The requirement to address the impact that a new source or modification will have on local vegetative and animal species can be found in 40 CFR 52.21(o). The maximum ambient concentrations emitted by a facility must be assessed in order to ensure that adverse impacts do not occur on plants, soils, and animals. Currently, the Department's Air Pollution Control Program requires applicants to submit two differing analyses based upon the following EPA documents in order to demonstrate that adverse impacts are unlikely to occur: " Air Quality Criteria for Oxides of Nitrogen, Summary of Vegetation Impacts" and "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals." Additional information on each of the analyses can be found in the following paragraphs.

"Air Quality Criteria for Oxides of Nitrogen, Summary of Vegetation Impacts"

Large emitters of oxides of nitrogen (NO_x) are required to evaluate the screening thresholds contained in the document entitled "Air Quality Criteria for Oxides of Nitrogen, Summary of Vegetation Impacts." Preliminary investigations indicate that short-term exposure to elevated NOx concentrations alone can cause damage to some sensitive plant species and crops. The guidance goes on to cite recent studies that have indicated that synergy between two or more criteria pollutants can cause vegetative damage at lower concentrations than from a higher exposure to a single pollutant.

"A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals"

The document entitled "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals" outlines the procedures and screening levels that are to be used in the air quality assessment.

The screening procedure document provides a multi-step process for estimating the impact from the new source or modification and begins by directly comparing pollutant concentrations to screening thresholds. The process also addresses annual soil deposition and the subsequent uptake of pollutants by plants and animals. Each step of the process is described in the following paragraphs.

Steps 1 & 2

Steps 1 and 2 of the screening procedures are designed to determine if the direct exposure of plant tissue to the pollutant stream will result in damage. The screening thresholds represent the minimum concentration at which adverse growth or tissue impacts have been reported in scientific studies. Although values for resistant, intermediate and sensitive species are presented, the guidance document suggests that the modeled outputs be compared to the thresholds for sensitive species since this will yield conservative results. Predicted concentrations in excess of the values would indicate that additional review might be necessary to ensure that damage will not occur due to the new source or modification. Table 1 summarizes the screening concentrations that were developed to assess direct tissue exposure.

Table 1 Screening Concentrations for Direct Tissue Exposure					
Pollutant	**Abbreviation**	**Averaging Time**	**Vegetative Sensitivity**		
			Sensitive	**Intermediate**	**Resistant**
			($\mu g/m^3$)	***($\mu g/m^3$)***	***($\mu g/m^3$)***
Sulfur Dioxide	SO_2	1-Hour	917	----	----
		3-Hour	786	2096	13100
		Annual	----	18	----
Ozone	O_3	1-Hour	392	686	1078
		4-Hour	196	294	686
		8-Hour	118	294	588
Nitrogen Dioxide	NO_2	4-Hour	3760	9400	16920
		8-Hour	3760	7520	15040
		1-Month	----	564	----
		1-Year	----	94-188	----
Carbon Monoxide	CO	1-Week	1800000	----	18000000
Hydrogen Sulfide	H_2S	4-Hour	28000-84000	----	560000
Ethylene	C_2H_4	3-4-Hour	----	47	----
		24-Hour	----	1.2	----
Fluoride	F	10 Days	----	0.5-10	----
Beryllium	Be	1-Month	----	.01	----
Lead	Pb	3-Month	----	1.5	----

It is important to note that modeling is not typically conducted to determine the ambient impact due to ozone because ozone results from a photochemical process that is difficult to replicate without extensive resources. In light of these difficulties, the EPA has established preconstruction monitoring thresholds to determine if the air quality standard for ozone is being met.

All comparisons to the screening thresholds contained within Table 1 should be based upon the concentrations obtained during the NAAQS compliance demonstration. In addition, when conducting the direct impact screening analysis, the synergy between SO_2, NO_x and ozone should be considered, refer to Table 2.

Table 2 Screening Criteria for Determining Synergy Between Pollutants		
Pollutants	**Concentrations**	**Exposure**
	($\mu g/m^3$)	
SO_2	130.5	1-Hour
NO_2	94.0	1-Hour
SO_2	783.0	1-Hour
O_3	196.0	1-Hour
SO_2	130.5	4-Hour
O_3	98.0	4-Hour
SO_2	365.4	6 Hours/Day for 28 Days
O_3	98.0	6 Hours/Day for 28 Days
NO_2	188.0	6 Hours/Day for 28 Days

Although the applicant is required to consider synergies, the guidance document states that the screening levels should not be applied for compliance purposes because the chemical reactions between pollutants are complex and may act to help tissue growth under certain conditions; as such, a direct screen for synergy has not been recommended to date.

Step 3

Steps 3 and 4 in the seven step screening process address the impact air pollution has on plants and animals once the material is deposited in the soil and becomes available for uptake by plants. This screen assumes that all of the deposited material is soluble and available for uptake. For each trace element emitted by the proposed new source or modification, the concentration in the soil should calculated from the maximum annual average concentration predicted by the dispersion model multiplied by the maximum lifetime of the facility and the depth of the soil through which the material is deposited, refer to Table 3. Applicants can use the default lifetime and soil depth recommended in the guidance document of 40 years and three centimeters.

Table 3 Calculation of Deposited Soil Concentration						
Pollutant	**Maximum Annual Concentration (X)**	**Facility Lifetime (N)**	**Soil Depth (d)**	**Constant (C)**	**Deposition Concentration (DC)**	**Screening Concentration**
	($\mu g/m^3$)	***(Years)***	***(CM)***		***PPMw***	***PPMw***
Arsenic	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	3.0
Boron	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	0.5
Cadmium	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	2.5
Chromium	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	8.4
Cobalt	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	----
Copper	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	40.0
Fluoride	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	400.0
Lead	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	1000.0
Manganese	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	2.5
Mercury	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	455.0
Nickel	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	500.0
Selenium	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	13.0
Vanadium	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	2.5
Zinc	Based Upon Model Output	40	3	21.5	DC = C* (N/d)*X	----

The calculated soil deposition concentrations will be compared to the appropriate screening thresholds in Step 6 below.

Step 4

Current literature indicates that an increase in certain trace elements over the endogenous soil concentration may be cause for concern if the increase is greater than 10% over the lifetime of the facility, refer to Table 4.

Table 4 % Increase of Trace Elements Above the Endogenous Soil Concentration				
Pollutant	**Deposition Concentration (DC)**	**Constant (C)**	**Endogenous Soil Concentration (ESC)**	**% Increase**
	PPMw		***PPMw***	
Arsenic	Obtain from Table 3	100.0	6.0	% Increase = (DC * C) / ESC
Beryllium	Obtain from Table 3	100.0	6.0	% Increase = (DC * C) / ESC
Boron	Obtain from Table 3	100.0	10.0	% Increase = (DC * C) / ESC
Cadmium	Obtain from Table 3	100.0	0.06	% Increase = (DC * C) / ESC
Chromium	Obtain from Table 3	100.0	100.0	% Increase = (DC * C) / ESC
Cobalt	Obtain from Table 3	100.0	8.0	% Increase = (DC * C) / ESC
Copper	Obtain from Table 3	100.0	20.0	% Increase = (DC * C) / ESC
Fluoride	Obtain from Table 3	100.0	200.0	% Increase = (DC * C) / ESC

Pollutant	Deposition Concentration (DC)	Constant (C)	Endogenous Soil Concentration (ESC)	% Increase
	PPMw		***PPMw***	
Lead	Obtain from Table 3	100.0	10.0	% Increase = (DC * C) / ESC
Manganese	Obtain from Table 3	100.0	850.0	% Increase = (DC * C) / ESC
Mercury	Obtain from Table 3	100.0	1.0	% Increase = (DC * C) / ESC
Nickel	Obtain from Table 3	100.0	40.0	% Increase = (DC * C) / ESC
Selenium	Obtain from Table 3	100.0	0.5	% Increase = (DC * C) / ESC
Vanadium	Obtain from Table 3	100.0	100.0	% Increase = (DC * C) / ESC
Zinc	Obtain from Table 3	100.0	50.0	% Increase = (DC * C) / ESC

The results obtained from the calculation of the increase over the endogenous soil concentration strictly serves as a flag for concern and no action is taken if the increase is greater than 10%.

Step 5

After the deposition concentration in the soil has been calculated, the amount of trace element ingested by plants can be calculated through the application of the plant to soil concentration ratios, refer to Table 5.

Table 5
Plant to Soil Concentration Ratios

Pollutant	Maximum Annual Concentration (X)	Facility Lifetime (N)	Soil Depth (d)	Constant (C)	Deposition Concentration (DC)	Screening Concentration	Plant:Soil Ratio (CR)	Tissue Concentration (TC)
	($\mu g/m^3$)	***(Years)***	***(CM)***		***PPMw***	***PPMw***		***PPMw***
Arsenic	Based Upon Model Output	40	3	21.5	Obtain from Table 3	3.0	1.4E-01	TC = DC * CR
Boron	Based Upon Model Output	40	3	21.5	Obtain from Table 3	0.5	5.30E+00	TC = DC * CR
Cadmium	Based Upon Model Output	40	3	21.5	Obtain from Table 3	2.5	1.07E+01	TC = DC * CR
Chromium	Based Upon Model Output	40	3	21.5	Obtain from Table 3	8.4	2.00E-02	TC = DC * CR
Cobalt	Based Upon Model Output	40	3	21.5	Obtain from Table 3	----	1.10E-01	TC = DC * CR
Copper	Based Upon Model Output	40	3	21.5	Obtain from Table 3	40.0	4.70E-01	TC = DC * CR
Fluoride	Based Upon Model Output	40	3	21.5	Obtain from Table 3	400.0	3.00E-02	TC = DC * CR
Lead	Based Upon Model Output	40	3	21.5	Obtain from Table 3	1000.0	4.50E-01	TC = DC * CR
Manganese	Based Upon Model Output	40	3	21.5	Obtain from Table 3	2.5	6.60E-02	TC = DC * CR
Mercury	Based Upon Model Output	40	3	21.5	Obtain from Table 3	455.0	2.00E-02	TC = DC * CR
Nickel	Based Upon Model Output	40	3	21.5	Obtain from Table 3	500.0	4.50E-02	TC = DC * CR
Selenium	Based Upon Model Output	40	3	21.5	Obtain from Table 3	13.0	1.00E+00	TC = DC * CR
Vanadium	Based Upon Model Output	40	3	21.5	Obtain from Table 3	2.5	1.00E-02	TC = DC * CR
Zinc	Based Upon Model Output	40	3	21.5	Obtain from Table 3	----	6.40E-01	TC = DC * CR

This analysis will be used in Step 6 to determine if all applicable thresholds are being met.

Step 6

The application of Step 6 requires the applicant to apply a direct comparison between the following impacts and screening levels:

1. Deposited concentration versus the soil screening level,
2. Tissue concentration versus the tissue screening level, and
3. Tissue concentration versus the dietary screening level for animals.

The concentrations predicted in Step 3 and Step 5 are compared to the screening concentrations in Tables 3.4 and 3.7 in the screening document. The first table compares predicted impacts to the screening concentrations for exposure of vegetation to concentrations in the soil and plant tissues. The second table is used to evaluate the impact trace elements have on the dietary systems of animals and when dietary concentrations become toxic, refer to Table 6.

Table 6
Trace Element Adverse Impact Screen

Pollutant	Deposition Concentration (DC)	Soil Screening Level	Tissue Concentration (TC)	Dietary Screening Level	Tissue Screening Level
	PPMw	*PPMw*	*PPMw*	*PPMw*	*PPMw*
Arsenic	Obtain from Table 3	3.0	Obtain from Table 5	3.0	0.25
Boron	Obtain from Table 3	0.5	Obtain from Table 5	----	11.0
Cadmium	Obtain from Table 3	2.5	Obtain from Table 5	15.0	3.0
Chromium	Obtain from Table 3	8.4	Obtain from Table 5	----	1.0
Cobalt	Obtain from Table 3	----	Obtain from Table 5	1.0-3.0	19.0
Copper	Obtain from Table 3	40.0	Obtain from Table 5	20.0-30.0	0.73
Fluoride	Obtain from Table 3	400.0	Obtain from Table 5	100.0-300.0	310.0
Lead	Obtain from Table 3	1000.0	Obtain from Table 5	80.0-150.0	126.0
Manganese	Obtain from Table 3	2.5	Obtain from Table 5	500.0-5000.0	400.0
Mercury	Obtain from Table 3	455.0	Obtain from Table 5	----	----
Nickel	Obtain from Table 3	500.0	Obtain from Table 5	1000.0	60.0
Selenium	Obtain from Table 3	13.0	Obtain from Table 5	5.0-30.0	100.0
Vanadium	Obtain from Table 3	2.5	Obtain from Table 5	10.0-500.0	----
Zinc	Obtain from Table 3	----	Obtain from Table 5	500.0-1000.0	300.0

If the trace elements are below the dietary and tissue screening thresholds outlined in the guidance document, it is unlikely that adverse impacts will take place and no further analysis is necessary. If the screening thresholds are exceeded, proceed to Step 7.

Step 7

Based upon the screening concentrations contained within Table 6, adverse impacts are likely to occur and every effort should be made to reduce the ambient impact through the installation of additional controls or the acceptance of operational limits.