ENVIRONMENTAL ARMATURE CONCEPT SUMMARY

April 15, 2009

Sponsors:

EAST VALLEY PARTNERSHIP

LINCOLN INSTITUTE OF LAND POLICY

SONORAN INSTITUTE

Consultant Team:

Robert Grow consulting

FREGONESE ASSOCIATES

HarrisInteractive®

RCLCO ROBERT CHARLES LESSER & CO.

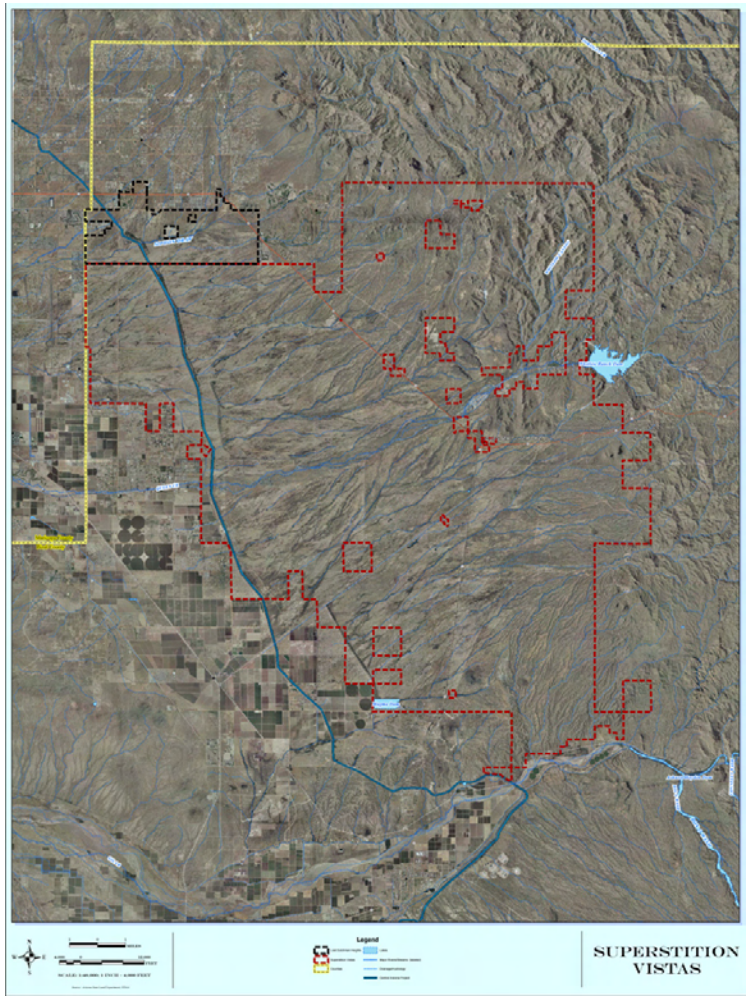
EDAW | AECOM

Overview

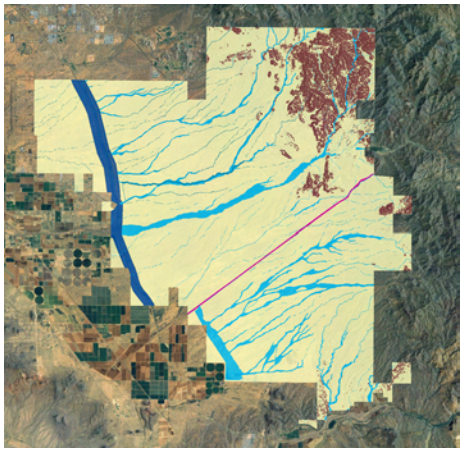
This summary describes the process leading to 5 open space (environmental armature) concepts that were developed for Superstition Vistas during the spring and summer of 2008. The process included: a) inventory of site features and regional context; b) review of the existing planning context; c) identification of best practices; d) data analysis; and e) development of the rationale and configuration for the 5 scenarios. Additionally, as an independent initiative by the EDAW project team, performance analysis was performed between the 5 scenarios using an experimental modeling process. This independent research is also included in this summary. The team included EDAW (San Diego (Biological), Irvine (Landscape Ecology), Phoenix (Hydrology and local knowledge), and Fort Collins (hydrology); WoodPatel (Hydrology); and David Sailor (Urban Heat Island).

Generally, the 5 scenarios were based on following potential development paths; maximum development, current planning recommendations, current best practices, emerging best practices, and deep ecology sustainability. These scenarios are largely hierarchical, with each building upon the previous leading to the deep ecology sustainability scenario which included all aspects of each previous scenario and the most aggressive open space concept and rationale.

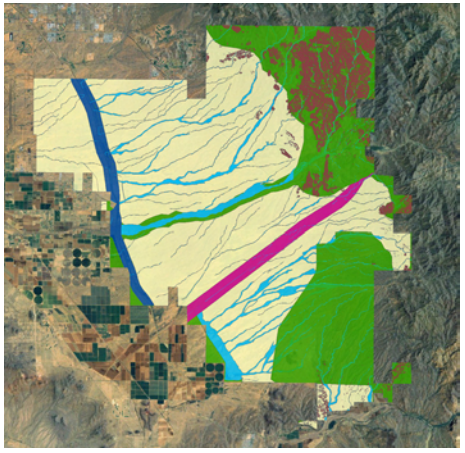
The concepts explore plan scenarios ranging from most aggressive development to most aggressive conservation. The most aggressive development scenario assumed sprawling, relatively large lot development that has been the a common practice in suburban growth areas of Phoenix over the last several decades. Middle scenarios followed the Pinal County Open Space Plan; recommendations the SALT study and The Nature Conservancy combined with current best planning practices for the region, and currently accepted best practices. Finally, the most aggressive conservation scenario considered emerging open space planning measures considering climate change mitigation and adaptation, biodiversity sensitivity and robust ecosystem services planning.



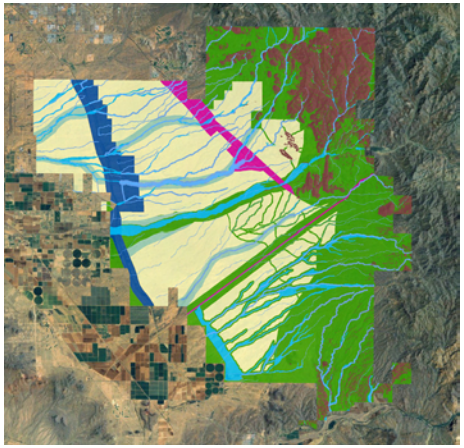
1.



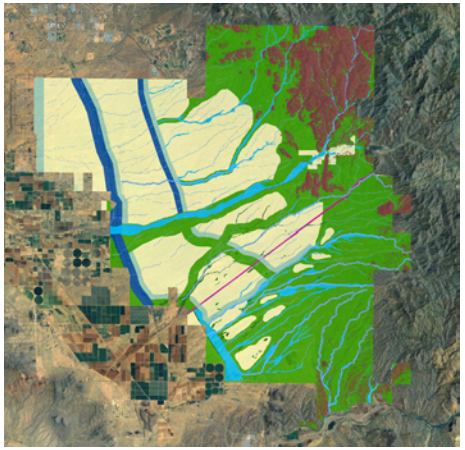
2.



3.



4.



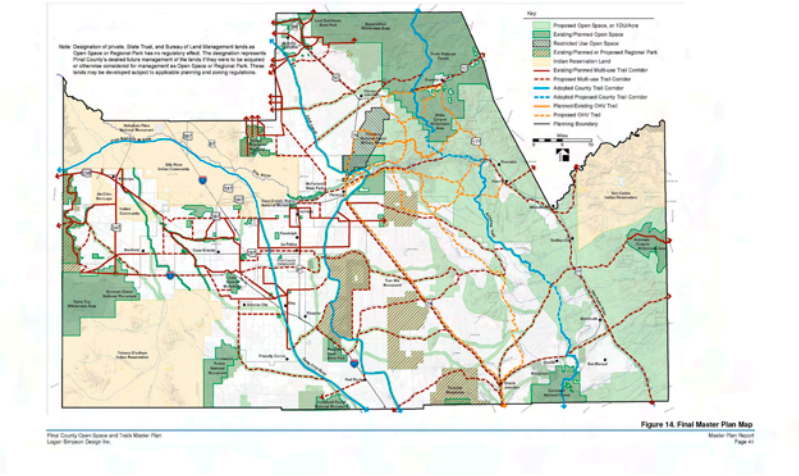
5.

1. Project site aerial photo
2. Concept 1a - Maximum Development
3. Concept 1b - Current Planning Recommendations - Pinal County Open Space Plan
4. Concept 2 - Current Best Conservation Practices
5. Concept 3 - Emerging Best Practices Concept

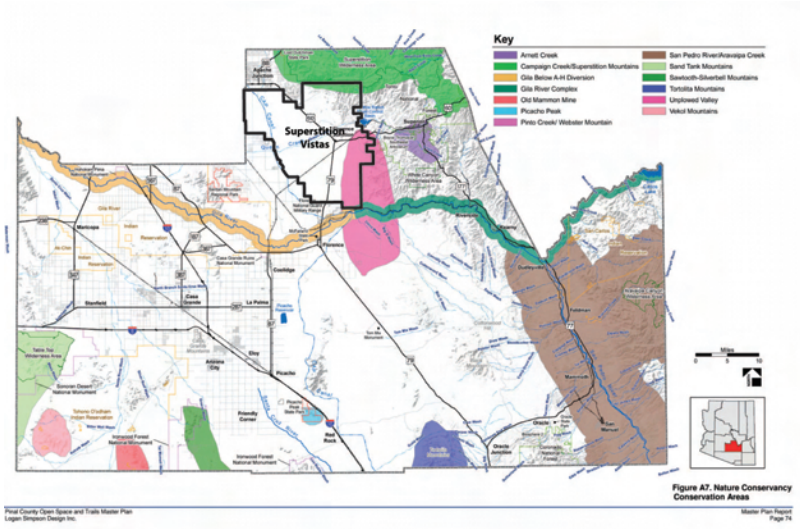
Site Analysis

Existing Recommendations

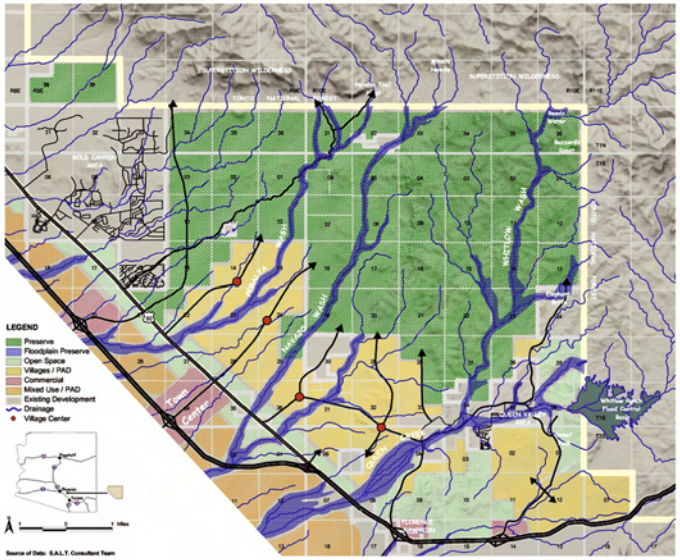
The site analysis began with an inventory of existing recommendations for the site. References included the Pinal County Open Space Plan, the SALT study, recommendations from the Nature Conservancy contained in the Pinal County Open Space Plan, and the Carter Burgess studies addressing alternative design treatments for drainage and the CAP canal.



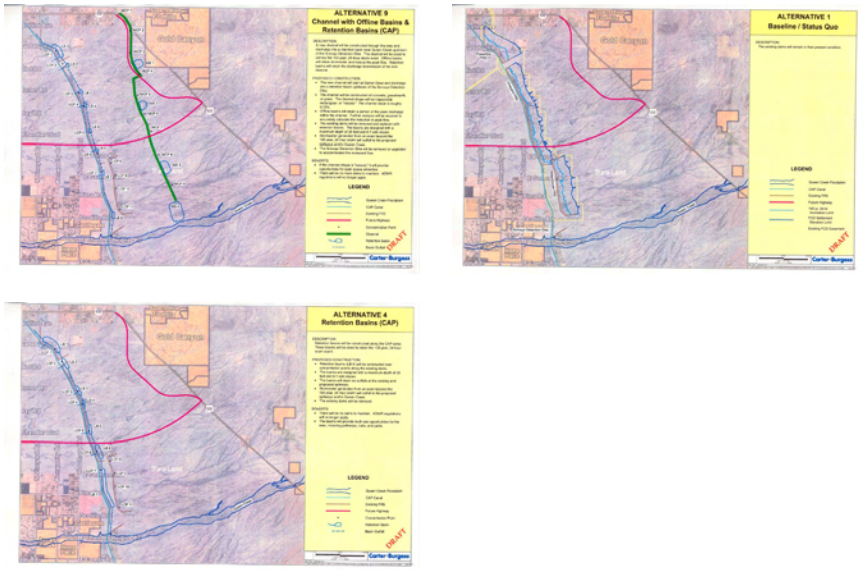
1.



2.



3.

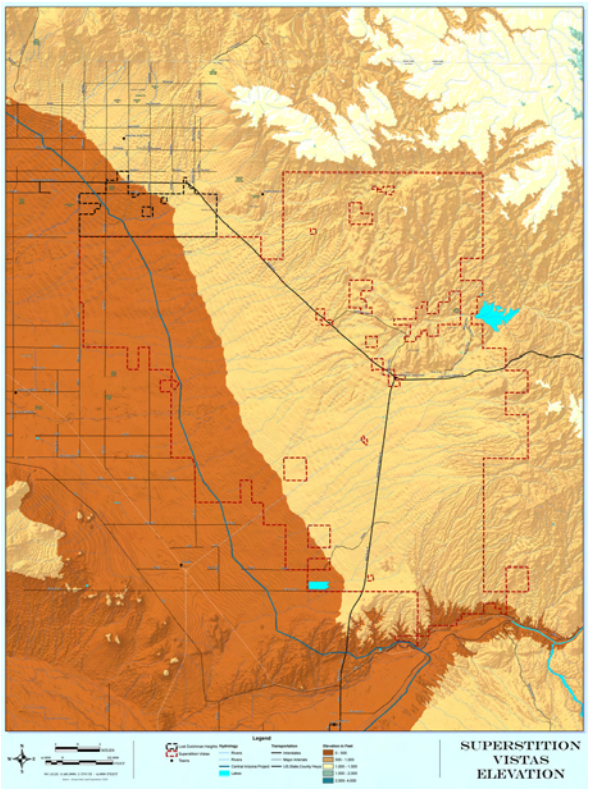


4.

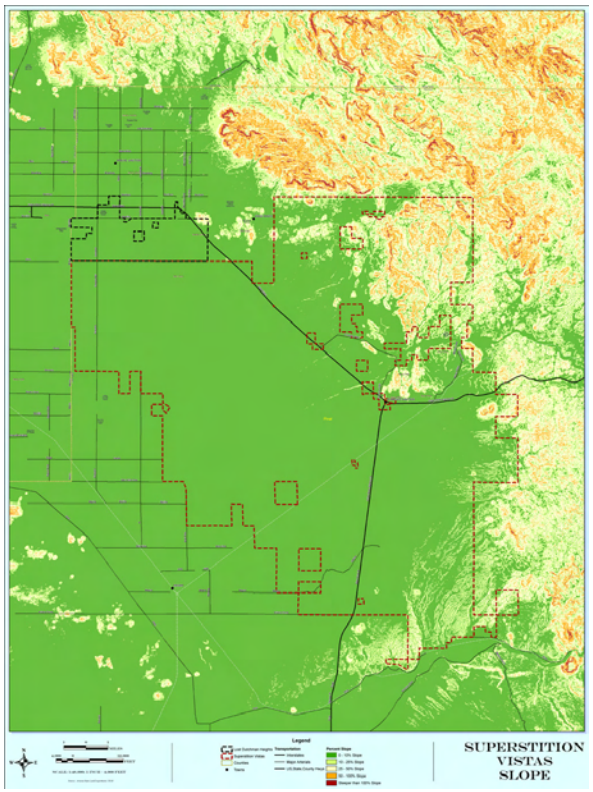
1. Pinal County Open Space Plan
2. Nature Conservancy Conservation Areas
3. S.A.L.T. Study
4. Carter-Burgess CAP Alternatives

Physiography

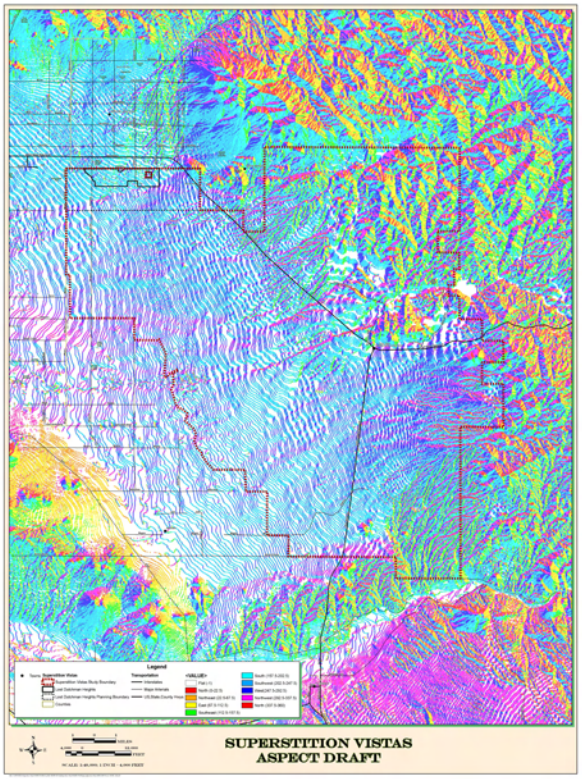
Basic site analysis studies included elevation, slope %, and aspect. These studies helped to identify drainage patterns, buildable areas, and basic infrastructure capabilities and constraints.



1.



2.



3.

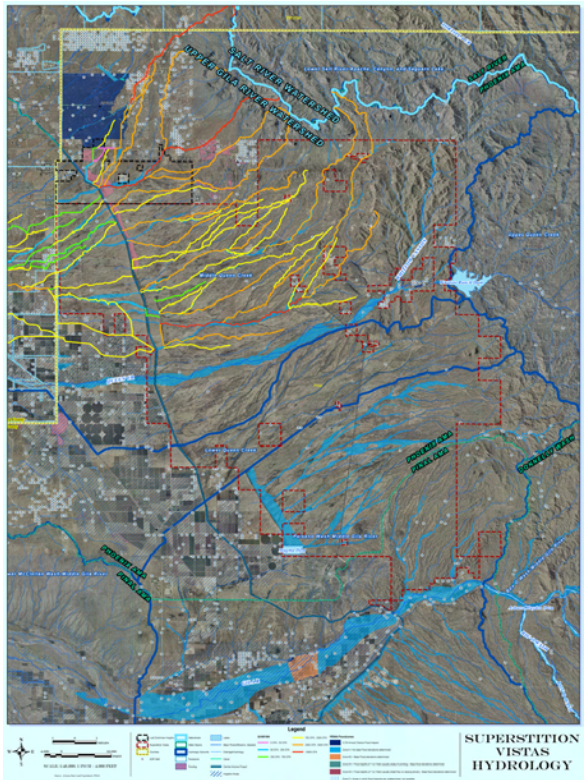
1. Elevation
2. Slope %
3. Aspect

Hydrology

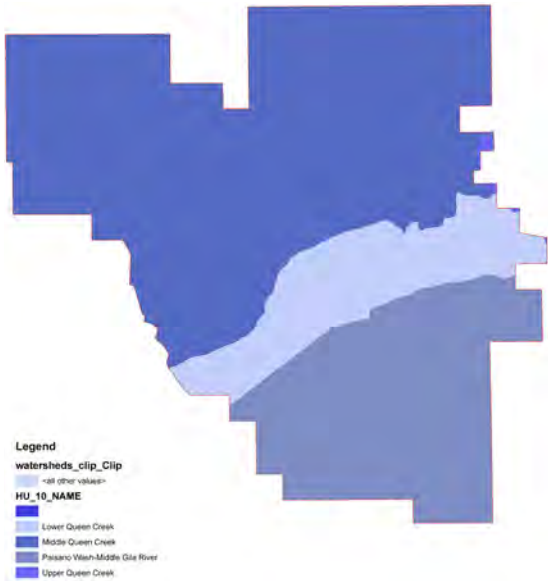
Hydrologic analysis considered floodzones, wash locations, and wash flow rates where data was available. Wash locations were determined from existing data plus additional washes were delineated based on visual analysis of whether sand channels appeared to be present. This data helped determine appropriate wash setbacks, flood protection measures, and stormwater management approaches.

Overall, the site encompasses 3 primary watersheds and three general hydrologic zones based on topography. The three watersheds include Middle Queen Creek, Lower Queen Creek, and Piasano Wash-Middle Gila River. The topography dependent hydrologic zones included mountainous and hilly areas where defined channels and canyons are present. Low sloped transition areas between the mountains and the plains that also have fairly defined washes in shallow gullies. In the lowest areas of the site, washes disperse into areas of sheet flow. Wash channels in this area are less predictable and frequently shift spatially across the plain. Wood/Patel delineated wash flow rates for areas north of Queen Creek where data was available.

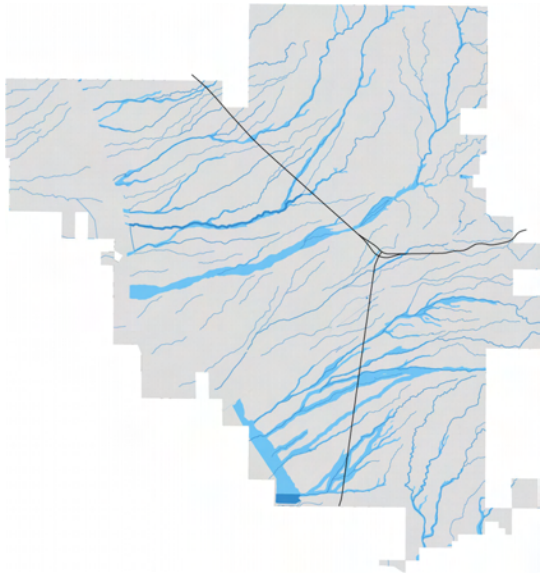
Changing hydrology as a result of climate change is likely one of the most important climate change adaptation issues for the project. Seasonal rains may become heavier with climate change, and large flood events may become more frequent. Drainage infrastructure and floodplain setbacks should be designed addressing the latest climate change precipitation predictions for the region. FEMA is currently preparing a study of anticipated floodzone changes for the region considering climate change which should be available by late 2010.



1.



2.



3.

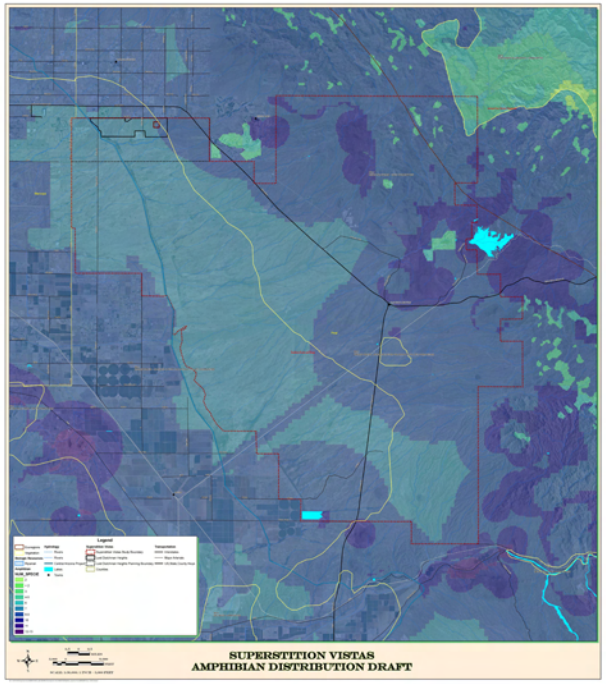
1. Wash Flow Rates, Preliminary Wash Locations, FEMA Flood Zones
2. Primary Watersheds
3. FEMA Flood Zones and Preliminary Wash Locations

Species Richness

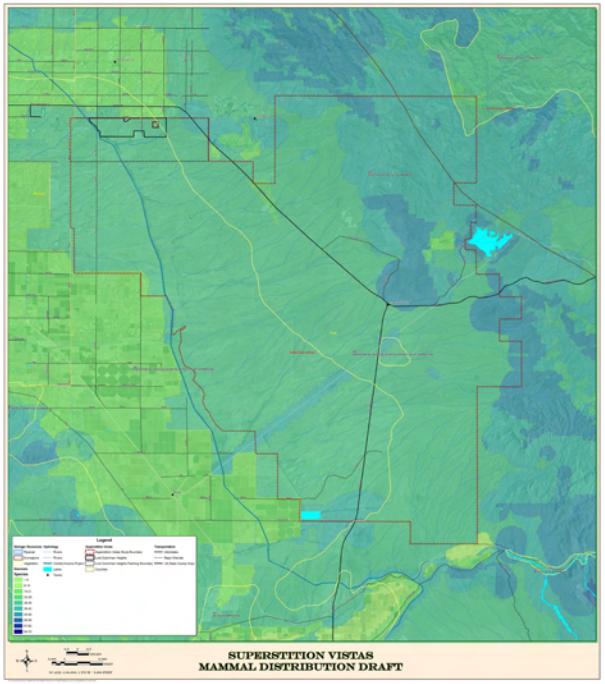
Fairly detailed species richness data was available for the site from the Missing Linkages Project (http://www.dot.state.az.us/Highways/OES/AZ_WildLife_Linkages/assessment.asp), which focused on regional conservation planning for the Superstition Mountains. The highest species richness on the site occurs in the transition zone between the Superstition Mountains and the flat plains. This is typical of such regional ecotones where habitat and ecological conditions contain features of both adjacent ecosystems. Preserving these areas of high species richness was a priority in the more aggressive conservation concepts.

It should be noted that the Missing Linkages data is relatively coarse and does not include more localized areas of higher species richness such as along Queen Creek or along more fine grain ecotones.

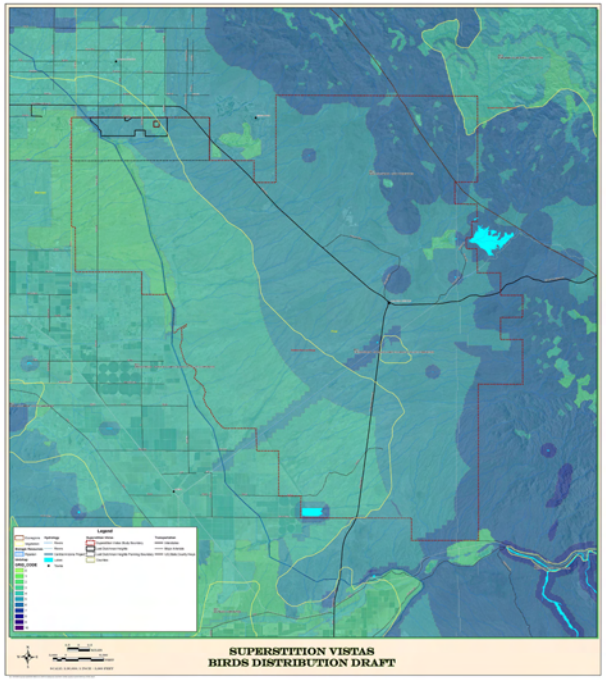
Although species richness is an important consideration in conservation planning, lower species richness zones may also be important for overall regional biological and ecological function. In the most aggressive conservation scenarios, some lower species richness zones were preserved to better maintain a more wholistic network of regional landscape ecological patterns and processes.



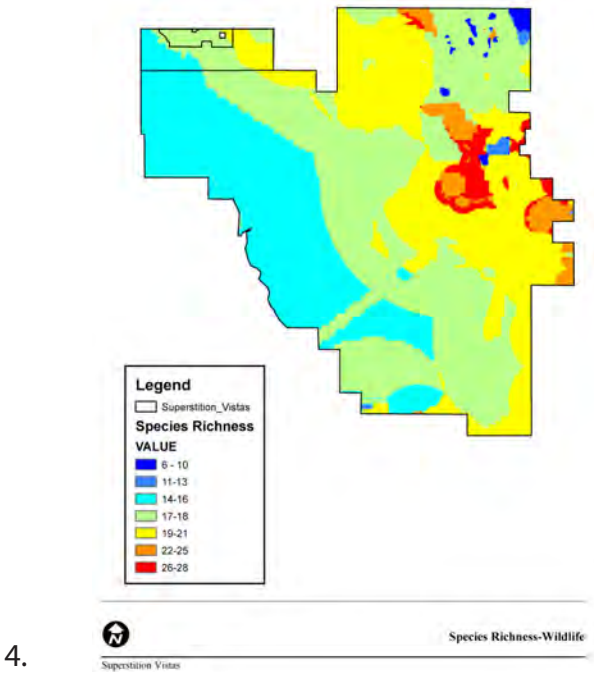
1.



2.



3.



4.

1. Amphibian Distribution (source: Missing Linkages Project)
2. Mammal Distribution (MLP)
3. Bird Distribution (MLP)
4. Composite Species Richness (Wildlife)

Ecosystems

Understanding the site as containing a nested hierarchy of ecosystems was also an important consideration. These maps help to organize opportunities for ecosystem services and to understand how to sustain site biodiversity. We combined the major vegetation, soils, landforms and natural processes to identify five major zones of analogous ecological function. These five zones helped to lay the final piece of the framework for organizing conservation networks to maximize biodiversity protection, ecosystem services, and added value. The final composite Ecosystem Functional Zones map was digitized through arerial interpretation by EDAW. The five primary ecological functional zones included:

Rock Outcrop Zone - Including the Superstition Mountains where rugged rocky terrain dominates and Evergreen Sclerophyll Communities are present.

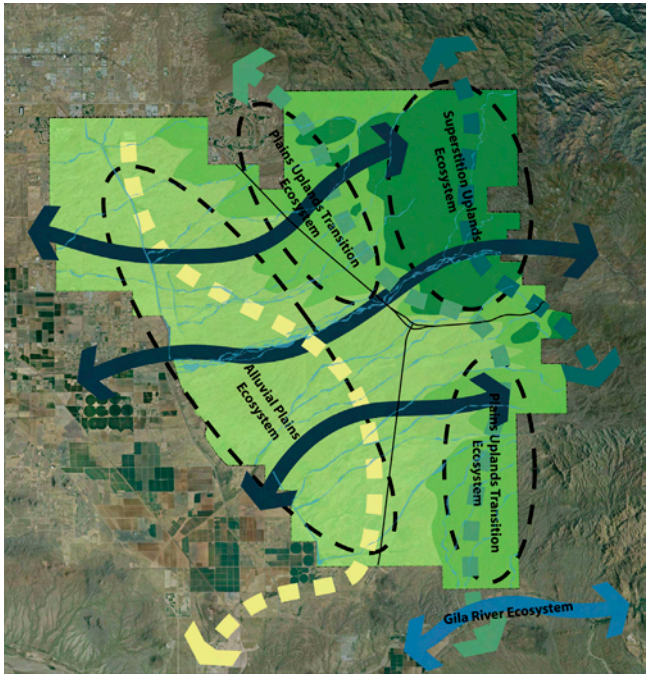
High Slope Alluvial Zone - The zone at the foot of the Superstition Mountains with relatively sloping terrain and incised drainage channels. Mixed Palo Verde Cactus Communities dominate this zone.

Low Slope Alluvial Zone - This zone includes gentle slopes with slightly incised drainage channels. This area includes both Mixed Palo Verde Cactus Communities and Creosote Bush-Bursage Communities.

Sheet Flow Zone - This area is very flat and drainage frequently occurs as sheet flow. This zone is dominated by Creosote Bush-Bursage Communities.

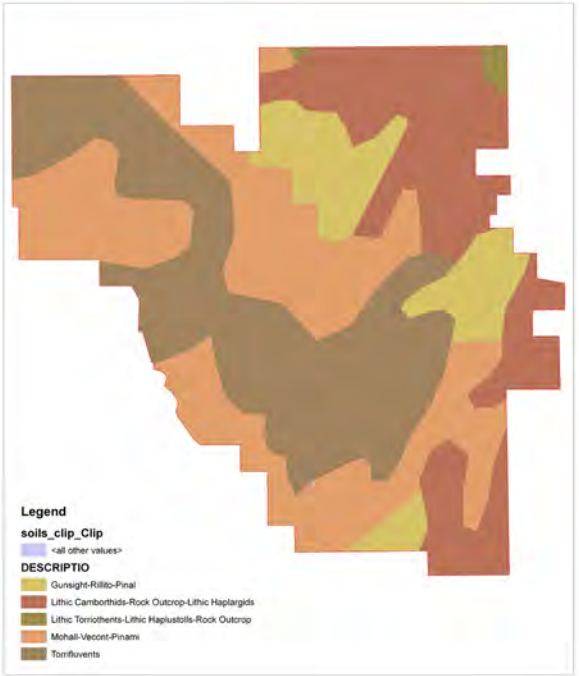
Queen Creek Floodplain - Floodplains associated larger drainage channels such as Queen Creek are also an important landforms. Riparian plant associations occur in these areas.

More aggressive conservation concepts strived to preserve representative areas of each of these zones, the transitions between them (ecotones) and their associated natural processes such as sheet flow drainage, flood regimes, and wildlife movement and migration.

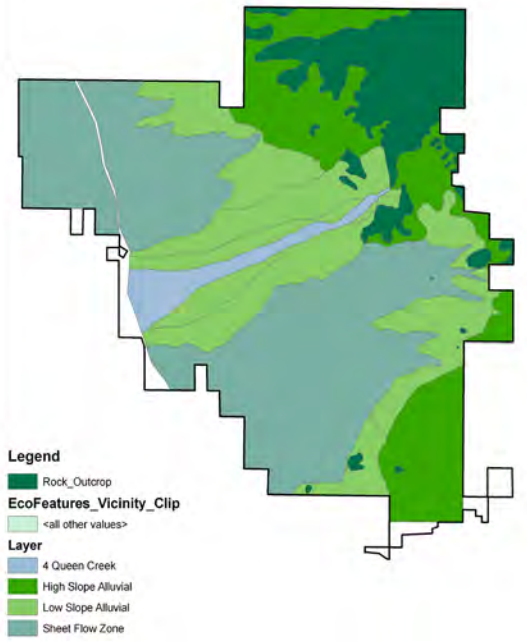


1.

2.



3.



4.

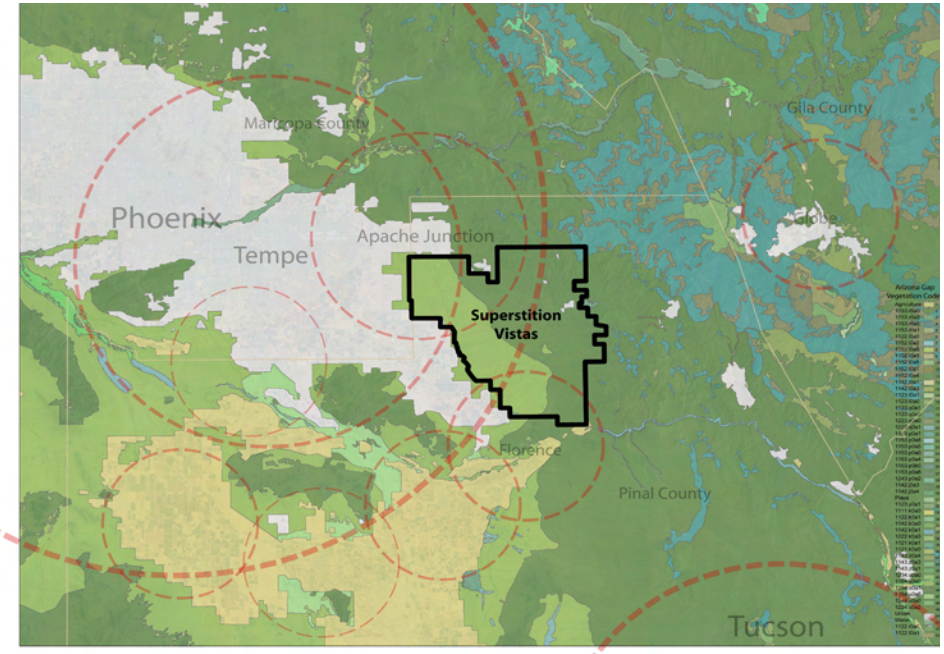
1. Landscape Ecology Diagram
2. Vegetation
3. Soils
4. Primary Ecosystem Functional Zones

Regional Ecology

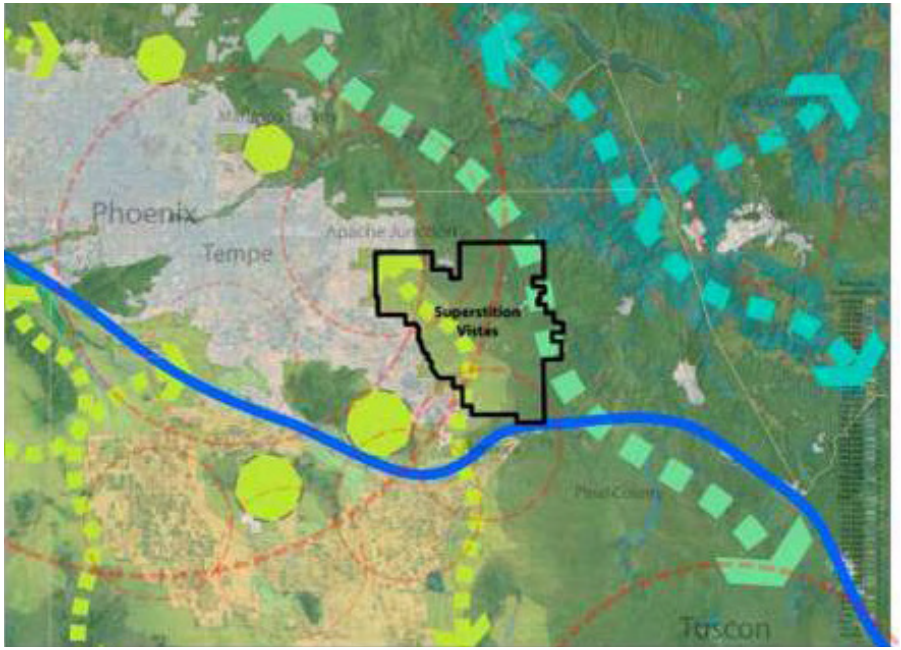
The site's regional ecological context was evaluated to understand the relative importance of conservation planning on the site. Evaluation included the site's relationship to regional habitat corridors, patterns of biodiversity and development, and the regional processes occurring between the site and the surrounding landscape.

Regional habitat corridor considerations included the adjacency to the Gila River corridor, an important habitat corridor bisecting the emerging Phoenix-Tucson megaregion.

The site contains a relatively high consentration of biodiversity for it's size relative to the region. It includes diverse ecosystems and associated biodiversity ranging from the Gila River, Creosote-Bush Bursage Plains, to the higher elevation Superstition Mountains. Maintaining this pattern and associated processes through a network of open space cores and corridors was a consideration in more aggressive conservation scenarios.



1.



2.

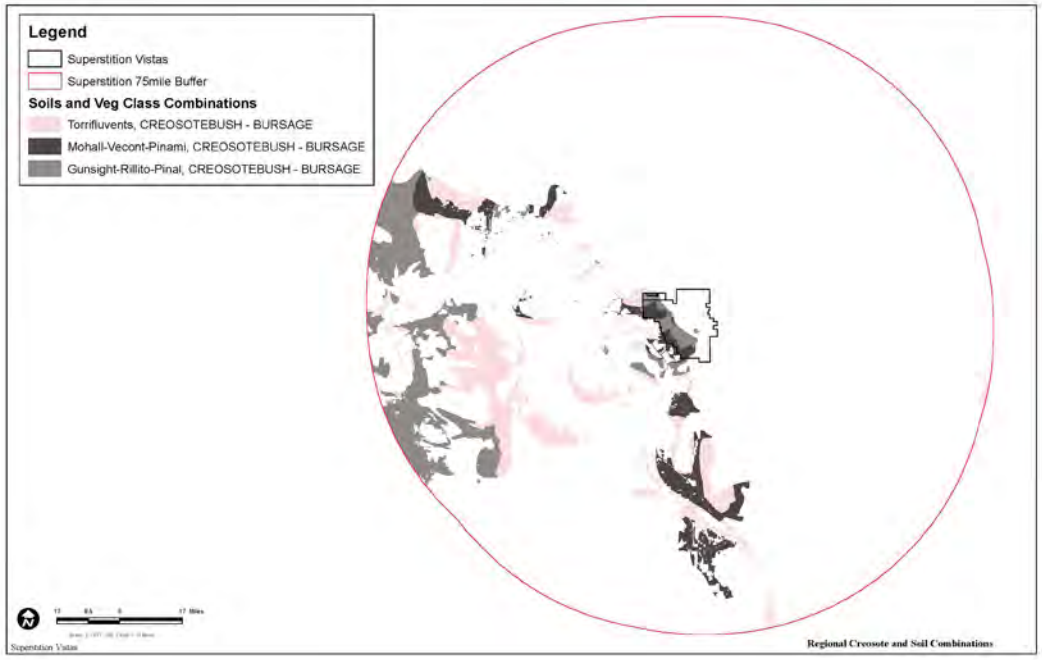
1. Regional Vegetation
2. Regional Landscape Ecology Diagram

Regional Ecology

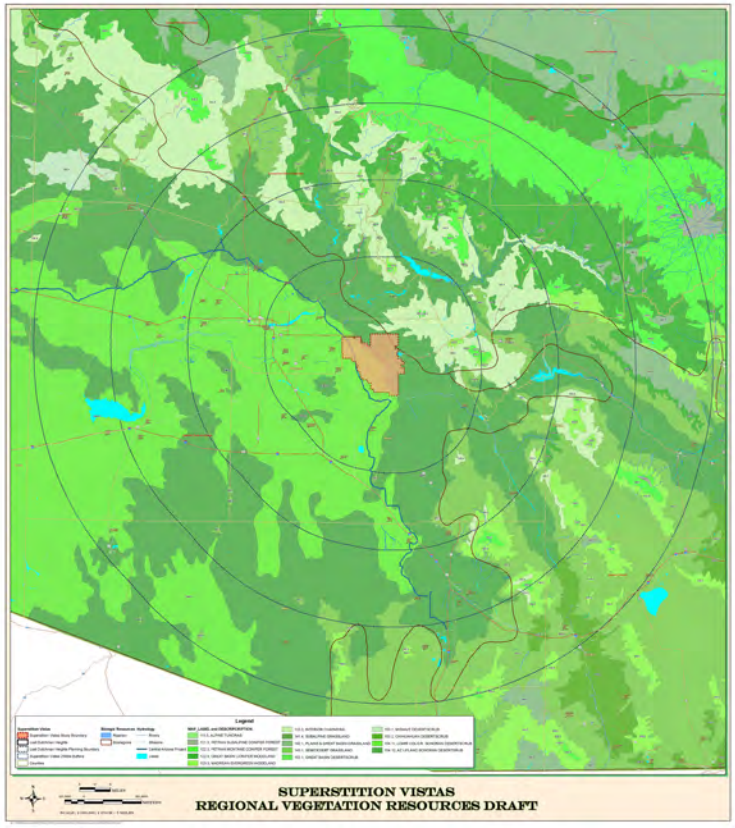
Although Creosote Bush-Bursage Communities are generally a lower priority for conservation in the region, the fact that the site contains such a large patch of this vegetation type adjacent to the Superstition Mountains lead us to further consider the site's role in maintaining the regional pattern of biodiversity.

Figure 1 on the following page evaluates the occurrence of Creosote Bush-Bursage Communities associated with various soil types within a 75 mile radius of the site. The analysis shows that the site contains one of the last large patches (particularly associated with Gunsight Rialto-Pinal Soil type) of Creosote Bush-Bursage Communities along the Superstition Mountains ecotone.

Maintaining a regional scale habitat core area of this patch may be beneficial to long term species adaptation and migration between the Superstition Mountains, the Creosote-Bursage plains, and the Gila River.



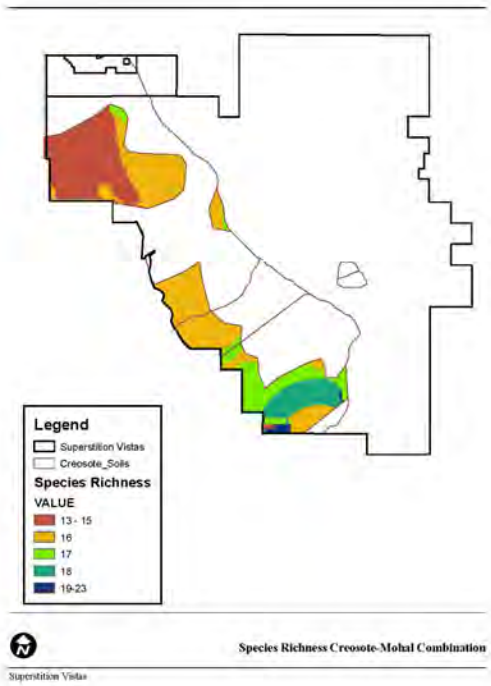
1.



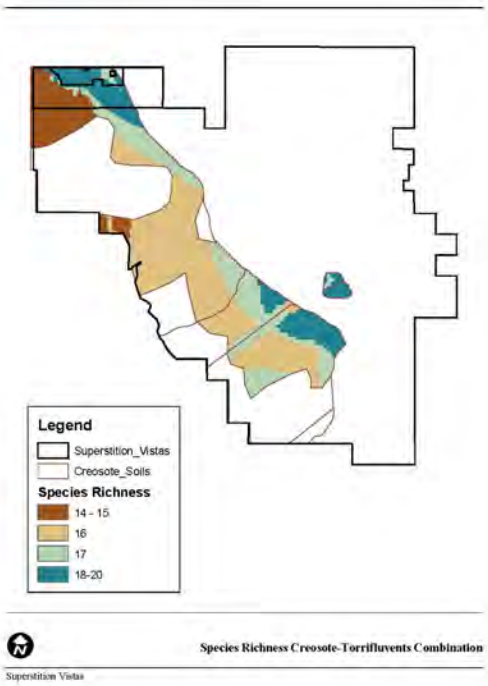
2.

1. Regional Creosote-Bush Bursage/Soils Distribution Analysis
2. Super-Regional Vegetation

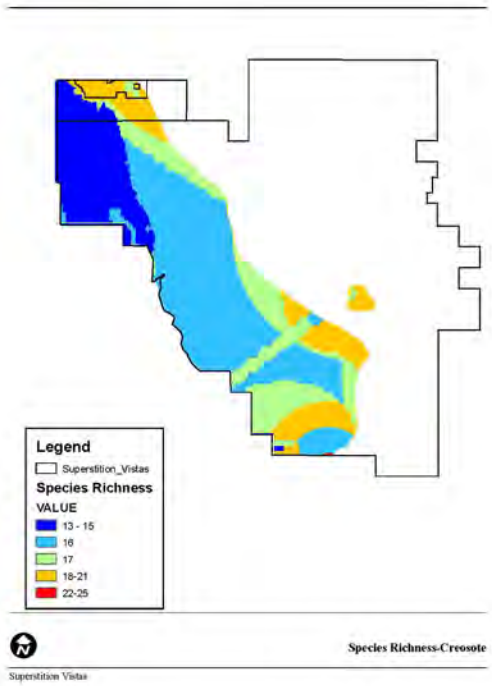
In order to determine which areas of Creosote Bush-Bursage communities are most beneficial to preserve, we evaluated species richness specifically within this vegetation type for each soil type present. Areas in the southeast tended to have the highest species richness for each soil type.



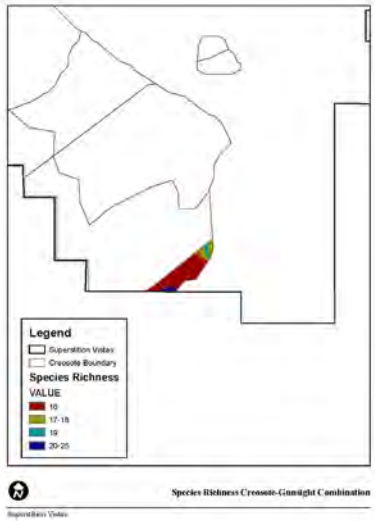
1.



2.



3.

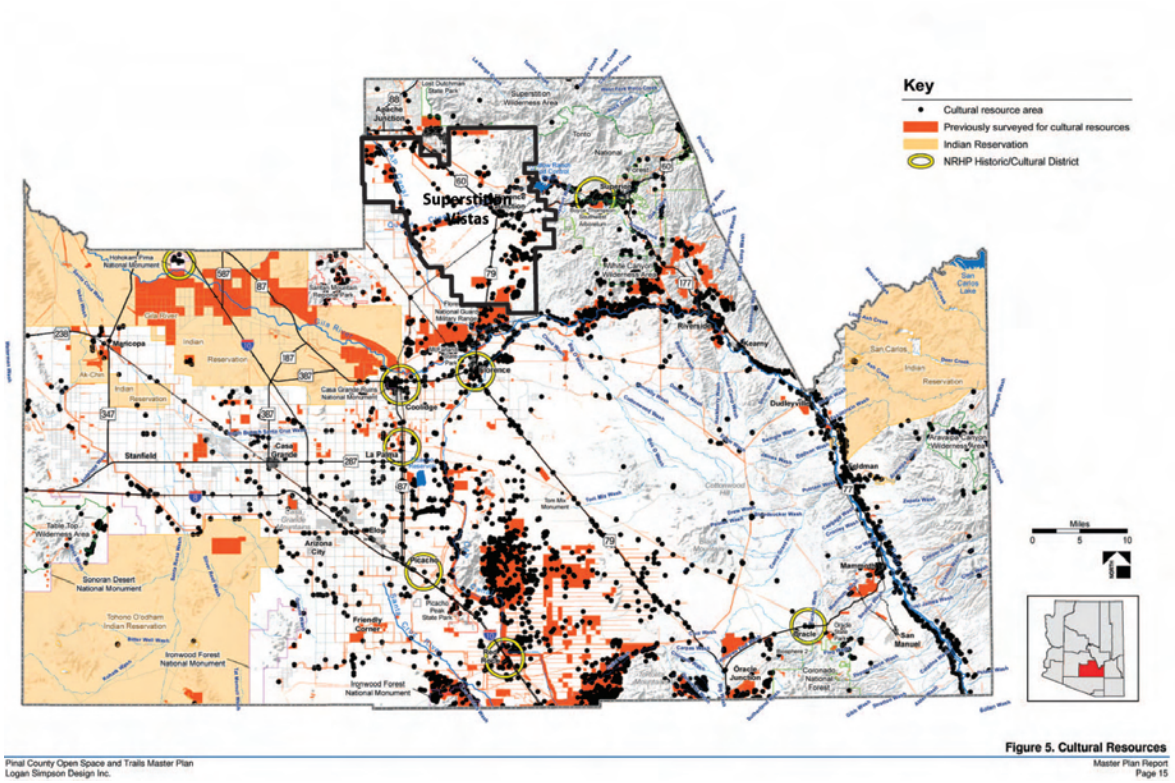


4.

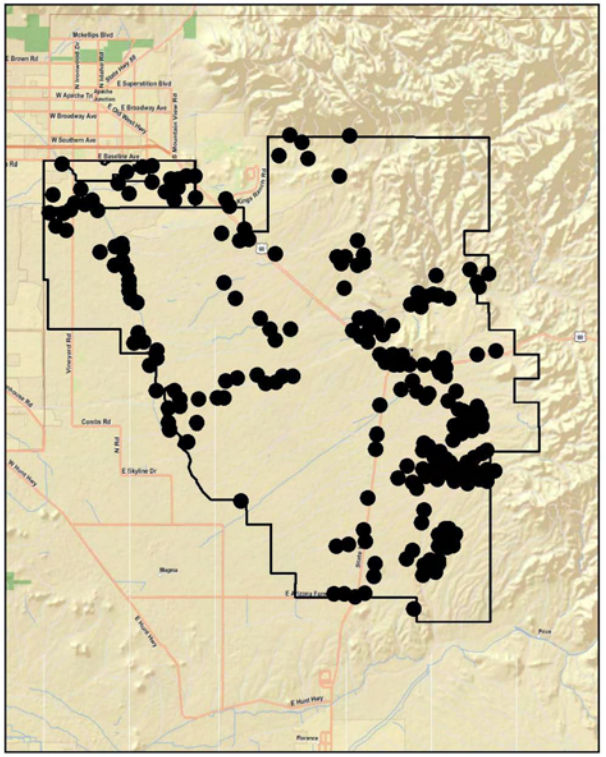
1. Species Richness Study: Creosote-Mohal Soils
2. Species Richness Study: Creosote-Torrufulent Soils
3. Species Richness Study: Creosote Soils Composite
4. Species Richness Study: Creosote-Gunsight Soils

Cultural Sites

Cultural sites were inventoried based on previous studies by others. A majority of the known cultural sites are located to the east of Hwy 79, along Queen Creek and along the CAP canal. More detailed study is needed to adequately determine priority areas.



1.



Superstition Vistas

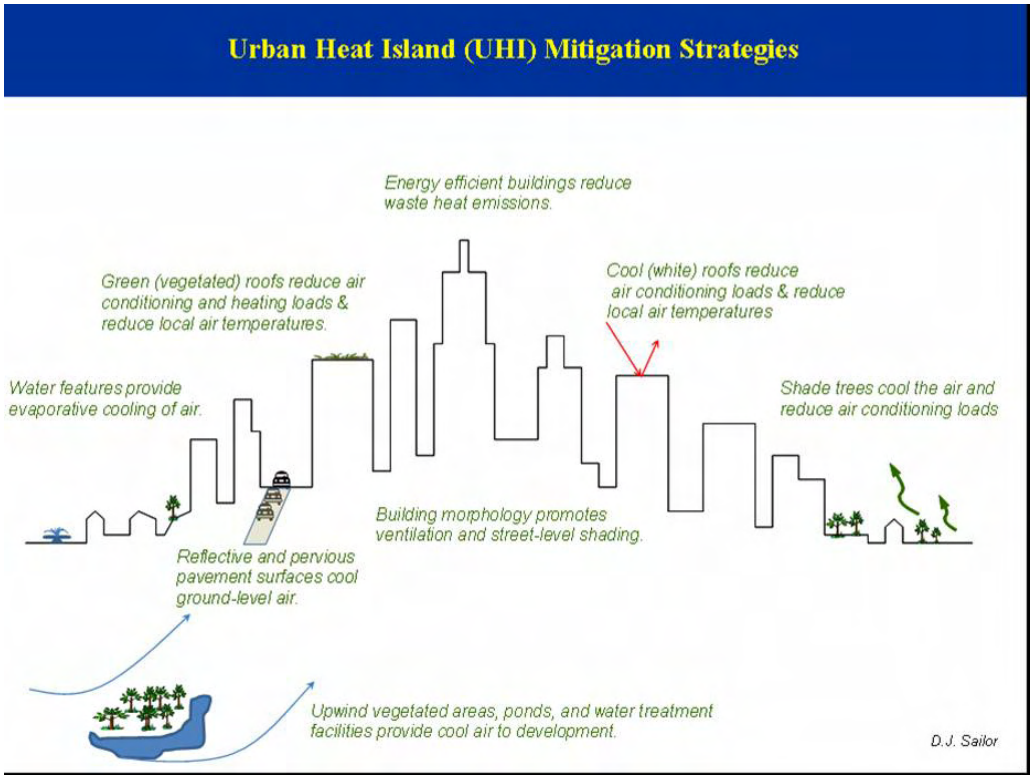
2.

1. Cultural Resources - Pinal County Open Space Plan
2. Cultural Resources - Superstition Vistas (from Pinal County Open Space Plan)

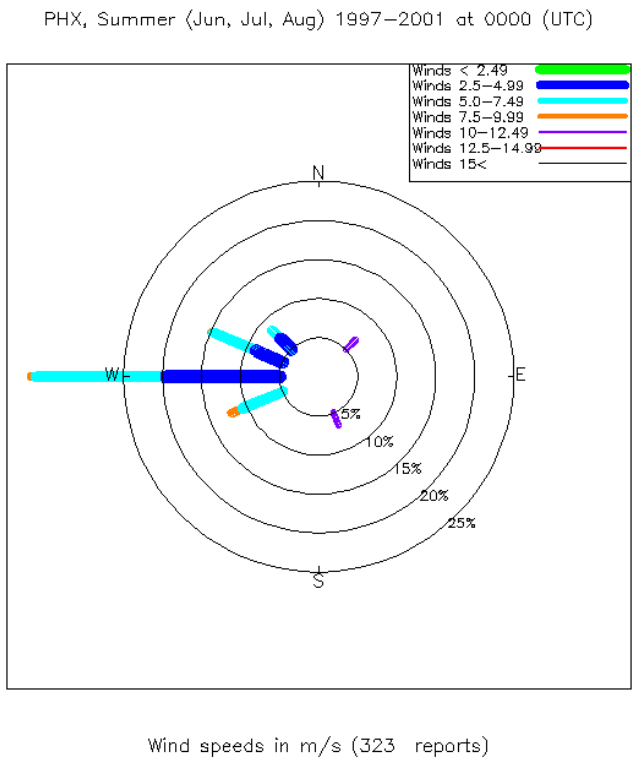
Urban Heat Island

Site climate and wind patterns were evaluated considering how site design might help to regulate temperature and the urban heat island effect. Open space configuration may be aligned with wind patterns and water features to channel cool air into higher density urban areas.

The fact that drainage channels naturally run east-west is favorable for channeling prevailing westerly summer winds. Drainages can be combined with stormwater and wastewater treatment wetlands placed upwind (west) of higher density areas to provide additional cooling benefits. Restoring native woodlands and grasslands along drainages just west of higher density centers could also provide cooling benefits.



1.



2.

1. Urban Heat Island Mitigation Strategies (David Sailor)
2. Phoenix Wind Rose - Summer

Environmental Armature Concepts

Concept 1a

Maximum Development Concept

All areas with less than 25% slopes are built upon and minimal wash setbacks are dedicated. This concept is not intended as a possibility for buildout, but provides a benchmark representing the most aggressive development scenario possible. This is a useful environmental and economic baseline from which to evaluate performance of other concepts.

Hydrologic Protection (wash flow rates from Wood Patel – setback recommendations from Ecological Resources Team)

- setback from wash center lines (assumes minimal wash/floodzone setbacks):
    - 25' for level 3-4 washes;
    - 50' from level 5;
    - 200' from level 6
- 25% encroachment into FEMA floodzones with the exception of Queen Creek
- Carter Burgess Alternative 4, retention basins along CAP

*Wastewater/Stormwater Storage and Treatment (*Recommendation from EDAW water resources team)

- 10% of development envelope dedicated to stormwater treatment – distributed throughout community to minimize piping (not visible on concept plan)

Urban Heat Island

- Heat island addressed through shading and materials, no consideration for urban heat island in urban configuration

Biodiversity

- Not considered

Trails, Cultural Sites

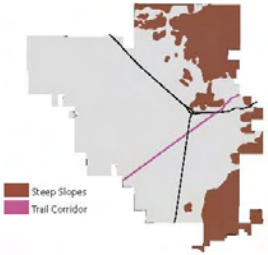
- Not considered

Topography

- Preserve slopes over 25% only

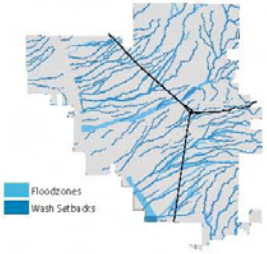
Cultural Sites, Steep Slopes and Trails

> Steep slopes avoided (greater than 15%)
> 400' railroad corridor preserved



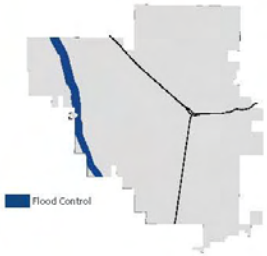
Hydrology: Floodzones and Washes

> Reduce Floodzones by 25%
> Preserve level 3 and greater washes (25'-200' setbacks)



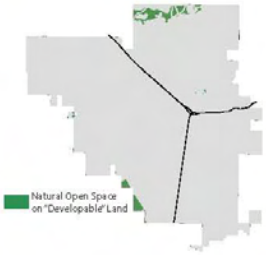
Stormwater, Wastewater and Urban Heat Island

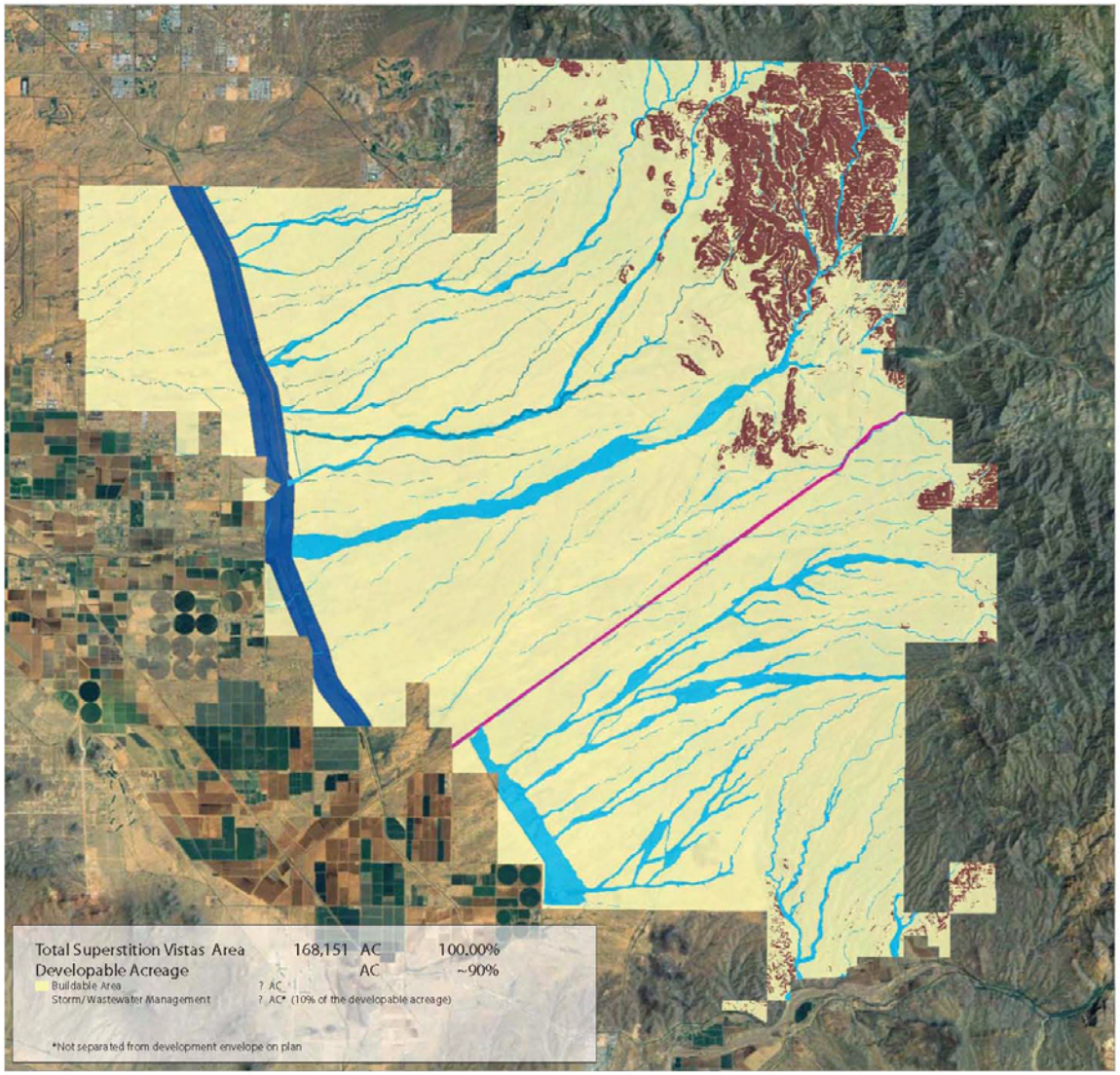
> Channel and basin system installed along CAP
> Urban stormwater managed in basins scattered throughout project (10% of development area, not called out on plan)
> Unban configuration not considered for urban heat island impacts



Biodiversity: Corridors and Reserves

> Minimum amount of developable land set aside for biodiversity conservation





Environmental Armature Benchmark 1a: Maximum Development
Superstion Vistas

March 17, 2008

EDAW

Concept 1b

Current Planning Recommendations - Pinal County Open Space Master Plan Concept

This concept includes open space dedicated in the Pinal County Open Space Plan. It also includes typical setbacks for washes and FEMA floodzones.

Hydrologic Protection (wash flow rates from Wood Patel – setback recommendations from Ecological Resources Team)

- setback from wash center lines (assumes minimal wash/floodzone setbacks):
    - 25' for level 3-4;
    - 50' from level 5;
    - 200' from level 6
- 25% encroachment into FEMA floodzones with the exception of Queen Creek
- Carter Burgess Alternative 4, retention basins along CAP

Wastewater/Stormwater Storage and Treatment (recommendation from EDAW water resources team)

- 10% of development envelope dedicated to stormwater treatment – distributed throughout community to minimize piping (not shown on plan)

Urban Heat Island

- Heat island addressed through shading and materials, no consideration for urban configuration

Biodiversity

- Follow Pinal County Open Space Master Plan

Trails, Cultural Sites

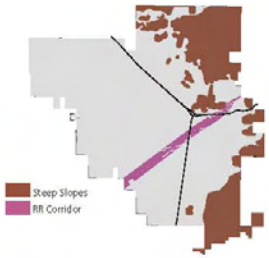
- Follow Pinal County Open Space Master Plan

Topography

- Preserve slopes over 25% only

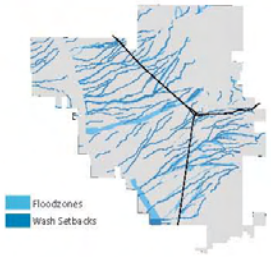
Cultural Sites, Steep Slopes and Trails

> Steep slopes avoided (greater than 15%)
> 1/2 mile+ railroad corridor preserved



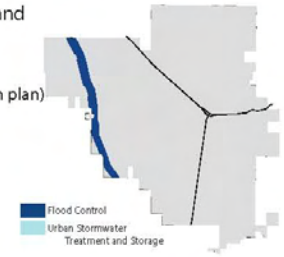
Hydrology: Floodzones and Washes

> Reduce Floodzones by 25%
> Level 3 and greater washes preserved (25'-200' setbacks)



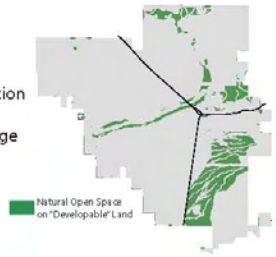
Stormwater, Wastewater and Urban Heat Island

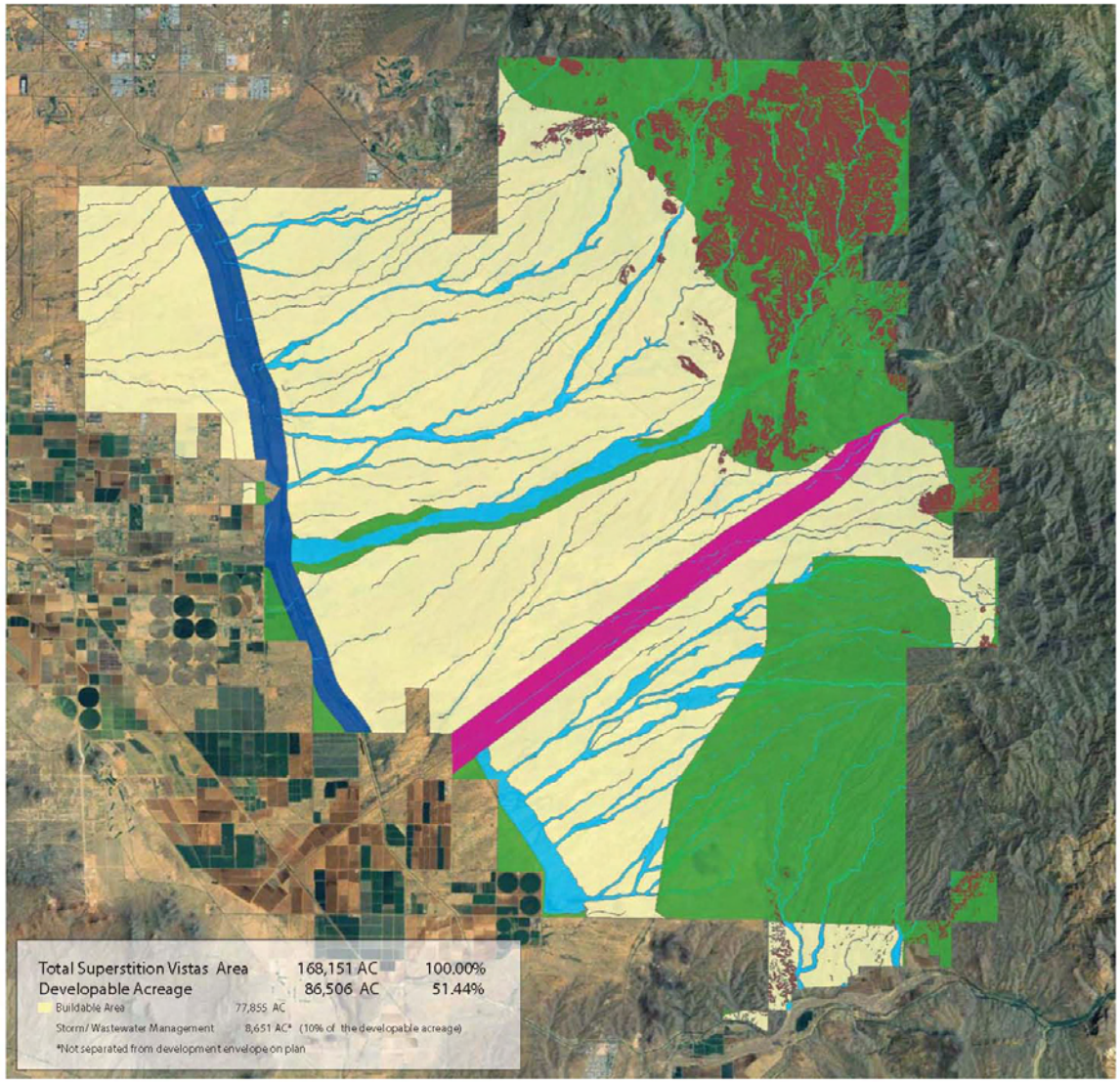
> Channel and basin system installed along CAP
> Urban stormwater managed in basins scattered throughout project (not called out on plan)
> Urban configuration not considered for urban heat island impacts



Biodiversity: Corridors and Reserves

> County open space plan overlay
- Setback from Queen Creek
- Preserve high biodiversity areas near Superstition Mountains
- Preserve Florence National Guard Military Range





Environmental Armature Benchmark 1b: County Open Space Plan Overlay

Superstion Vistas

March17, 2008

EDAW

Concept 2

Currently Accepted Best Practices Concept

This concept integrates the Pinal County Open Space Master Plan; SALT Study recommendations; the Nature Conservancy Conservation Area indicated in the Pinal County Open Space Master Plan; and more generous wash and FEMA setbacks. This concept also addresses the Urban Heat Island effect by aligning drainage corridors and aggregated stormwater treatment zones along washes to maximize cooling benefits of prevailing winds. Ideally, highest density centers would be located downwind of these water management areas. Biodiversity conservation is also addressed by avoiding or sensitively developing areas of high species richness identified by Missing Linkages Project data sets.

Hydrologic Protection (wash flow rates from Wood Patel – setback recommendations from Ecological Resources Team)

- Setback from wash center lines (assumes moderate wash/floodzone setbacks throughout the site except larger setbacks for washes/floodzones that cross high species richness zones):
  - 25' from level 1 in high species rich ness zones only;
  - 25' from level 2
  - 50' from level 3, 200' if they cross higher species richness zones;
  - 100' from level 4, 200' if they cross higher species richness zones;
  - 200' from level 5;
  - 660' from level 6
- Avoid FEMA Floodzones
- Setback 400' from FEMA flood zones for washes that cross zones of higher species richness east of Queen Creek
- Queen Creek min 5280' corridor to maintain habitat function, provide significant park opportunities and to maintain a significant visual buffer between development zones. (Encroachment into this zone is encouraged only for high density and civic oriented land uses that seek to maximize socio-economic benefits of this substantial open space)

Wastewater/Stormwater Treatment (Recommendation from EDAW water resources team)

- 10% of development envelope dedicated to stormwater treatment – aggregated along FCD Settlement Zones and washes upwind of intensive development zones
- 4% additional area dedicated for wastewater treatment wetlands, LID
- Wastewater and stormwater treatment features similar to the Irvine Water District's San Joaquin water treatment plant/wildlife sanctuary are envisioned

Urban Heat Island

- Recommendations are based on urban form design measures recommended by Urban Heat Islands experts at the Experts Workshop on Sustainability and discussions with David Sailor.
- The current FCD Settlement Zone remains in place to leverage it's UHI mitigation benefits of high soil moisture/vegetation across a broad area upwind of urban areas.
- Wastewater/Stormwater Management areas aggregated along washes upwind of urban centers offer added UHI mitigation benefit

Biodiversity

- Follow SALT recommendations
- Includes County Open Space Plan
- Includes TNC recommendation to preserve the "untilled valley" east of Hwy 79
- Considers species richness data from Missing Linkages project
- Avoidance or conservation development is recommended in high species richness zones identified in the Missing Linkages project
- Wider drainage corridors per above that preserve adjacent uplands when they cross high species richness areas
- Biodiversity maintained through preserving existing FCD system and enhanced through UHI mitigation strategies

Trails, Cultural Sites

- County OS Master Plan

Topography

- Preserve slopes under 15% in compliance with LEED ND requirement

Concept 2

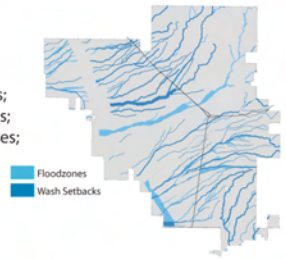
Cultural Sites, Steep Slopes and Trails

> Steep slopes avoided (greater than 15%)
> SALT recommended setback from HWY 60
> 400' railroad corridor preserved

Hydrology: Floodzones and Washes

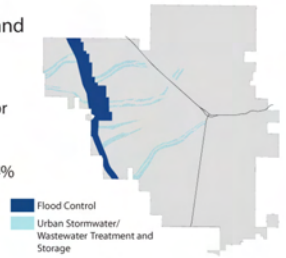
> FEMA floodzones Avoided
> Preserve Level 2 and greater washes (200' min setbacks in high species richness zones)
- 25' from L1 in high species richness zones;
- 25' from L2, 200' in high species richness zones;
- 50' from L3, 200' in high species richness zones;
- 100' from L4, 200' in high species richness zones;
- 200' from L5
- 660' from L6

> 400' setback from FEMA floodzones if they connect high species richness areas
> 200' setback from geologic floodplain of Queen Creek



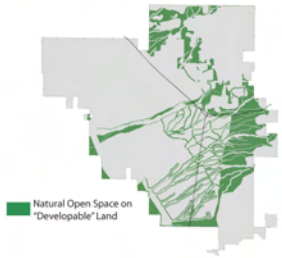
Stormwater, Wastewater and Urban Heat Island

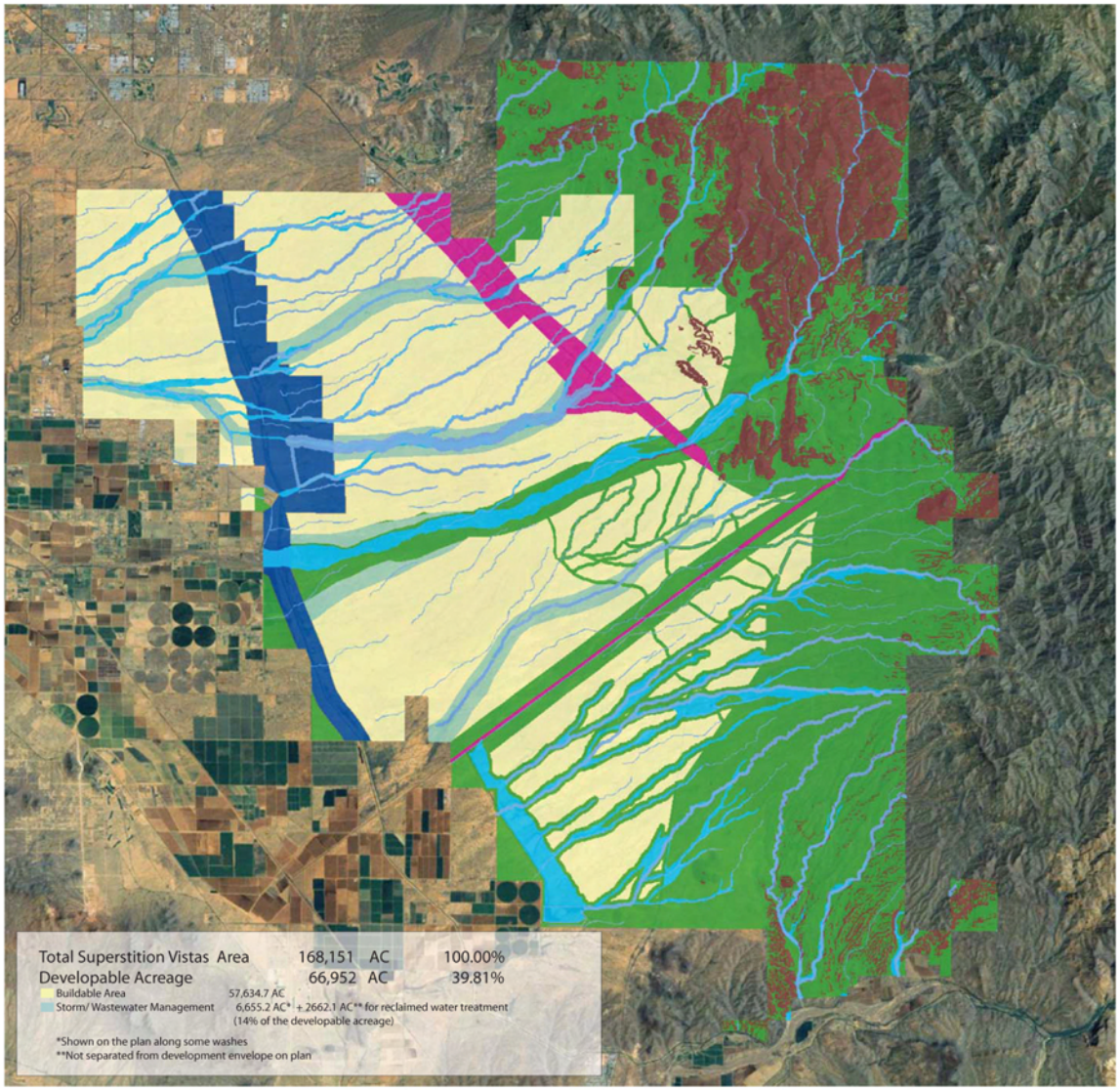
> Maintain existing FCD Dam Settlement Zones, rehab or remove dams. (Existing expansive lush vegetation and soil moisture regime favorable for UHI mitigation)
> Urban stormwater management (10% of development area) and wastewater treatment (4% of development area) aggregated along major washes to help with UHI reduction through ventelation from prevailing east/west winds



Biodiversity: Corridors and Reserves

> Follow SALT recommendations north of HWY 60
> Follow TNC conservation recommendation East of HWY 79
> Avoid highest species richness zones
> 400' upland corridors linking washes in high species richness zones @ 1/4 to 1/2 mile spacing
> Wider wash and floodzone setbacks preserve upland areas within corridors connecting high species richness areas





Environmental Armature Concept 2: Armature Organized Around Drainage Corridors

Superstion Vistas

March 17, 2008

EDAW AECOM

Concept 3

Emerging Best Practices Concept

This concept preserves a substantial network of open space throughout the project area. This network is designed both to maximize biodiversity and ecosystem services and to provide more robust open space necessary to support vibrant and sustainable high density development and equitable access to nature. The network is anchored by a series of 1/2 mile wide corridors organized around washes and ecotones which should provide the most robust biodiversity preservation opportunity. The network is envisioned to be designed to optimize biodiversity preservation and ecosystem services including urban heat island reduction, community agriculture, carbon sequestration, recreation, hydrology management, aesthetics and visual boundaries, air quality improvement, and to provide sites for renewable energy generation. Broad areas of conservation east of Queen Creek provide regional scale preservation of natural communities and significant populations of species. The rationale for such aggressive conservation is that over the course of buildout, climate change will drastically increase species protection needs. Therefore, the level of conservation in this concept is similar to that dedicated in the Orange County Natural Communities Conservation Plan. NCCP's like this one may be a good analog for typical conservation planning the future in all regions of the country.

Hydrologic Protection (wash flow rates from Wood Patel – setback recommendations from Ecological Resources Team)

- Setback from wash center lines (assumes minimum wash/floodzone setbacks north of Queen Creek and moderate setback south of Queen Creek):
    - o 0' or Min 404 requirement from level 1 in Middle Queen Creek Watershed (MQCW) and South of HWY60; 25' from level 1 in high species richness zones;
    - o 0' or Min 404 requirement from level 2 in MQCW and S of HWY60; 25' from level 2 otherwise, 200' if they cross high species richness zones
    - o 25' from level 3 in MQCW and S of HWY60; 50' from level 3 otherwise, 200' if they cross high species richness zones
    - o 25' from level 4 in MQCW and S of HWY60; 200' otherwise, 660' if they cross high species richness zones
    - o 50' from level 5 in MQCW and S of HWY60; 200' otherwise, 660' if they cross high biodiversity zones
    - o 200' from level 6 in MQCW and S of HWY60: 660' from level 6 otherwise
- Avoid FEMA Floodzones in MQCW and S of 60, ¼ mile buffer from FEMA floodzones in Paizano Wash-Middle Gila Watershed (PW-MGW)
- Queen Creek min 5280' corridor, maintain min. 1320 upland corridor on either side.

Wastewater/Stormwater treatment

- Recommendation from EDAW water resources team
- 10% of development envelope dedicated to stormwater treatment – aggregated to along washes in MQCW, parallel to washes as a connecting feature otherwise
- 4% additional area for wastewater treatment wetlands, LID
- Modified CB Alt 9: CAP flood protection system moved to center of development running north south and channel naturalized and combined with wastewater treatment and UHI mitigation through soil moisture engineering

Urban Heat Island

- Recommendations based on sustainability measures from UHI experts at the Superstition Vistas Experts Workshop on Sustainability and discussions with David Sailor.
- Mitigate UHI impact on ecologically sensitive areas downwind of development through modified CB Alt 9 aggregated with wastewater treatment wetlands downwind of high density development zones

Biodiversity

- Recommendations follow conceptual rationale used in Natural Communities Conservation Plans in California and elsewhere.
- Preserve high species richness zones from Missing Linkages Project
- Minimal development adjacent to the Superstition Mountains north of HWY 60. Preserve substantial corridor along Superstition Mountains in this area
- Preserve min. 3 mile wide corridor east of HWY 79 running north/south between Gila River and the Superstition Mountains to preserve Gila River, Sonoran Desert Plain, Superstition Mountains macroecological association present on the site .
- Preserve min. 500 acre core reserve in each of the ecological functional zones south of Queen Creek.
- Preserve ½ mile buffer along ecotones of ecological functional zones outside of MQCW south of HWY 60.
- Optimize open space network edge to area ratio, connectivity index, and Simpson's diversity index outside of MQCW South of HWY60.
- Water treatment facilities optimized for biodiversity to function as corridors.
- Reduce amount of edge compared to area of development envelopes.

Trails, Cultural, Ecosystem Services

- County OS Master Plan for cultural sites
- Large areas of open space network may be used for other ecosystem services (i.e. agriculture, carbon sequestration, renewable energy generation, large parks, etc)

Topography

- Preserve slopes under 15% in compliance with the LEED ND requirement

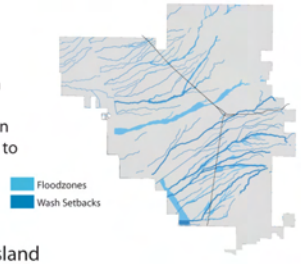
Concept 3

Cultural Sites, Steep Slopes and Trails

> Avoid slopes over 15%
> Preserve trail corridor along RR
> Cultural sites preserved in open space

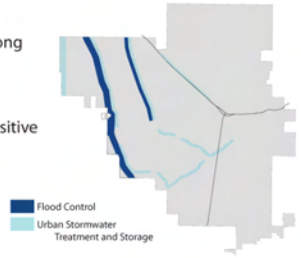
Hydrology: Floodzones and Washes

> Minimum wash setbacks in north
> Broad wash setbacks in south
> Floodzones preserved in south
> Floodzones heavily engineered/mitigated in north
> 200' setback from Queen Creek Floodplain on north bank, 1/4 mile setback on south bank to support wildlife corridor
> Preserve sheetflow in south



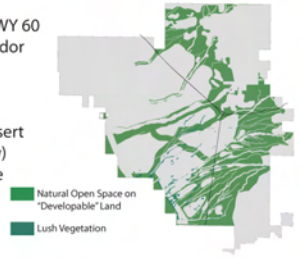
Stormwater, Wastewater and Urban Heat Island

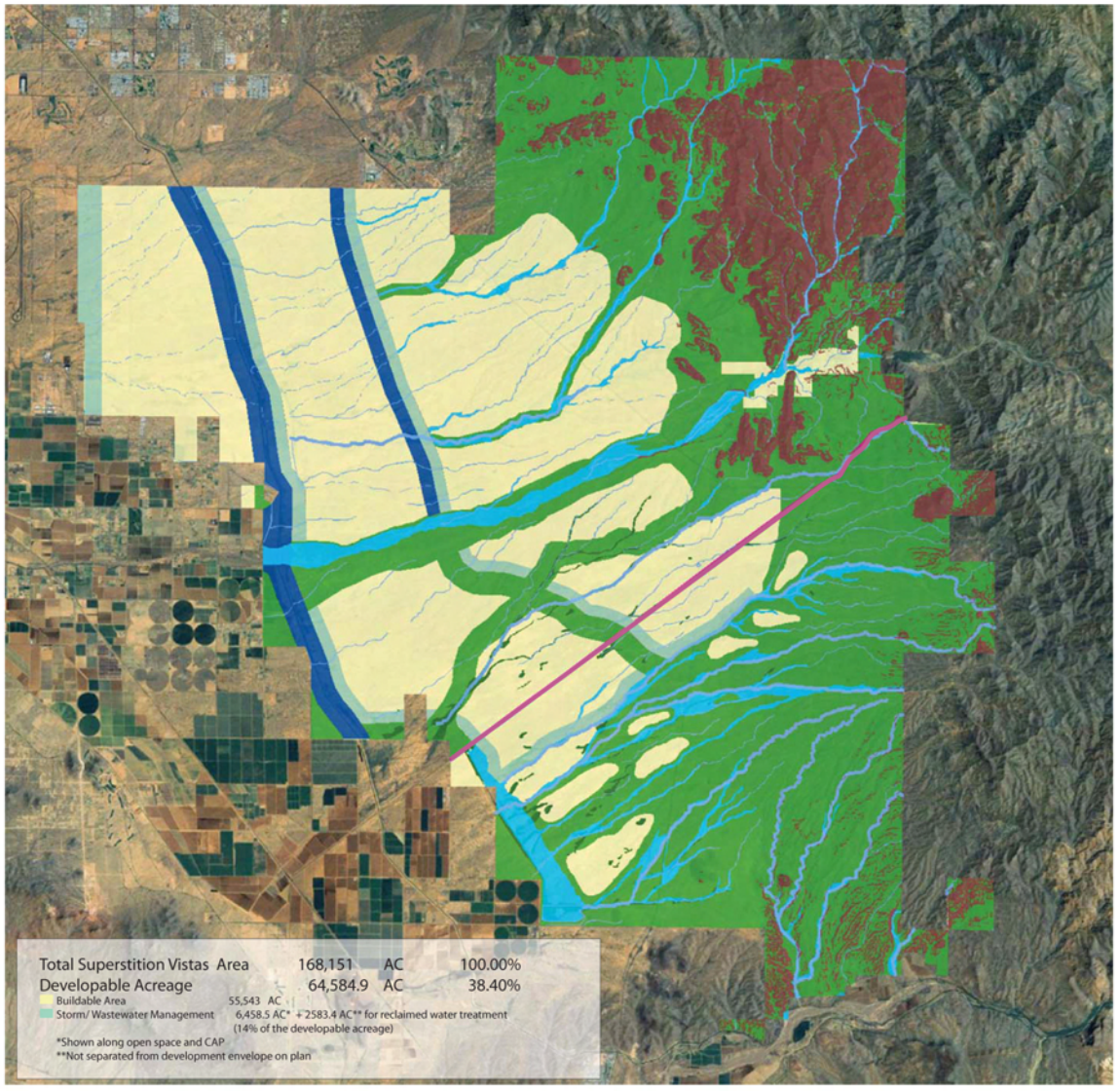
> CAP Flood Control Moved to East Carter/Burgess Alt 7
> Urban stormwater treatment aggregated along N/S open space corridors and flood control features
> Water treatment and storage infrastructure mitigates Urban Heat Island adjacent to sensitive ecological areas



Biodiversity: Corridors and Reserves

> Concept preserves multi-scale natural patterns, processes and species richness
> Preserve high quality vegetation north of HWY 60
> Preserve regional scale Sonoran Desert corridor along Superstition Mountains connected to Gila River
> Enhance Gila River Regional Ecological Corridor - Preserve core area of Sonoran Desert and associated natural processes (sheetflow) adjacent to Sky Islands and Gila River on site
> Broad internal corridors oriented along boundaries of major ecological features including Queen Creek





Environmental Armature Concept 4: Emerging Best Practices Concept

Superstion Vistas

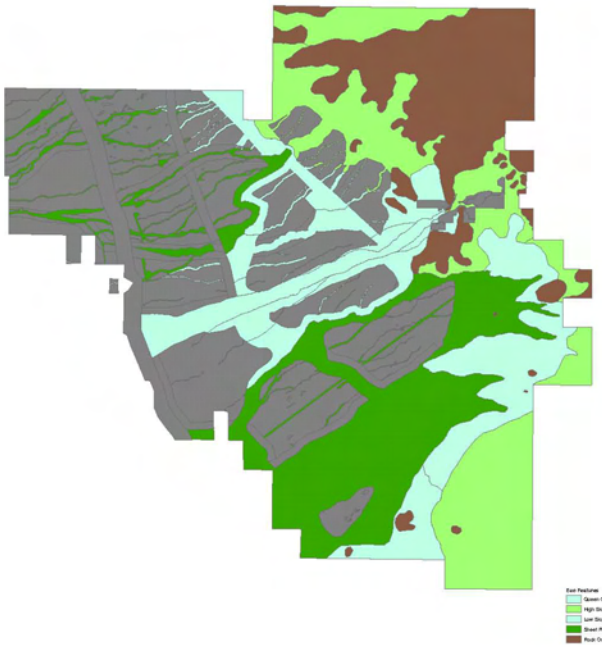
March 17, 2008

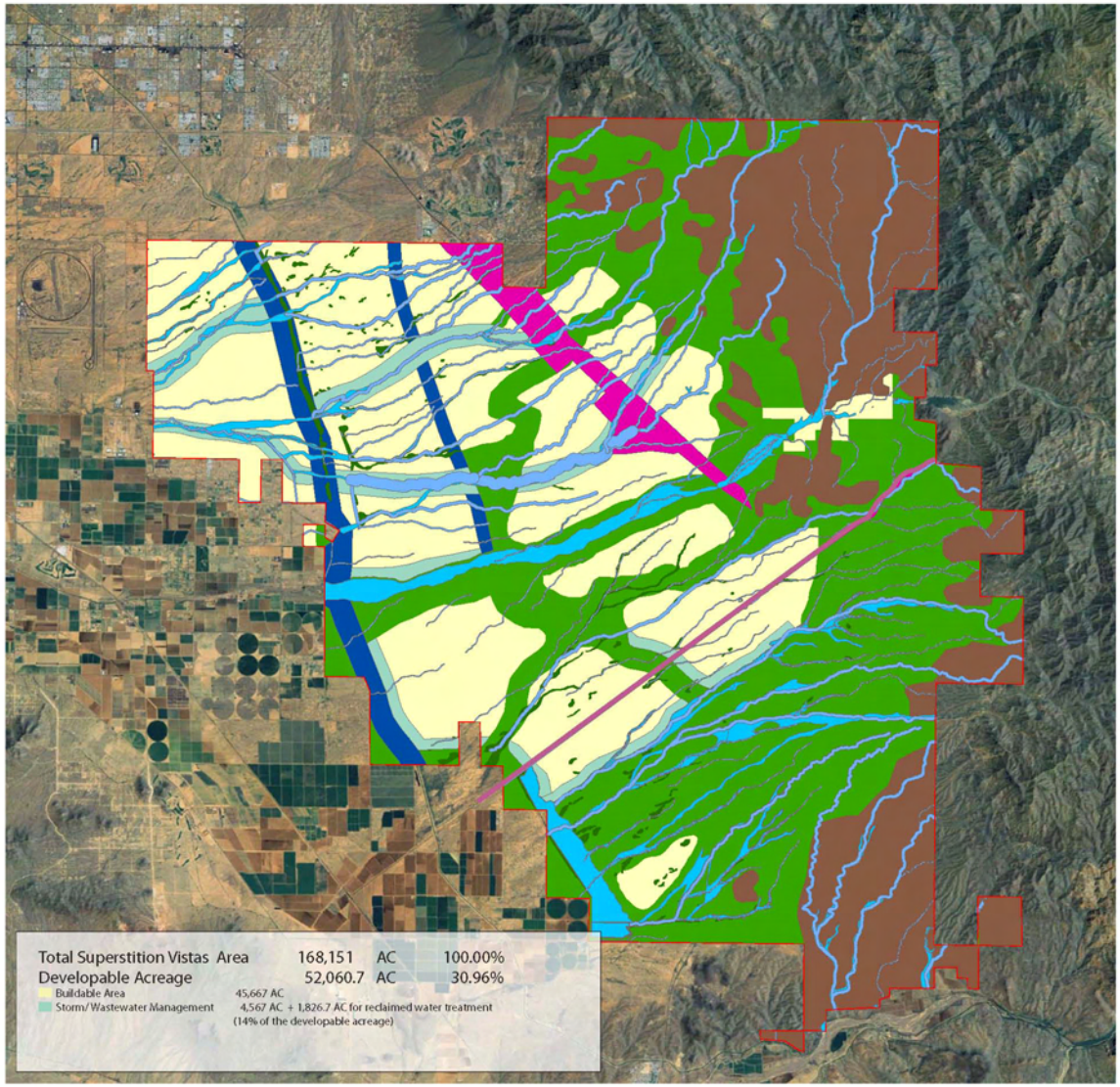
EDAW AECOM

Concept 4

Deep Ecology Concept

This concept integrates all conservation measures from all concepts plus additional measures leading to a maximum conservation scenario for the site. While this concept is an unlikely scenario, it is a useful benchmark from which to compare other scenarios.





Deep Ecology Sustainability Concept (Developable Acreage = 52,060.7 acres)

> Concept preserves multi-scale natural patterns, processes and species richness
> Preserve high quality vegetation north of HWY 60
> Preserve regional scale Sonoran Desert corridor along Superstition Mountains connected to Gila River
> Enhance Gila River Regional Ecological Corridor - Preserve core area of Sonoran Desert and associated natural processes (sheetflow) adjacent to Sky Islands and Gila River on site
> Broad internal corridors oriented along boundaries of major ecological features (ecotones) including Queen Creek

Environmental Armature Concept 4: Deep Ecology Sustainability Concept

Superstion Vistas

March 17, 2008

EDAW

Landscape Ecology Performance Analysis

Landscape Ecology Performance Analysis

The following analysis was performed using the FRAGSTATS Landscape Ecology analysis tool. The performance metrics generated can help to quantify the difference in biodiversity conservation performance between each concept. The following is a description of each of the ecological metrics generated.

Area Conserved

- Percent Conserved
- Percentage calculation of area conserved/ total area
- Higher percentage conserved = Ecologically Desirable
- Also important to consider what areas conserved
    - o Are ecofeatures represented in similar proportions to original landscape?
    - o Are areas of high biodiversity preserved?

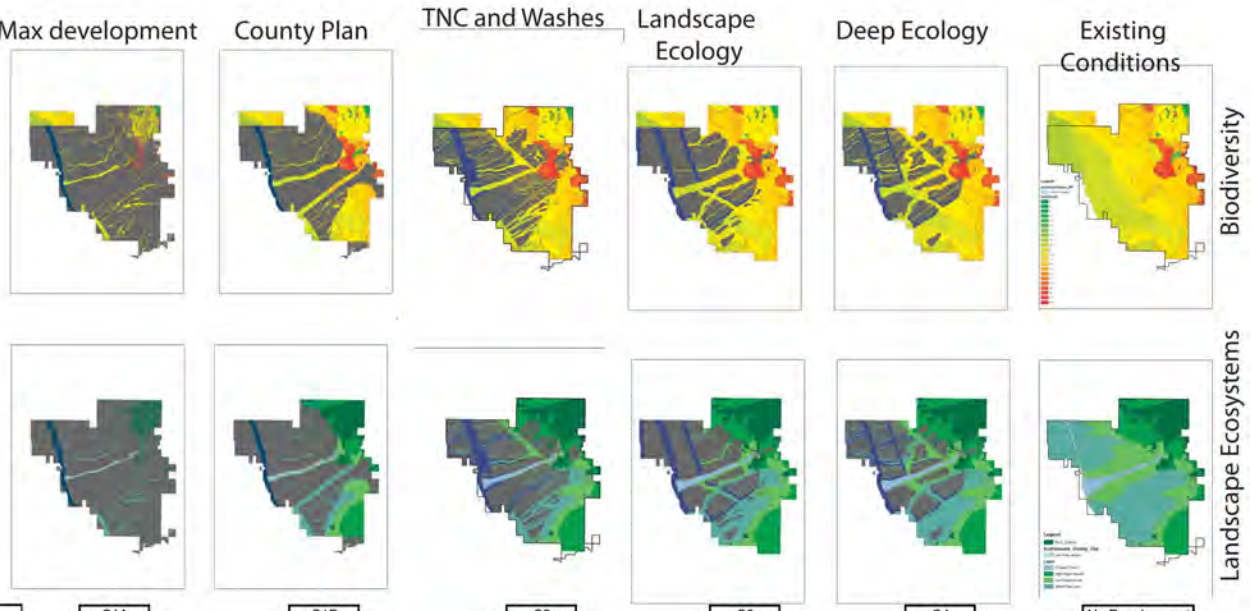
Diversity

- Simpson's Diversity Index (Fragstats)
- Common ecological diversity index
- Considers richness (number of patches or ecofeatures in this case) and Evenness (proportion of landscape represented by each patch/ecofeature)
- Values range from 0 to 1
- SDI = 0 when landscape contains only 1 patch
- SDI approaches 1 as the number of different patch types increases and the proportional distribution of area among patch types becomes equitable
- Higher values = more diversity = Ecologically Desirable

Fragmentation

- Number of Patches (Fragstats)
    - o Equals number of patches in a corresponding class (open space)
    - o NP> 1 without limit
    - o NP = 1 when landscape contains only 1 patch
    - o Lower values = less fragmentation = Ecologically Desirable
- Core Area (Fragstats)
    - o Area of patch not considered edge (100m for SV)
    - o CORE > 0, without limit
    - o CORE = 0 when every patches are all 'edge' (patches are less than 100m in any direction for SV)
    - o CORE approaches total area of landscape as patch shape is simplified
    - o Higher values = more core are = Ecologically Desirable (in this case when edge is developed)
- Edge Density (Fragstats)
    - o Compares total length of edge in a landscape to total area
    - o Values range from > 0, without limit
    - o ED = 0 when there is no edge or when the landscape contains only 1 patch
    - o ED > 0 as number of patches and edge within landscape increases
    - o Lower values = less edge = Ecologically Desirable
- Connectance (Fragstats)
    - o Calculates percentage of maximum possible connectance given the number of patches (ecofeatures)
    - o Values range from 0 – 100
    - o CONNECT = 0 when the landscape contains only 1 patch or none of the patches are connected
    - o CONNECT = 100 when every patch in the landscape is connected
    - o Higher values = more connectivity = Ecologically Desirable

DRAFT 4/9/08
SUPERSTITION VISTAS
STAGE 1 SSIM
Landscape Ecology
and Open Space Metrics



Metric	C1A	C1B	C2	C3	C4	No Development
AREA CONSERVED						
Total Area Conserved	16.2	42.8	55.5	58.2	65.7	100.0
% 4 Queen Creek Conserved	39.4	56.8	68.8	75.6	75.7	100.0
% High Slope Alluvial Conserved	9.3	62.6	83.3	88.7	91.0	100.0
% Low Slope Alluvial Conserved	5.4	31.9	46.3	47.8	59.9	100.0
% Rock Outcrop Zone Conserved	55.0	88.1	99.2	99.7	99.7	100.0
% Sheet Flow Zone Conserved	11.6	24.4	33.0	35.4	45.6	100.0
% Low Species Richness Conserved (6-12 species)	57.3	99.9	76.4	76.6	76.6	100.0
% Medium Species Richness Conserved (13-20 species)	15.1	39.9	52.7	55.5	63.8	100.0
% High Species Richness Conserved (21-28 species)	26.5	76.4	97.0	96.5	96.5	100.0
DIVERSITY						
Simpson's Diversity Index (Fragstats) (EcoFeatures w/Developed as Class)	0.2836	0.623	0.7261	0.7422	0.7779	0.7261
Simpson's Diversity Index (Fragstats) (EcoFeatures minus Developed area)	0.6962	0.7656	0.7669	0.7671	0.7646	0.7261
FRAGMENTATION						
Number of Patches (Fragstats) (Open Space)	825	265	27	91	41	1
Core Area-hectares (Fragstats) (Open Space)						Total Area
Edge Density (Fragstats) (Open Space)	13.1044	6.529	5.237	4.1793	4.0817	0
Connectance Index (Fragstats) (Open Space)	0.7246	2.51	3.9886	2.7839	2.3171	0

Performance Indicators

Case Studies

Wash Design Analogs

The following project analogs represent some of the ideas included in the concepts.

1) This aerial photo includes the Irvine Water District's San Joaquin Wildlife Sanctuary and Treatment Wetlands, Back Bay Nature Area and University of California Irvine treatment wetlands and wildlife area. This major ecological feature within the urban core of Irvine and Newport Beach, CA provides diverse ecosystem services and is one of the best examples of combining water treatment, drainage and wildlife habitat within an urban context. This feature also may provide significant mitigation of the urban heat island effect and is a valuable resource for adjacent high density living in the Irvine Business Complex. This urban ecological corridor ranges between 1/2 and 3/4 miles in width.

2) This stream corridor near Ladera Ranch in Orange County, CA is a good example of designing for habitat preservation. Not only is the floodzone preserved, but upland habitat corridors are preserved on both sides of the floodplain. Bridges also have broad spans to maximize ecological permeability and wildlife movement beneath. This project falls within the Orange County Natural Communities Conservation Plan area.

3) and 4) The Aqua Fria project in Maricopa County integrates parks within the floodzone as well as a natural stream channel.

1.

2.

3.

4.