operating under EPA NPDES     │
│  General Permit (40 CFR 122.23[b]).               │
│  [2] Concentrated Animal Feeding Operations       │
│  [3] Hydrologic Unit Catalog (watershed subunit)  │
│                                                   │
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Databases:
None available

References:
U.S. EPA. 1992. A Synoptic Approach to Cumulative Impact Assessment: A Proposed
Methodology. Office of Research and Development, EPA/600/R-92/167, Washington, D.C.

U.S. EPA. Code of Federal Regulations. (40 CFR 122.23[b]

Definitions, Assumptions, Limitations, Uncertainties:
1.   Regulated concentrated Animal Feeding Operations (CAFOs) are lots or facilities where
      animals have been, are, or will be stabled or confined and fed or maintained for a total of
      at least 45 days in any 12-month period, and the animal confinement areas do not sustain
      crops, vegetation, forage growth, or post-harvest residues in the normal growing season
      (40 CFR 122.23[b]).
2.   The greater the percentage of unregulated CAFOs in a HUC, the greater the potential for
      negative environmental impacts.

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┌─────────────────────────────────────────────────────┐
│              D_V criteria: Presence of Aquifer        │
│                                                       │
│   Aquifer presence[1]                     Score       │
│   No aquifer present at site                1         │
│   Confined aquifer present at site          3         │
│   Unconfined aquifer present at site        5         │
│                                                       │
│   [1] Aquifer or recharge area by data set overlay    │
│       in GIS.                                         │
│                                                       │
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Databases:
US Geological Survey Digital Data Series DDS-11. Geology of the coterminous United States at 1:2,500,000 scale- a digital representation of King, P. B., and H. M. Beikman map 1974.

US Geological Survey, 1994. Hydrologic unit maps of the coterminous United States.

References:
US EPA, 2000. U.S. Environmental Protection Agency Designation of Sole Source Aquifers, Fact Sheet, http://www.epa.gov/earth1r6/ 6wq/swp/ssa/ssafacts.htm, Region 6 Ground Water / UIC Section.

Federal Registers: Edwards Underground Reservoir   (40 FR 58344,12/16/75), Chicot Aquifer System (53 FR 20893, 06/07/88), Austin-Area Edwards Aquifer (53 FR 20897, 06/07/88), Southern Hills Aquifer System (53 FR 25538, 07/07/88), Arbuckle-Simpson Aquifer (54 FR 39230, 09/25/89).

Definitions, Assumptions, Limitations, Uncertainties:
1.   Local aquifers might not be shown on generalized databases

2.   Assumes that contaminants will enter aquifer through leakage or seepage from the surface environment

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D_V Criterion: Landscape Texture	
ASM	Score
< 0.20	1
0.20-0.29	2
0.30-0.39	3
0.40-0.49	4
≥ 0.50	5

Databases:
U.S. Geological Survey. 2000 National Land Cover Database. Compiled from Landsat satellite TM imagery (circa 1992) with a spatial resolution of 30 meters.

References:
Mladenoff, D. J. and B. DeZonia. 2001. *APACK 2.22 Analytical Software*. User's Guide.

Musick and Grover. 1991. Image textural measures as indices of landscape pattern. IN Turner and Gardner (eds) Quantitative Methods in Landscape Ecology. Springer-Verlag. New York, New York.

Definitions, Assumptions, Limitations, Uncertainties:
1. Landscape texture is measured by the metric Angular second moment (ASM), calculated using the APACK software.
2. The formula for ASM is $ASM = \sum_{i=1}^{\text{Total classes}} \sum_{j=1}^{\text{Total classes}} t(i,j)^2$

3. Angular second moment is a measure of image texture and habitat fragmentation.
4. Angular second moment has a range of 0 to 1. A zero equals a landscape with many cover types and little clumping. Unity equals a landscape with a single cover type and maximum clumping of a cover type.
5. Maximum clumping likely has more core habitat for interior species. A high degree of edge habitat may be indicative of more opportunistic, "weedy" species.
6. Wildlife habitats include flood plains, wetlands, bottomland hardwoods, rangelands, upland forests and grasslands.
7. Landscape texture (ASM) should be used with the other descriptive aspects of APACK in order to adequately characterize the landscape.
8. APACK is a program that calculates statistics of interest to landscape ecologists from raster data. It calculates many metrics useful in determining landscape pattern and structure and calculates these metrics faster and upon larger data sets than other packages (e.g., FRAGSTATS).

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│      D_V Criterion: Landscape Aggregation │
│                                           │
│   AI                          Score       │
│   ≥ 0.50                        1         │
│   0.49-0.40                     2         │
│   0.39-0.30                     3         │
│   0.29-0.20                     4         │
│   < 0.20                        5         │
│                                           │
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Databases:

U.S. Geological Survey. 2000 National Land Cover Database. Compiled from Landsat satellite TM imagery (circa 1992) with a spatial resolution of 30 meters.

References:

Mladenoff, D. J. and B. DeZonia. 2001. *APACK 2.22 Analytical Software*. User's Guide.

He, H. S., B. E. DeZonia, and D. J. Mladenoff. 2000. An aggregation index (AI) to quantify spatial patterns of landscapes. Landscape Ecology 15:591-601

Definitions, Assumptions, Limitations, Uncertainties:

1. Aggregation index reports the degree to which patches of certain land cover classes (selected by the user for a particular project) are clumped or dispersed.
2. Aggregation index can be reported for the landscape as a whole or for each land cover class of interest.
3. The formula for AI is $AI = \frac{\text{Total adjacent edges of class i with itself}}{\text{Maximum adjacent edges of class i with itself}}$
4. The aggregation index   has a range of 0 to 1. A zero equals when each patch is narrow in one direction and long in aother. Unity equals a land cover class that is completely aggregated into a single square patch.
5. Landscape aggregation is measured by the metric Aggregation Index (AI) calculated using the APACK software.
6. Wildlife habitats include flood plains, wetlands, bottomland hardwoods, rangelands, upland forests and grasslands.
7. Aggregation Index (AI) should be used with the other descriptive aspects of APACK in order to adequately characterize the landscape.
8. APACK is a program that calculates statistics of interest to landscape ecologists from raster data. It calculates many metrics useful in determining landscape pattern and structure and calculates these metrics faster and upon larger data sets than other packages (e.g., FRAGSTATS).

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D_V Criterion: Patch Area (normalized, average)	
Ratio	Score
< 0.20	1
0.21-0.30	2
0.31-0.40	3
0.41-0.50	4
> 0.50	5

Databases:
U.S. Geological Survey. 2000 National Land Cover Database. Compiled from Landsat satellite TM imagery (circa 1992) with a spatial resolution of 30 meters.

References:
Mladenoff, D. J. and B. DeZonia. 2001. *APACK 2.22 Analytical Software*. User's Guide.

Riitters, K. H., R. V. O'Neill, C. T. Hunsaker, J. D. Wickham, D. H. Yankee, S. P. Timmins, K. B. Jones, and B. L. Jackson. 1995. A factor analysis of landscape pattern and structure metrics. Landscape Ecology 1:23-39

Definitions, Assumptions, Limitations, Uncertainties:
1. Normalized average patch area is a measure of habitat fragmentation.
2. Patch area is measured by the metric normalized average patch area (AAM) calculated using the APACK software.
3. Normalized average area per patch reports the average of each patch area relative to the area of a square with the same perimeter.
4. The formula for normalized average patch area (AAN) is
$$AAN_i = \frac{\sum_{j=1}^{\substack{\text{Number of} \\ \text{patches of} \\ \text{class } i}} \frac{16 \times (\text{Area of patch } j)}{(\text{Perimeter of patch } j)^2}}{\text{Number of patches of class } i}$$

5. Normalized average area can be reported for the landscape as a whole or for each land cover class of interest.
6. Normalized average area has a range of 0 to 1. A zero equals a patch that is narrow in one direction and long in another. Unity equals a square.
7. Normalized average patch area (AAN) is calculated using the APACK software.
8. Wildlife habitats include flood plains, wetlands, bottomland hardwoods, rangelands, upland forests and grasslands.
9. Normalized average patch area should be used with the other descriptive aspects of APACK in order to adequately characterize the landscape.
10. APACK is a program that calculates statistics of interest to landscape ecologists from raster data. It calculates many metrics useful in determining landscape pattern and structure and calculates these metrics faster and upon larger data sets than other packages (e.g., FRAGSTATS).

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