2. 0 METHODS

2.1 Base Unit Selection

Technical experts from TERS agencies discussed the relative merits of using ecoregions or watersheds as the base unit for the assessment. It is generally agreed that both watersheds and ecoregions provide "essential geographic frameworks necessary to describe, diagnose, and eventually, predict landscape influences on water resources" (Harrison et al. 2000). The TERS Steering Committee concluded that ecoregions have the following distinct advantages over watersheds for ecosystem management:

> An ecoregion approach provides a comprehensive review of an area's functionality in relationship to terrestrial habitat, aquatic habitat, and the species and communities they supported. Some species and communities depend upon a single large patch or several different kinds of habitat that span more than one watershed.
>
> Texas has over 200 watersheds. A watershed-based assessment would be time and resource intensive. Therefore, using watershed-based assessment would not be expedient enough to meet the initial needs identified by the TERS executives.
>
> Large watersheds, particularly basins, do not necessarily correspond to areas that contain a similarity in the mosaic of geographic characteristics which include, physiography, soils, vegetation, geology, climate, that influence the physical, chemical or biological nature of water bodies (Omernik 1995, Omernik and

Bailey 1997). However, the quantity and quality of water tends to be similar within ecoregions (Griffith et al. 1999).

Land cover and other spatial data are readily available by ecoregion to summarize and map numerous landscape features thought to be important to water quality concerns.

Ecoregions are functional conservation areas that maintain focal species, communities, and/or systems, and support ecological processes within their natural ranges of variability (Poiani et al. 1998, Poiani and Richter 1999, Poiani et al. 2001).

TEAP used ecoregions, developed by Bailey (1985, 1987, 1994, 1996) because of extensive delineation of representative ecoregions and sub-regions within Texas and the use of plant community relationships (Bailey 1994) (Figure 1). There are eighteen ecoregions identified by Bailey in Texas. The characteristics of each are described in Appendix A. Bailey's ecoregions has broad usage by a number of agencies and organizations, including the USFS, USGS, FWS, EPA, and The Conservancy.

GIS data, particularly NLCD, used in specific calculations were summarized for each square kilometer (1km^2). Although NLCD has a 30 m^2 pixel resolution, performing calculations for a "1 km^2 grid" allowed maintenance of confidentiality of rare species occurrences, as well as reducing computer computation resources.

The NLCD classification contains twenty-one different land cover categories with a spatial resolution of 30 m. The NLCD was produced as a cooperative effort between USGS and EPA to produce a consistent, land cover data layer for the conterminous U.S. using early 1990s Landsat thematic mapper data purchased by the Multi-resolution Land Characterization (MRLC) Consortium. The MRLC Consortium is a partnership of federal agencies that produce or use land cover data. Partners include the USGS, EPA, USFS, and the National Oceanic and Atmospheric Administration (NOAA).

Several steps are used to process NLCD: 1) an automated process is used to create clusters of pixels for a given regional area, 2) these clusters are interpreted and labeled with the help of aerial photographs, 3) in cases where clusters of pixels include multiple land cover types, models that use data such as elevation or population density, are used to help assign land cover classes, and 4) lands that are bare and many grassy areas, such as parks and golf courses are not easily distinguished from other land cover classes, so on-screen verifications are used for clarification (Vogelmann et al. 1998, 2001).

The analysis and interpretation of the satellite imagery was conducted using very large, sometimes multi-state image mosaics (i.e. up to eighteen Landsat scenes). Using a relatively small number of aerial photographs for 'ground truth', the thematic interpretations were necessarily conducted from a spatially-broad perspective.

The accuracy of NLCD and satellite-derived data is related to many factors including the amount of data available, the detail of the required land cover information, classification methods, computing power, and time and money (H. John Heinz III Center for Science, Economics and the Environment 2002). Furthermore, the accuracy assessments are performed on groupings of contiguous states. Thus, the reliability of the data is greatest at the state or multi-state level. Assessments of the NLCD for the eastern U.S. indicate an accuracy of approximately 80% or higher for general land cover categories (e.g., forest, agriculture, developed) (H. John Heinz III Center for Science, Economics and the Environment 2002).

2.2 TEAP Sub-layers and Layers

Ultimately, the CrEAM (Mysz et al. 2000, White et al. 2003) was selected as a base method. Due to differences between Region 5, the Midwest U. S., and Texas, subsequent modifications were made (Table 3).

Data were provided by EPA, TPWD, TCEQ (Table 4) and The Conservancy (for the spatial accuracy assessment). Data were processed and analyzed by EPA Region 6, TPWD, and The Conservancy (spatial accuracy assessment). Several processing steps were needed to convert the data or coverages to the same scale. General descriptions of the layers and sub-layers can be found in the Introduction.

2.2.1 Diversity Layer

The overall diversity layer was calculated for each ecoregion by taking the mean of the four diversity sub-layers and rescaling on a 0-100 scale. The values of the 30 m pixels that made up each 1 km^2 grid cell were averaged to determine the Diversity Index score for each cell.

2.2.1.1 Appropriateness of Land Cover

TEAP reclassified the Potential Natural Vegetation (PNV) 2000 (Kuchler 1964) grid to the NLCD classification (Table 5). Reservoirs were also reclassified and grouped according to ecoregion because of their anthropogenic nature. The current NLCD was compared to the modified PNV 2000 data and values that were the same received a score of 10,000, representing no change from pre-settlement to modern times and those that were not the same received a score of zero, indicating disturbance due to human activities. The 0 to 10,000 values, based on thirty meter pixels, were then converted to a 0 to 250 scale and reclassified the resulting data onto an 8-bit grid. It was rescaled so that the data could be stored as 8-bit. Eight-bit data avoids computer memory and buffer overloads during processing and in no way affects the outcome, since the relative scores within the data set accurately reflect the content of the data. The final score is an average of all pixels in a 1 km^2.

Kuchler's PNV map was refined by USFS to match terrain using a 500 m Digital Elevation Model (DEM), 4th level Hydrologic Unit Codes (HUC), and Ecological Subregions (Bailey's Sections). These biophysical data layers were integrated with current vegetation layers to develop generalized successional pathway diagrams. Expert regional panels refined the PNV map based on these successional pathways. Summaries of the data were restricted to state or USFS regional scales.

2.2.1.2 Contiguous Size of Undeveloped Land

Using NLCD coverage and land cover classes, the data were classified as either developed or non-developed within each ecoregion. "Non-developed" classes are identified by the following land cover categories: 1) open water, 2) bare rock/sand/clay, 3) deciduous forest, 4) evergreen forest, 5) mixed forest, 6) shrubland, 7) grasslands/herbaceous, 8) woody wetlands, and 9) emergent herbaceous wetlands. All other classes are considered "developed."

For this measure in TEAP, adjacent undeveloped land cover types in each ecoregion are combined into one polygon, e.g., adjacent forest, wetlands, and grasslands are all one polygon. Thirty meter pixels of each land cover type were scored in each ecoregion. The size of the contiguous area in each Texas ecoregion was computed as was a linear index based on area using the following parameters: (1) contiguous areas < 10 hectares (ha) received a score of zero, indicating small areas of an undeveloped land cover type; and (2) contiguous areas > 100,000 ha, received a score of 250, indicating large areas of an undeveloped land cover type in each ecoregion. All other areas were ranked in the index by dividing the total contiguous area by 400. Rescaling was done so that the data could be stored as 8-bit data which avoids computer memory and buffer overloads during processing. Rescaling does not affect the outcome, since the relative scores within the data set accurately reflect the content of the data.

2.2.1.3 Shannon Land Cover Diversity Index

This calculation applies the Shannon-Weiner diversity index using the NLCD coverage to the relative land cover diversity within each ecoregion. The Shannon index is an established method used to measure ecological diversity (richness and evenness) (Begon et al. 1986). It usually calculates the proportion of individuals, but as used here, land cover types, related to the total number of land cover types. Other ecological diversity measures used in landscape assessment are discussed in Herzog et al. (2001). The Shannon-Wiener equation considers both richness (the quantity of different categories) and the evenness (the similarity of relative abundance).

The Shannon land cover diversity index for each ecoregion was calculated using the Analytical Tools Interface for Landscape Assessments Version 3.0 (ATtILA) (Harrison et al. 2000). Water land cover classes were removed in the GIS coverage used due to human-made reservoirs. Calculations were made by summarizing 30 m^2 pixels into a one kilometer grid. The results of the Shannon land cover diversity index calculations using ATtILA were normalized to a 1 to 250 scale so that the highest value in an ecoregion is equal to 250 and the lowest value is equal to one. The 1 to 250 scores were then used to populate the 1 km raster grid.

Reservoirs are considered "developed" due to the managed and many, characteristically "unnatural" attributes when compared to natural lakes. Differences in shoreline shape, nutrient balance, water temperature, drainage characteristics, salinity, plus the lack of or reduced seasonal flow fluctuation (though this may be simulated by controlled dam releases) contribute to lower biodiversity, and lower "ecological value" of this land cover type as compared to natural and non managed aquatic ecosystems.

2.2.1.4 Ecologically Significant Stream Segments

For this sub-layer, the initial data was reprojected from the Texas State Mapping System (TSMS) to TxAlbers map projection and attribute data was added to facilitate overlays with other coverages. The results were applied to the raster grid and all grid cells containing significant stream segments received a value of 10,000.

2.2.2 Rarity Layer

The overall rarity layer was calculated by taking the mean of the four rarity layer sub-layers and rescaling on a 0 to 100 scale. The values of the 30 m pixels that made up each 1 km^2 grid cell were averaged to determine the rarity score for each cell. Overall rarity was calculated by recoding rarity ranks using an exponential growth function 0 to 250 to produce a statewide land cover rarity data set. Data were scaled 0 to 250, due to machine processing of 8-bit data. Because the input data sets for Texas were large, rescaling the data from 1 to 250 (8-bit) allowed for much faster machine processing without any significant loss of granularity. Exponential scaling was chosen to give appropriate weight to rarer features. The statewide land cover rarity data set and the land cover rarity by ecoregion data set were input into an averaging model to compute the mean value of each grid cell for the combined data sets.

2.2.2.1 Vegetation Rarity

The land cover or vegetation rarity measure is derived from the NLCD and represents rarity of all natural (undeveloped) cover types including water and bare rock. The following cover types are represented in this data set: 1) open water, 2) bare rock/sand/clay, 3) deciduous forest, 4) evergreen forest, 5) mixed forest, 6) shrubland, 7) grasslands/herbaceous, 8) woody wetlands, and 9) emergent herbaceous wetlands. All developed (non-natural) cover types were recoded as no-data. Because some land cover types may be common at the ecoregion level but rare statewide (e.g. coastal wetlands), land cover rarity was assessed at both the ecoregional and statewide level, then combined to produce a final land cover rarity measure. This process avoids under-evaluation of many important and rare cover types. For example, wetlands are rare statewide, but may be locally common in an ecoregion. The results of the two analyses (ecoregion and state) were combined by averaging the values of the corresponding grid cells to obtain an "average score" reflecting both the ecoregional and state scales. Pixel counts were conducted for each of the ecoregions and each cover type was recoded to a rarity rank based on its frequency distribution. Land cover rarity ranks were then recoded using an exponential growth function of 0 to 250 scale. Rescaling was done so that the data could be stored as 8-bit. Eight-bit data avoids computer memory and buffer overloads during processing and in no way affects the outcome, since the relative scores within the data set accurately reflect the content of the data. A shape file containing ecoregions was overlain on the NLCD coverage and a frequency distribution of land cover type by ecoregion was tabulated. The highest number of occurrences of a land cover type was considered the most common and given a score of one. The smallest number of occurrences of a land cover type was considered the rarest, and it was given a score of 10,000. Vegetation rarity was averaged over 30 m pixels in each 1 km^2 grid cell.

2.2.2.2 Natural Heritage Rank

This measure is derived from the TPWD's Biological Conservation Database (TXBCD). TXBCD, established in 1983, is TPWD's most comprehensive source of information on rare, threatened, and endangered plants, animals, invertebrates, high quality natural communities, and other significant features. The TXBCD is continually updated, providing current or additional information on statewide status and locations of these unique elements of natural diversity. However, the data are not all-inclusive. There are gaps in coverage and species data due to the lack of access to land or data, and insufficient staff and resources to collect and process data on all rare and significant resources.

The TXBCD was developed by The Conservancy back in the early 1970's and was continually maintained and updated by The Conservancy until its central science function was established as the Association for Biodiversity Information (now NatureServe). The data set that TPWD maintains as TXBCD is operating on an expired license. The official node of the NatureServe network in Texas is the Texas Conservation Data Center (TxCDC) housed within The Conservancy. The TxCDC collaborates with and provides data to TPWD, but there is no data sharing agreement at this time. The TxCDC database (BIOTICS), is a geographically-based system that contains records on nearly 9,000 species and communities in Texas.

Natural heritage rank for TEAP is derived from TXBCD attributes of global rank, state rank, federal protection and state protection. Natural heritage rank for TEAP is an absolute rank based upon natural heritage ranking criteria; which is itself a measure of rarity. Very specific criteria are used to determine rarity both globally and statewide, which is reflected in the natural heritage ranking system.

The natural heritage rank sub-layer reflects the combination of the state and global rankings for rare species in the state. Those that have a combined G1 and S1 rank are the "most imperiled." Locations that support G1 or S1 species are by definition unique ecological areas. Any state or federal listed species gets a rank= 1. TEAP ranks of 2-10 were computed by combining the SRANK and GRANK into a single score, e.g. G1 + S2 = TEAP rank 3 etc.

Because the spatial accuracy of each TXBCD point ranged from 30m to 8km, initial attempts at producing a polygon data set reflecting the spatial and attribute accuracy of the TXBCD produced a complex series of "regions" where polygons overlapped. Each of the thousands of resulting regions had multiple values for the class attribute. Accordingly, a decision was made to compute rarity by USGS quadrangle (7.5 minute) by intersecting the

TXBCD points with the USGS quadrangle boundaries. To better reflect the spatial extent of actual TXBCD data, the resulting USGS quadrangle shapes (attributed for rarity) were then intersected with the buffers (based on the spatial accuracy attribute of each point) of the TXBCD points, thus eliminating areas of the quad sheets beyond the actual spatial limits of the buffered points

After Natural heritage rank was computed, its value was used to populate the “class” field for TXBCD point shape file. Each class was then selected iteratively and separate shape files were created for each class. A spatial select of each TXBCD class was then done by USGS quadrangle boundary using a USGS quadrangle boundary shape file. Each quadrangle was accordingly attributed with a single class attribute reflecting the highest class rank that occurred within it. A separate polygon file was then generated from the TXBCD point shape file corresponding to the documented spatial accuracy of each point using the "precision" field. Seconds precise points were buffered to 30 m, minutes precise to 1800 m, etc. This file was then used to clip out the 7.5 minute quadrangle polygons to create a polygon coverage reflecting the known spatial extent (spatial accuracy of the TXBCD points) attributed with the corresponding USGS quadrangle’s "class" attribute. Finally, the polygons were attributed for class rank using the process used for the TXBCD point data described above. The resulting attributed polygon shape file was then merged with the output from the clip process described above to produce a species rarity shape file.

2.2.2.3 Taxonomic Richness

The taxonomic richness measure, or the number of rare taxa per USGS quadrangle, is derived from the TXBCD. The TXBCD point data were filtered by the same method used for the rarity rank measure. The number of observations of discrete broad taxonomic groups was based on classifications by The Conservancy (bryophyte, pterodophyte, gymnosperm plant, dicot plant, monocot plant, lichen, platyhelminthe, uniramian arthropod, insect, chelicerate, crustacean, mollusk, fish, amphibian, reptile, bird, and mammal). Unique values for the attribute for taxa were summed for each quad in which an observation occurred. The unique number of taxa per grid cell was sorted using a max filter to preserve the highest possible number of taxa per grid cell then recoded 0 to 250.

2.2.2.4 Rare Species Richness

The rare species data set suffers from a lack of geographic coverage and up-to-date inventories for many species, but is the best data set available. The species richness measure, or the number of rare species per USGS quadrangle, is derived TXBCD. The TXBCD point data were filtered by the same method used for the rarity rank measure and further processed and computed similar to the taxonomic richness measure described above.

2.2.3 Sustainability Layer

2.2.3.1 Contiguous Land Cover Type

Sources used for this layer were the NLCD and Bailey's Ecoregion Sections. Only undeveloped land cover types over 10 ha (100,000 square meters) were scored. The land cover types that were identified as undeveloped were 1) open water, 2) bare rock/sand/clay, 3) deciduous forest, 4) evergreen forest, 5) mixed forest, 6) shrubland, 7) grasslands/herbaceous, 8) woody wetlands, and 9) emergent herbaceous wetlands. The bare rock/sand/clay class designation contains features such as natural rock exposures, beaches, and sandbars and does not include mines and quarries. Using the ArcGIS Spatial Analyst Extension, adjacent cells of the same land cover type were grouped together and then the total area was calculated for each region (contiguous cells of the same land cover type). The $\log_{10}$ of each area was calculated and then normalized to a 0 to 100 in each ecoregion by land cover type. The largest area of each land cover type within each ecoregion received a score of 100. The smallest area of each land cover type within each ecoregion received a score of one. Other areas were scored exponentially between 1-100. Developed lands and undeveloped lands under 10 ha received a score of zero.

2.2.3.2 Regularity of Ecosystem Boundary

Sources used for this layer were the NLCD and Bailey's Ecoregions. Only undeveloped land cover types over 10 ha were scored. The land cover types that were identified as undeveloped were 1) open water, 2) bare rock/sand/clay, 3) deciduous forest, 4) evergreen forest, 5) mixed forest, 6) shrubland, 7) grasslands/herbaceous, 8) woody wetlands, and 9) emergent herbaceous wetlands.

The optimum case would be a perfect circle where the PAR approaches or is equal to one. Therefore, PAR would be (2*pi*r)/(pir2) = 2/r. Since it is preferable to represent PAR as a relative measure, rather than in absolute units, PAR is represented as [ideal PAR / real PAR]. This ratio is always less than or equal to one. Using the ArcGIS Spatial Analyst Extension, adjacent cells of the same land cover type were grouped together and the area and perimeter were then calculated for each region (contiguous cells of the same land cover type). The values for each polygon region ranged from 1.0 to 0.0000001. This value was then normalized to a 0 to 100 in each ecoregion by land cover type. With the exception of open water cells, the largest value of each land cover type within each ecoregion received a score of 100. The smallest value of each land cover type within each ecoregion received a score of one. Other values were scored exponentially between 1 to 100. For open water, the smallest value received the score of 100 and the largest value received the score of zero. Developed lands and undeveloped lands under 10 ha received a score of zero. A score of 100 means that the polygon is nearly a circle and a score of one is the most irregular polygon in the layer. This was done for each land cover type. For open water, irregular shorelines were deemed as being more ecologically important and received a score of 100. The open water portion of these reservoirs was scored zero to account for the reduced ecological value of open water as compared to the shoreline habitat.

2.2.3.3 Appropriateness of Land Cover

Appropriateness of land cover is calculated as described in the diversity section. TEAP reclassified the PNV 2000 (Kuchler 1964) grid to the NLCD classification (Table 5). Reservoirs were also reclassified and grouped according to ecoregion because of their anthropogenic nature. The current NLCD data was compared to the modified PNV 2000 data and values that were the same received a score of 10,000 representing no change from pre-settlement to modern times and those that were not the same received a score of zero, indicating disturbance due to human activities. The 0 to 10,000 values, based on thirty meter pixels, were then converted to a 0 to 250 scale and reclassified the resulting data onto an 8-bit grid. Rescaling was done so that the data could be stored as 8-bit. Eight-bit data avoids computer memory and buffer overloads during processing and in no way affects the outcome, since the relative scores within the data set accurately reflect the content of the data. The final score is an average of all pixels in a 1 km^2.

2.2.3.4 Waterway Obstruction

Sources used for this layer were data on dams from TCEQ, the National Hydrography Dataset (NHD) and 4th level (8-digit) HUCs from the USGS. This is the most refined level of hydrologic data that covers the entire state and is the best available data for the State of Texas. For each HUC in the state, the number of dams and the total length in miles of all streams and rivers was calculated. The number of dams was then divided by the stream miles to calculate dams per stream mile. This number was then normalized from 1 to 100 for each ecoregion. Those hydrologic units without dams received a score of 100 and the hydrologic unit in each ecoregion with the highest number of dams per stream mile received a score of one.

2.2.3.5 Road Density

Sources used for this layer was the 2000 Topological Integrated Geographic Encoding and Referencing System (TIGER)/line files from the U.S. Bureau of the Census. For each 1 km^2 cell the number of road miles by road classification was calculated. The road miles were then modified by multiplying the road miles with a factor based on the road classification. The following factors were applied to each road type:

TIGER Code	Classification	Factor
A0-A9	Miscellaneous Roads	1
A10-A29	Primary Roads	3
A30-A39	Secondary Roads	2.67
A40-A49	Local & Rural Roads	2
A50-A79	Miscellaneous Roads	1

After multiplying the road length by the road factor above, the totals for each classification were summed for each 1 km^2 cell. The $\log_{10}$ was then calculated for each cell. These were then normalized to 0 to 100. Cells having no roads would indicate no fragmentation and would be the ideal condition. These cells were given a score of 100. Cells having the highest density of roads were scored zero. Road density was calculated using the following formula:

$$(R*F)\ i\text{-}v = L$$

$$S = \{1- [\log_{10} (L) / 5.919]\}*100$$

where R = the total road length of a classification code type within a grid cell
F = the loading factor for a classification code type
i-v = the five classification code types
L = the total loaded road length for a grid cell
S = the inverse loaded road length for a grid cell, i.e., road score
5.919 = $\log_{10}$ [road length*F]

A road score of 100 indicates an absence of roads and represents the ideal condition for self-sustainability.

The factors were derived from Sutherland (1994). In this document, the conclusion is made that disturbance effects may extend 500 to 600 m from quiet rural roads to 1600 to 1800 m from busy highways. Therefore, a factor of three presumably exists between the zones of disturbance generated by the smallest, least used roads and large, interstate highways. Local and rural roads are presumed to be intermediate generators of disturbance (thereby receiving a factor of two), whereas secondary roads, which include U.S. highways and state roads, are presumed to create disturbance regimes more similar to primary roads than to local and rural roads, thereby receiving a factor of 2.67. Since a road score of 100, indicates the complete absence of any roads, it represents ideal road presence for ecological self-sustainability.

2.2.3.6 Airport Noise

All runways were buffered, representing a zone of minimum disturbance around the airport based on runway size (Sutherland 1994). The buffer distances used were selected because the size of the zone of disturbance surrounding an airport is proportional to the size of the aircraft using it. Airplane size is directly related to the length of the runway. Therefore, the extent of the area of disturbance around an airport is related to runway length. The buffer zone is proportional to the runway length and each runway was grouped as follows (White et al. 2003):

Airport Category	Buffer (m)	=	Runway Length (m)
very large	7500		> 1950
large	5300		1500-1800
medium	3100		1200-1500
small	900		540-1200
very small	755		183-540
very very small	610		≤ 183

All areas in the state within the buffer were scored zero and areas outside the buffer were scored 100. This layer was then converted to a grid with a cell size of 1 km^2.

2.2.3.7 Superfund NPL and State Superfund Sites

Sources used for this layer include the NPL sites (in polygon and point format) from EPA and state Superfund Sites from TCEQ (in point format). For sites where polygon data was available, the polygon data was used. Otherwise a buffer of 610 m was used as a default (Sutherland 1994) and applied to the points. All areas in the state within a buffer were scored zero and areas outside of the buffer were scored 100. This layer was then converted to a grid with a cell size of 1 km^2. These are un-owned sites where hazardous waste was released and where there was a formal clean up process during fiscal year 2000.

2.2.3.8 Water Quality

This includes waters identified as impaired with water quality concerns or meeting designated uses in CWA Section 303(d). Only designated use data pertaining to aquatic life is included (e. g., dissolved oxygen, pH extremes, ambient toxicity, elevated heavy metals, nutrient or sediment levels in excess of the statewide 85^{th} percentile). The CWA 303(d) year 2000 list is an assessment of water quality data collected during 1993-1998 by TCEQ. The impaired waters layer was intersected with the 1 km^2 cell grid. Cells with impaired waters were scored zero and all others cells were given a score of 100.

2.2.3.9 Air Quality

The Air Quality layer characterizes areas with poor air quality. The source for this layer is ozone nonattainment from EPA's Office of Air Quality Planning and Standards (OAQPS) and

TCEQ. All the counties in Texas were scored from 0 to100 based on their nonattainment status. Counties that are in attainment were scored 100 and counties that are in severe nonattainment status were scored zero. The scores were assigned as follows:

Attainment Status	Normalized Score
Severe Nonattainment	0
Serious Nonattainment	25
Moderate Nonattainment	50
Near Nonattainment	75
Attainment	100

2.2.3.10 RCRA TSD, Corrective Action and State VCP Sites

Data sources used for this layer include RCRA corrective action sites (in point format) from EPA, RCRA TSD sites (in polygon and point format) from EPA and state Superfund Sites from TCEQ (in point format). For sites where polygon data was available, the polygon data was used otherwise a buffer of 610 m was used as a default (Sutherland 1994) and applied to the points. All areas in the state within a buffer were scored zero and areas outside of the buffer were scored 100. This layer was then converted to a grid with a cell size of 1 km^2. These are sites where hazardous waste was released and where there is a formal clean up process during fiscal year 2000.

2.2.3.11 Urban/Agriculture Disturbance

Sources used for this layer were land cover types from the NLCD. Only urban/ agricultural regions over 10 ha were included. A buffer of 600 m was included around the urban/agriculture areas to represent disturbance to surrounding areas. This is a minimum buffer size based on differences in road size and traffic in these developed land cover types (Sutherland 1994). The land cover types that were identified as urban and agricultural were low intensity residential, high intensity residential, commercial/ industrial/transportation, orchards/vineyards, pasture/hay, row crops, small grains, fallow, and urban/recreational grasses in NLCD. Using the ArcGIS Spatial Analyst Extension, the land cover types in the NLCD were reclassified to urban/agriculture or non-urban/agriculture. Adjacent cells of the same type were then grouped together and the area was calculated for each region (contiguous cells of the same land cover type). Urban/agricultural areas that were smaller than 10 ha were reclassified to non-urban/agriculture. A buffer of 610 m was then created around the urban/agriculture areas. All areas that are in urban/agriculture or within 610 m of urban/agriculture received a score of zero. All other areas were assigned a score of 100. This is a binary sub-layer, with scores for either developed land cover types (urban and agriculture) scoring zero and all natural land cover types scoring 100.

2.2.4 Accuracy Assessment

The Conservancy ecoregion portfolios for the Edwards Plateau, Southern Shortgrass Prairie, Chihuahuan Desert, Upper West Gulf Coastal Plain, West Gulf Coastal Plain, and Gulf Coast Prairies and Marshes were combined into a single GIS coverage. Of these portfolios, which consist of both aquatic and terrestrial conservation areas, only aquatic portfolio areas rated as Tier I (strong confidence that viable target populations and/or high quality system occurrences are present) within the Edwards Plateau and Southern Shortgrass Prairie were used since Tier II portfolio sites have a lower conservation value primarily due to lack of ground-truthing.

The single Conservancy portfolio coverage was then converted into a grid matching the TEAP composite grid layer specifications. To ensure a similar area of comparison, the TEAP composite grid was clipped to mask out data for the ecoregions not yet completed by The Conservancy (Tamaulipan Thornscrub and Crosstimbers and Southern Tallgrass Prairie). However, it should be noted that small areas of these two ecoregions were included where adjacent ecoregion conservation areas crossed ecoregion boundaries.

To reduce noise within the data, The Conservancy classified the data into thirty equal classes. Each class contained ten pixel values; for example class 1 equals TEAP composite values 1 to10, class 2 equals TEAP composite values 11 to 20, and so on.

All the data processing was performed utilizing ArcGIS 8.3 (ESRI Inc., Redlands, CA 2001). The individual TEAP files were imported as ESRI GRID (raster) files and merged to create four statewide grids representing Rarity, Sustainability, Diversity, and Composite. The resulting grids were 1,183 rows by 1,245 columns with each pixel representing 1 km^2.

The intersect between the TEAP composite layer and The Conservancy portfolio grids was calculated using the raster calculator function in ArcGIS. The result was two statewide grids, one for inside and one for outside The Conservancy combined portfolio. Summary statistics generated for each grid layer (e.g., mean, standard deviation, count, minimum, maximum, and sum). A frequency table of the TEAP composite pixel values was calculated and used to compare the frequency of pixel values found inside The Conservancy portfolio versus those found outside the portfolio. An additional map focusing on the IH69 corridor study site was created by clipping these three data sets to the IH69 corridor extent and recalculating the summary statistics to generate a new frequency table.