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C.H. HUCKELBERRY
County Administrator

February 14, 2014

Cal Joyner, Reviewing Officer
United States Forest Service, Southwest Region
333 Broadway SE
Albuquerque, New Mexico 87102

Re: **Formal Objection to Final Environmental Impact Statement and Draft Record of Decision for the Rosemont Copper Project – a Proposed Mining Operation within the Coronado National Forest**

Project Name – Rosemont Copper Project: A Proposed Mining Operation
Responsible Official – Jim Upchurch, Forest Supervisor
National Forest, Ranger District – Coronado National Forest, Nogales Ranger District

Dear Mr. Joyner:

Pima County (lead objector) and the Pima County Regional Flood Control District (District) hereby submit the attached formal objections to the Rosemont Copper Final Environmental Impact Statement (FEIS) and Forest Service Draft Record of Decision (ROD) pursuant to 36 CFR Part 218. We are privileged to have a large number of employees that are experts in their fields and have been involved in reviewing and commenting on this proposed mining project for years. Many of the attached objections were drafted by these individuals, which is why the format may differ from one objection to the next, including a table of formal objections. However, all objections contain the required pre-decisional objection information. Below is a summary of some of our objections.

Mine Life

The County and District are submitting two objections concerning mine life. The first objection is that the mine life included in the FEIS and previous drafts is unrealistic. As we have witnessed with other major copper mines in Pima County, operations have continued beyond 45 years due to a series of temporary closures, market fluctuations that impact the

scale of operations over time, and a reluctance to incur closure costs. The FEIS includes an active mining life of just 25 years. This underestimation results in deficient modeling and analysis of a variety of environmental and social impacts, including the continued impacts to groundwater levels, springs and streams from a longer period of pit dewatering.

The second objection is that there is a failure in the FEIS to consistently define mine life when evaluating environmental and social impacts. In documents prior to the FEIS, the pre-mining and post-mining timeframes varied considerably, and the period of actual mining operations was defined as 20 years. It is unclear whether past modeling and analysis were redone using the longer mine life now contemplated in the ROD and FEIS. The FEIS and final decision should be based on the same mine life that was used for the modeling and analysis of environmental and social effects.

In all, the cumulative and reasonably foreseeable environmental and social impacts that will result from a longer mine life are not adequately identified, analyzed or disclosed.

Proposed Amendment to Forest Plan to Create New Mining Management Area

The County and District are submitting objections concerning a proposed amendment to the Forest Plan to create a new mining "Management Area 16". One objection is to the Forest Service's finding that the amendment to the Forest Plan is "non-significant." This management area is thousands of acres larger than just the area proposed for the Rosemont Mine preferred alternative. The Forest Service fails to consider the impacts that future mining activities within this management area would have on the Santa Rita Unit of the Coronado National Forest, particularly the isolation of the 13,000-acre area of the Forest north of the Rosemont Mine preferred alternative and the mine Management Area 16. Mining in this new management area would also sever wildlife movement corridors between this unit of the Forest, the Rincon Unit of the Forest, and other federal and local conservation areas.

Rosemont had disclosed in the FEIS that they intend to conduct at least $12 million worth of drilling and engineering associated with the Broadtop Butte mineral resource when funds are available. The FEIS includes the sale of federally-owned mineral fractions within Rosemont's patented mining claims in the Broadtop Butte area. If the mineral fractions are sold, there is no Forest Plan opportunity for National Environmental Policy Act (NEPA) review or mitigation of impacts to Forest resources. We disagree that effects of amending the forest plan and selling Broadtop Butte mineral fractions are non-significant.

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Air Quality – Particulate Matter Emissions

The County is submitting an objection concerning modeling deficiencies that have resulted in an underestimation of negative air quality impacts and, therefore, a false determination that the project will meet National Ambient Air Quality Standards. Based on this false determination, the FEIS also lacks sufficient mitigation controls.

Traffic and Transportation Impacts

The County and District are submitting objections concerning the lack of disclosure of increased traffic impacts, including impacts to road pavement conditions; County roadways, including Sahuarita Road and Santa Rita Road; and questionably traffic safety analysis and insufficient mitigation to address traffic safety concerns, including the lack of disclosure in the FEIS of increased death rate details that were included in prior drafts of the EIS.

Pima County Outdoor Lighting Code

The draft ROD and FEIS ignore the fact that the County has the authority to regulate outdoor lighting. This authority has repeatedly been ignored in prior drafts. This refusal to accept the County's authority results from a misinterpretation of a state law. Arizona law does not exempt mining activity lighting from county lighting codes. The FEIS and ROD should include language requiring compliance with the County's lighting code unless written instructions pursuant to the federal Mine Safety & Health Act (MSHA) regulations are provided to the contrary.

Floodplain Regulation

The County and District object to the Forest Service's failure to recognize in the draft ROD the District's authority to regulate floodplain activities on private property related to the Rosemont Copper project and request that the ROD must condition approval of the final Mining Plan of Operations on compliance with the District's floodplain regulations.

Stormwater/Surface water Quantity, Quality and Management

The County and District are submitting numerous objections regarding stormwater and surface water quality, quantity and management.

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- Potential runoff reduction impacts on downstream riparian and water resources for all phases of mine life are not fully disclosed– just the post-closure phase.
- Impacts on Outstanding Arizona Waters for all mining life phases are not fully disclosed.
- Cumulative runoff reduction impacts on downstream riparian and water resources, Davidson Canyon and Cienega Creek, are not fully disclosed.
- Long-term impacts from reduction of sediment yield have not been fully disclosed; and, in particular, such impacts to Outstanding Arizona Waters should be analyzed.
- Lack of detail in mitigation and monitoring plans concerning actions to be taken to restore damages of downstream water and riparian resources.
- Unclear description of how stormwater flows will be monitored after mine closure to assess post-closure and mitigation effects on downstream riparian vegetation and water resources.
- Deficiencies in the analysis of downstream water volume effects on Davidson Canyon, Cienega Creek and Outstanding Arizona Waters have resulted in the underestimation of reductions in surface water flows in FEIS.
- The FEIS does not consider risk from the likelihood of post-fire sediment impacts that could impact drainage infrastructure.
- The method used to estimate erosion is not appropriate to evaluate the impact of mining alternatives (as determined by the developers of the methods themselves) and is far below industry standards.
- The hydrological analysis supporting the surface water evaluation is inadequate, as the modeling should have considered shorter duration, high-intensity rainfall events; and the FEIS misrepresents the methods followed as those prescribed by Pima County.
- Rosemont Copper still intends to capture and retain surface water from watersheds northeast of the tailings, west of the mine pit, and south of the waste rock disposal area. Instead, this water should be released downstream to mitigate reductions in stream flows and impacts to riparian vegetation.

Groundwater Quantity, Quality and Modeling

The County and District are submitting numerous objections concerning groundwater quality, quantity and management.

- The FEIS fails to analyze and disclose impacts to approximately 360 to 370 individual domestic and production wells, apparently because insufficient information was

available. However, an analysis could be based on groundwater modeled drawdown at those locations even with caveats that these are average predictions.

- The FEIS fails to include a well owner mitigation plan for the east side of the mountain range.
- The FEIS underestimates impacts to low flow springs and streams by relying on a five-foot threshold of concern for predicting the environmental and social impacts of groundwater drawdown caused by the mine, including impacts to federally endangered fish and frogs. However, lowering the water table by much less than that may still have significant effects on springs and intermittent and or perennial streams. There is precedent for the use of models based on a one-foot threshold.
- The FEIS relies on inappropriate groundwater modeling boundary conditions, specifically models that do not recognize an impervious boundary on the west along the ridgeline. Without this western boundary, the model underestimates impacts over the long term to Davidson Canyon and other downstream areas.
- The FEIS includes results from modeling of precipitation seepage through waste rock that are unreasonably low; and, if incorrect, could result in underestimates of groundwater quality impacts.
- The FEIS ignores good science and observations that have found that precipitation seepage through waste rock and tailings discharges from a point at a concentrated location (preferential flow) rather than spreading across the entire facility. This discharge results in inadequate mitigation and monitoring at two points only, which increases the likelihood that water quality impacts could be overlooked.
- The FEIS should include Aquifer Protection Permit settlement terms approved by the Arizona Department of Water Quality Appeals Board.

Failure to Follow Forest Service Permitting Process for Wells and Pipelines on Forest Land

The County and District object to the Forest Service's failure to follow its own separate permitting process that requires Rosemont to receive a special use authorization from the Forest Service for the installation of wells and pipelines on Forest land. There is no mention of this permitting process in the FEIS or ROD, no disclosure of the location and sizes of the wells and pipelines proposed on Forest land, and no disclosure of the environmental and social impacts. Our understanding is that such wells would be for the purposes of dewatering the pit and pipelines for transporting the recovered water.

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Cultural Resources

The County and the District continue to share the concerns of the Tohono O'odham Nation and other concerned Tribes about the sheer scale and extent of destruction to significant ancestral archaeological sites, cultural resources, sacred places and springs, and other culturally and historically important places of Ce:wi Duag, a traditional cultural place of the Tohono O'odham and other tribes. These massive impacts will forever negatively alter the cultural landscape of the Santa Rita Mountains, destroying or permanently damaging sacred places, human burial remains, and impacting the social fabric and traditional practices that are essential to the living culture of the Tohono O'odham. Because cultural resources are nonrenewable, these impacts will cause an enormous loss of scientific knowledge. The County and District object to these impacts occurring on public lands; where, in this case, the Coronado National Forest's mandate to preserve and protect cultural and natural resources within the Forest appears to be an unwarranted presumption. The economic value of the proposed mine to the people of Pima County is extremely limited, but the short- and long-term costs and permanent losses to the Tohono O'odham Nation and the EuroAmerican community are immense and simply cannot be justified.

Cumulative Impacts

The County and District submit objections concerning the FEIS' limited consideration of cumulative impacts, including some that have been totally ignored and others that were deemed as not "reasonably foreseeable" despite the high likelihood they will occur. The impacts from the Rosemont Mine cannot be considered in isolation. Not only have the cumulative impacts from the Rosemont Mine not been adequately addressed or disclosed, the FEIS does not consider, as required, the cumulative impacts and degradation of the human environment from past, current, and future mining and how the Rosemont mine will exacerbate these impacts. In particular, the FEIS discloses intent to develop three additional deposits in the vicinity of the Rosemont Mine: "At some point in the future, Rosemont Copper Company intends to conduct further work at Broadtop, to better evaluate the mineral potential." Similar statements are included regarding the Peach-Elgin and Copper World deposits. One of the mitigation measures proposes that the Coronado transfer ownership of small slivers of land to Rosemont Copper. The mineral fractions identified in the map include areas mineral fractions at Broadtop Butte and elsewhere in Management Area 16.

Given that the life of the proposed mine and Rosemont's statements, it is reasonably foreseeable that mining activity in other areas of the prosed new mine Management Area 16, as well as nearby deposits, will occur within that timeframe. Mining these deposits in

conjunction with the proposed Rosemont Mine will have cumulative impacts on the Forest's Santa Rita Unit's nearby communities. To ignore these highly likely impacts simply because no firm development date has been stated by the mining companies is a significant flaw in the FEIS.

Another example is the pending grant to Pima County of a federal Section 10 permit under the Endangered Species Act. It is not listed as a cumulative effect despite the County's insistence. By excluding this pending Section 10 permit, the Forest Service ignored cumulative impacts to species. Issuance of this permit is certainly a "reasonably foreseeable action" by the federal government.

Mining Claim Validity

The County and District object to the fact that the FEIS and draft ROD fail to disclose the Forest Supervisor's decision not to require a mineral validity exam on Rosemont's unpatented mining claims and the impacts resulting from that federal action. The draft ROD and FEIS repeatedly contains statements such as "Federal law provides the right for Rosemont Copper to develop the mineral resources it owns and to use the surface of its unpatented mining claims for mining and processing operations and reasonable incidental uses." This and similar statements are included in the sections on Purpose and Need for Action, Forest Service Decision Space, and Geology. However, these statements assume Rosemont's unpatented mining claims are, in fact, valid claims. Conducting a mineral validity claim is definitely a discretionary decision, but such examinations have been conducted in the past in the Coronado National Forest and resulted in the curtailment of mining operations. This significant decision is a federal action that needs to be disclosed in the FEIS and the ROD, as well as disclosing that the ROD relies on unexamined claims to the federal mineral estate.

Mitigation in General

Many of the objections being submitted by the County and District relate to underestimated impacts that have led to inadequate mitigation and monitoring. From the start of this NEPA process, the County and District have insisted on meaningful mitigation. Based on the FEIS and ROD and continued discussions with the US Army Corps of Engineers (Corps) and the US Environmental Protection Agency (EPA), the project continues to fall short regarding acceptable levels of mitigation for the significant and long-term environmental and social impacts that will result from locating such a heavy industrial use in a relatively undisturbed natural environment.

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Bonding

The County and District raised concerns about bonding and financial assurances during several objections. One consistent theme is that the FEIS underestimates impacts and requires inadequate mitigation for impacts that are identified. Adequate bond is impossible to determine without an adequate FEIS. Little or no information has been provided regarding the financial assurances to be provided by Rosemont to offset costs that would be incurred by the federal taxpayer if the project causes air and/or water pollution that endangers the public health. No discussion has been completed that established any type of performance to assure mitigation and remediation of impacts should the project proponent fail to perform the mitigating or restoration actions stated. Significant and substantial financial assurances must be provided. We understand the Forest is not required to provide this in the FEIS, but we remind you that this was one of the scoping concerns expressed by Pima County, as well as others. In light of the past history of defaults, bankruptcies and inadequate reclamation bonding, we had hoped to see more information in the FEIS about this topic. Our point is that financial assurance is an important part of the regulatory framework to protect federal lands during mine operation, as well as to assure environmental remediation and reclamation. Reliance on the State Mine Inspector's mined land reclamation rules is inadequate because they apply only on private lands, and Arizona's average bond amount per acre ranks as one of the lowest of all the western states.[1]

Summary

My understanding is that the intent of this pre-decisional objection process is to involve you, as the reviewing officer, in helping to resolve outstanding concerns before the Forest Supervisor makes a final decision on the project. It is unfortunate that over 60 letters between the County and the Forest Service or other federal agencies and congressional members, between the start of this NEPA process in 2006 through 2014, were unable to address many of these outstanding concerns. Based on the history of this project, I expect you will be receiving a significant number of objections. The County's objections are based on our responsibility to protect the public's health, safety and welfare.

My staff and I are available to meet with you to discuss our objections should you wish to do so. Although it may not be your role to ensure the adequacy of the FEIS as the basis for the Corps' Clean Water Act Section 404 permit, for the purposes of consistency and

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[1]Kuiper, James R., et al, *Hardrock Reclamation Bonding Practices in the Western United States,* National Wildlife Federation, February 2000.

coordination, I hope you will be considering objections in light of the Corps' decision-making process as well.

Sincerely,

C.H. Huckelberry
County Administrator

CHH/mjk

Attachments

c: The Honorable Chair and Members, Pima County Board of Supervisors
Jim Upchurch, Forest Supervisor, Coronado National Forest
Colonel Kimberly Colloton, Los Angeles District Engineer, US Army Corps of Engineers
Jared Blumenfeld, Region IX Administrator, US Environmental Protection Agency

PREFACE TO
COMBINED PIMA COUNTY/PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT
OBJECTIONS

The following objections to the Forest Service's documents entitled "Final Environmental Impact statement for the Rosemont Copper Project" (December 2013) and the "Draft Record of Decision and Finding of Nonsignificant Forest Plan Amendment for the Rosemont Copper Project" (December 2013) are being jointly submitted by Pima County and the Pima County Regional Flood Control District. For purposes of the objections, "Pima County" or "County" refers to both Pima County and the Pima County Regional Flood Control District.

Other conventions used in the County's objections include:

"FEIS" means the document entitled "Final Environmental Impact statement for the Rosemont Copper Project" (December 2013).

"ROD" means the document entitled "Draft Record of Decision and Finding of Nonsignificant Forest Plan Amendment for the Rosemont Copper Project" (December 2013).

"ADEIS" means the Forests Service's Administrative Draft Environmental Statement (June 2011).

"DEIS" means the Forest Service's Draft Environmental Statement (September 2011).

"PAFEIS" means the Forests Service's Preliminary Administrative Final Environmental Statement (July 2013).

"County June 2011 ADEIS comments" means the combined Pima County/ Pima County Regional Flood Control District comments, filed on June 30, 2011, in response to the ADEIS issued in this matter.

"County August 2011 ADEIS comments" means the additional, combined Pima County/ Pima County Regional Flood Control District comments, filed on August 1, 2011, in response to the ADEIS issued in this matter.

"County DEIS comments" means the combined Pima County/ Pima County Regional Flood Control District comments, filed on January 18, 2012, in response to the DEIS issued in this matter.

"County PAFEIS comments" means the combined Pima County/ Pima County Regional Flood Control District comments, filed on August 14, 2013, in response to the PAFEIS issued in this matter.

Objections to the Apparent Extension of Mine Life

Throughout the EIS process, the various Forest Service-generated documents specify mine life as lasting anywhere from 20 to 30 years.

- The 2007 Augusta Rosemont Mining Plan of Operations estimated mine life was 25 years (MPO Executive Summary, page 1), with the production period being 20 years (page 12).

- Draft EIS: Chapter 2, mine life 20 years, with reclamation occurring from years 21-25. Page 51. 25 year mine life, from construction to closure (page 75). Page 86, proposed mine life is 25 year (20 years of mine operation). Chapter 3, Impacts common to all alternative: The projected active mine life would be approximately 25 years, including construction, operation, reclamation, and closure (page 177). Chapter 3: The groundwater resource commitment associated with the flow into the mine pit is the approximately 16,000-27,000 acre-feet of groundwater withdrawn to maintain minable conditions in the pit during the approximate 20-year active mine life. Page 278. Summary of impacts lists active mine life at 25 years pg 325

- PAFEIS—chapter 2, page 14 estimated mine life 24.5-30 years. Mine life, active mining 20-25 years, post-closure 3 years, total 24.5-30 years. Chapter 2, pg 39-40.

- FEIS: The mine life, including construction, operation, reclamation, and closure is approximately 24.5 to 30 years. Executive summary, page vii with footnote: *The draft environmental impact statement (DEIS) gave the mine life as 20 to 25 years. However, this only refers to the operational mine life, and it has been corrected in the final environmental impact statement (FEIS).* The stages of mine life are as follows: pre-mining (18 to 24 months), active mining (20 to 25 years), final reclamation and closure activities (3 years), and post-closure (indefinite). Chapter 1 Changes from the Draft Environmental Impact Statement: Minor changes were made to clarify the duration of the various phases of mine life, as well as the overall mine life (page 3). Impacts common to all Alternatives: The projected active mine life would be approximately between 24.5 to 30 years, including pre-mining, active mining, and closure and final reclamation. Page 249

Previous County comments concerning mine life

a. ADEIS: Executive Summary/ES-3/line 8-9: *Change to "potentially" estimated mine life of 100,000 acre-feet. Rosemont indicates a mine life of 20-years. This would only be true if the mine operated year-round for 20 years. Based upon similar mines in the Tucson Copper Mining District, mines there have been in operation over 45-years.*DEIS: Executive Summary/ESxii. Comment was not added. In addition, the DEIS should disclose an additional 16,000-25,000AF over mine life would be lost due to pit dewatering. County DEIS comments, No. 18.

b. This DEIS assumed a 20-year operational life, but the DEIS does not clearly state what happens after the time period is up. The Supplemental EIS should tell the reader under what conditions would Rosemont have to renew its operational permit from the Forest, and how periods of inactivity will be defined and treated relative to the overall 25-year term. County DEIS comments, No. 30.

c. A serious evaluation of a 40-year operating life should be made in the Supplemental EIS. This would be more consistent with how open-pit copper mines have actually operated in southern Arizona. A longer timeframe to operate the mine would allow for amortization of investments over a longer time period and provide a longer term of employment for the region. It could also allow for a much smaller mill and reduce instantaneous energy demands. It might allow for different energy solutions. Evaluate tradeoffs from the standpoint of the environmental effects from a slower extraction of resources. County DEIS comments, No. 31.

d. Change to "potentially estimated mine life of 100,000 acre-feet". Rosemont indicates a mine life of 20-years. However, based upon similar mines in the Tucson Copper Mining District, mines there have been in operation over 45-years. County June 2011 ADEIS comments, Special Expertise Required Comment Form, p. 14.

e. A footnote or caveat is needed to indicate that the Rosemont proposal is 20 years. However, as witnessed with the Tucson Copper Mining District, mine life can extent to 40-50 year and beyond. In addition, the duration of effect on water level will continue beyond 20 years. Recovery of the water table from continuous stress for 20 years will not take place instantaneously. Recovery of the aquifer back to baseline conditions may take another 20 years. County June 2011 ADEIS comments, Special Expertise Required Comment Form, p. 14.

f. Economic Impacts: Mine life is stated to be 20 years. However an alternative to place tailings in Sycamore Canyon on fee title lands outside public lands was rejected because it would impede future expansion, while the EIS states it was to protect views from Tucson. This is inconsistent and demonstrates a pattern of grossly underestimated impacts and exaggerated claims of when reclamation would be completed. County August 2011 ADEIS comments, Special Expertise Required Comment Form, p. 4.

g. A footnote or caveat is needed to indicate that the Rosemont proposal is 20 years. However, as witnessed with the Tucson Copper Mining District, mine life can extent to 40-50 year and beyond. In addition, the duration of effect on water level will continue beyond 20 years. Recovery of the water table from continuous stress for 20 years will not take place instantaneously. County August 2011 ADEIS comments, Special Expertise Required Comment Form, p. 16.

Objection 1 Unrealistic Mine Life

Throughout the EIS process, the County and the District have repeatedly requested that the Forest Service base its study on a more realistic mine life. See comment references "a" through "g", above. Despite the confusing array of time periods discussed for the different phases of the mine life, none take economic reality into account. County comments point out that mines frequently temporarily suspend operations for a variety of reasons. Based on past copper mining history in Arizona, these temporary cessations are the norm rather than remote prospects.

Despite the high likelihood of temporary cessations and the resulting significant extensions of mine life, the FEIS and ROD fail to adequately discuss the impacts of the temporary cessations. In particular, dewatering and other impact-causing activities may occur at the facility during the cessations. The FEIS

must identify these activities and the impacts resulting from them. They also fail to analyze impacts resulting from multiple cessations periods.

Failure to consider and discuss these impacts flies in the face of the "hard look" standard imposed on federal agencies conducting environmental impact statements. The impacts of highly probable delays in reclamation and closure are "direct effects" as defined by 40 CFR § 1508.8(a) and discussion of those effects is required under 40 CFR § 1502.16. The Forest Service's failure to recognize these direct effect also means that the FEIs includes no discussion of mitigation options, as required by 40 CFR § 1502.16(h). The Forest Service must supplement the FEIS to include a discussion of temporary cessation impacts and their resulting extension of mine life.

Objection 2. Failure to Properly Define Mine Life When Evaluating Impacts

As discussed in objection 1, above, the various public documents released for comment by the Forest Service inconsistently define the life of the proposed Rosemont mine. Until the PAFEIS and FEIS, the inconsistencies pertained to the pre-mining and post-mining periods. The prior documents defined the actual mining operation period as 20 years. For the first time, the PAFEIS expands the total mine life as ranging from 24.5 to 30 years with the active mining period ranging from 20 to 25 years. The FEIS expands active mining life to 25 years.

It is not clear from the record that the Forest Service considered environmental impacts, especially groundwater extraction in the Sahuarita wellfield and the dewatering in the Cienega Basin, on a 25-year active mining basis. Was the basis for modelling a 20-year or a 25-year active mining period? The FEIS must clearly explain the active mine life basis for its impact discussion. Furthermore, if the ROD is based on improper mine life modelling periods, the ROD must limit active mine life to 20 years.

Objection to "Finding of Nonsignificant Forest Plan Amendment"

In the draft ROD, the Forest Service formalizes its finding that its proposed amendment to the Forest Plan is "nonsignificant." This was briefly discussed in the DEIS (Chap. 2, pp. 89-96) wherein the Forest Service proposed creation of a new Management Area 16 and made a preliminary finding of nonsignificance. Pima County and the Pima County Regional Flood Control District, in their January 18, 2012 DEIS comments, included the following comment:

> 44. The DEIS should contain an explanation of the basis for the Supervisor's finding that the amendment is "nonsignificant".

The Forest Service response to that (and comments by others) concerning the finding is:

> Several comments expressed concern about the necessity and appropriateness of amending the "Coronado National Forest Land and Resource Management Plan," as amended (forest plan) (U.S. Forest Service 1986), for this project and questioned the nonsignificant determination for the amendment. The amendment process and significance determination were reviewed in light of applicable direction and regulation. The review determined that no substantial changes to the process or determination were needed.

FEIS, Chap. 2, p. 26. The FEIS contains no other reference to the nonsignificance finding.

In the ROD, the Forest Service discusses, for the first time, its rationale for the nonsignificance finding. ROD, pp. 57-59. This rationale relies primarily on the size ratio between the new Management Area and the total Coronado National Forest while conceding that "effects are substantial" but 'highly localized." ROD, p. 59. The Forest Service also concedes that "environmental effects could extend beyond the Rosemont area." ROD, p. 58.

Pima County and the Pima County Regional Flood Control District object to the Forest Service attempt to marginalize the impacts of proposed amendment allowing mining activity within Management Area 16 by determining significance through comparison to impacts on the Forest, as a whole. The effects within the proposed Management Area and within the Santa Rita Unit of the Forest will be substantial. They will "significantly alter the multiple-use goals and objectives for long-term land and resource management" within the Rosemont area, the proposed Management Area 16, and the Santa Rita Unit and, therefore, the proposed amendment warrants a "significant" determination when using the FSM 1926.51(1) criterion.

DRAFT

Pima County Air Quality Objection

Pima County objects to the FEIS because it does not accurately analyze the impact the Rosemont Mine would have on the air quality within Pima County. Pima County commented on the air quality analysis during the public comment period for the Draft Environmental Impact Statement (DEIS) and the Preliminary Administrative Environmental Impact Statement (PAEIS). These comments addressed a number of modeling deficiencies that were not adequately addressed in the Final Environmental Impact Statement (FEIS).

The Barrel Alternative increases the PM_{10} concentration from a background concentration of 47.7 $\mu g/m^3$ to a maximum concentration of 148.8 $\mu g/m^3$. Pima County believes that proper modeling would result in additional negative air quality impacts that show the alternative is not protective of NFS resources beyond the perimeter fenceline and exceed the National Ambient Air Quality Standard (NAAQS) for PM_{10} of 150 $\mu g/m^3$. In order to mitigate the negative air quality impacts, the Forest Service Supervisor would need to require additional controls which are not currently in the FEIS.

Pima County's comments to support this objection that have been submitted in writing during the public comment periods are:

> **DEIS - Comment 223 -** Stormwater control system as a source of dust. The perimeter ditches and peripheral detention basins, as well as the on-surface evaporation ponds should be included in the model as sources of dust, as well as grading operations.
> and
> **PA-EIS Comment - Chapter 3, Page 9, Line 3 -** The Forest Service claims that perimeter buttresses of waste rock will "break up the air flow". They ignore the possibility that the buttresses will instead induce strong turbulent eddies and thereby actually promote wind erosion.
>
> **DEIS -Comment 227 -** Tailings Storage Emissions. Rosemont has grossly underestimated PM emissions from the Tailings Storage pile (TDS10). If the correct Tailings Storage emission factor were to be used in the AERMOD projections then the PM levels would be even higher than already predicted.
> and
> **PA-EIS Comment - Chapter 3, Page 8, Line 36 -** Particulate matter emissions from the Tailings Storage areas have been grossly underestimated. If the correct Tailings Storage emissions factor were to be used in the AERMOD projections then the modeled particulate matter levels would be greater than predicted.
>
> **DEIS - Comment# 232 #'s 1&2 -** Rosemont relies on an EPA document (AP-42, Section 13.2.5; November, 2006) to calculate PM10 emissions, but makes a number of serious mistakes while doing so. The effect of wind strength is incorporated through the concept of wind speed at the surface, the surface friction velocity (m/s). Rosemont erroneously uses the surface threshold friction velocity for coal dust instead of using the value for mine tailings, thereby significantly underestimating tailings emissions. Rosemont used = 0.43 m/s instead of = 0.172 m/s, the value actually measured for copper mine tailings at Hayden, AZ (Nickling and Gillies, 1987). A lower value means that it is easier to create dust from mine tailings than from coal dust.
> and
> **PA-EIS Comment - Chapter 3, Page 9, Line 3 -** When estimating the dust arising from wind erosion of the tailings impoundments the Forest Service relies on an assumed threshold friction velocity of 0.43 m/s. This is two-and- a-half times higher than the threshold actually measured for mine tailings at Hayden, Arizona, of 0.17 m/s (Evaluation of Aerosol Production Potential of

Type Surfaces in Arizona, W. G. Nickling and J. A. Gillies, 1986). By using such a high threshold, the Forest Service has severely underestimated the ability of the wind to cause erosion. They have set the bar unreasonably high and again, they have failed to take a conservative approach.

DEIS - Comment# 232 #4 - In these calculations, Rosemont assumed that each year the number of disturbances N = 1 because "the tailings storage area will only be disturbed when tailings are added". This statement makes no sense at all. It appears that Rosemont has not interpreted N correctly. N = the number of disturbances of the tailings pile that are expected each year, and the "disturbance" is the wind, not the addition of tailings. The addition of fresh tailings every day ensures a steady supply of erodible material for the wind to disturb so there is no shortage of material. The single event EF calculated above must be multiplied by the expected number of windy days each year. For the sake of this argument, arbitrarily define "windy" as an hourly maximum wind speed ≥7 m/s, and then after examining the meteorological data gathered by Rosemont at their site, assume an average of approximately 3 windy events each month (36 events/y), i.e., N = 36.
and
PA-EIS Comments in '13-07-22 Eric Betterton Comments on ADEQ Permit Application and Mining Plan Revision Final Draft July 19 2013'

DEIS - Comment# 232 #5 - Rosemont used just one value of wind speed, the "fastest mile" ever recorded over a three year period of 10.7 m/s, to represent the effect observed wind speed. This value is twice as high as the threshold wind speed reported by Nickling and Gillies (1987) for Hayden mine tailings (5.11 m/s).
and
PA-EIS Comment - Chapter 3, Page 9, Line 4 - The highest wind speed recorded over the three year period is listed as 10.7 m/s, to represent the effective observed wind speed. This value is twice as high as the threshold wind speed reported by Nickling and Gillies (1987) for Hayden mine tailings (5.11 m/s).

Based upon these comments, Pima County objects to the FEIS air quality analyses of the Rosemont Mine and the negative impacts it would have on air quality. Pima County believes that the air quality impacts of the Rosemont Copper Mine Project should be reevaluated with further air quality modeling using more appropriate parameters as identified in the County's comments. By evaluating the full scale of the negative air quality impacts from the mine, the Forest Service Supervisor can require additional mitigation and appropriate control strategies to ensure air quality beyond the perimeter fenceline is protected and the mine is in compliance with the federal clean air standards.

Objection to the Forest Service's Failure to Require Compliance with the Pima County Lighting Code

On pages 44 and 45 of the draft ROD is a section entitled "Permit, Licenses and Authorizations Needed to Implement the Decision." The list of required submittals includes no reference to the Pima County Outdoor Lighting Code. Pima County Code, Ch. 15.12. There is limited discussion of the Code requirements on page 754, chapter 3, of the FEIS wherein the Forest Service essentially punts on the issue of the Code's applicability to Rosemont.

Pima County offered numerous comments on the applicability of the Code to Rosemont's lighting scheme. These include:

> Outdoor lighting is regulated by Pima County under A.R.S. §11-861 and §11-251(35), the latter of which provides counties authority to adopt and enforce standards for shielding and filtration of commercial outdoor portable or permanent light fixtures in proximity to astronomical observatories. The *2006 Pima County Outdoor Lighting Code* has been adopted under these Statutes and comprises standards for shielding and filtration accomplished through regulating fixture geometry, lumen output and spectra. Mines are not exempt from standards for shielding and filtration adopted under A.R.S. §11-251(35). County DEIS comment, No. 492.
>
> Contrary to the claim in the *Rosemont Mine Outdoor Lighting Pima County Outdoor Lighting Code Technical Mem*o (M3-PN08036), the *2006 Pima County Outdoor Lighting Code* applies to the Rosemont site including all developed areas and roadways. More specifically, Rosemont is required to comply with this code and/or subsequently adopted editions for all fixed and portable outdoor lighting. Furthermore, and in line with the intent of the regulation, maximum lumen and lamp type output shall be limited to the net acreage of developed areas and not to the entire Rosemont site as proposed in the technical memo. Developed area calculation for lumen cap purposes shall be limited to roads, parking lots, mine process area and a set allowance for the portions of pit, waste rock, tailings and leach pads actively in use at any given time. County DEIS comment, No. 493.
>
> Lighting plans are discussed out of context of legal requirements to meet 2012 Pima County Outdoor Lighting Code for which no plans have to date met scope requisite for analysis. County PAFEIS comments, Document Review Comment Form, p. 14.
>
> Lighting plans cannot be proposed or considered that do not meet the 2012 Pima County Outdoor Lighting Code. County PAFEIS comments, Document Review Comment Form, p. 14.
>
> Lighting impact continues to reference plans not reflecting compliance with the 2012 Pima County Outdoor Lighting Code. This approach is prevalent throughout the Dark Skies section. County PAFEIS comments, Document Review Comment Form, p. 14.
>
> Incorrect reference to enabling legislation for lighting at 11-830 as lighting regulating mines is enabled under §11-251(35). County PAFEIS comments, Document Review Comment Form, p. 14.
>
> Concludes with a "mitigation plan" which has not demonstrated compliance with the 2012 Pima County Outdoor Lighting Code. County PAFEIS comments, Document Review Comment Form, p. 14.

> Implementation of an outdoor lighting plan needs to capture that it requires compliance to the 2012 Pima County Outdoor Lighting Code. County PAFEIS comments, Document Review Comment Form, p. 14.
>
> Impacts to dark skies are listed as "…being mitigated to the extent possible, given the mine's need to operate 24 hours a day and safety requirements. Thus this conflict cannot be rectified." Mitigating to the extent possible requires full compliance with the 2012 Pima County Outdoor Lighting Code which is again absent from this section. If safety requirements cannot be reconciled with outdoor lighting code compliance, then the mine should not operate 24 hours a day. 24 hours/day operation is a desire on the part of the mine and not a "need". County PAFEIS comments, Document Review Comment Form, p. 14.

Pima County objects to the Forest Service's continued reluctance to require compliance with the Pima County lighting code (Pima County Code, Ch. 15.12). Rosemont asserts that it, pursuant to A.R.S. § 11-812, is exempt from the Pima County lighting code but cannot explain away the County's authority under A.R.S. § 11-251(35).

Nothing in A.R.S. §11-812(A)(2) suggests that it is intended to supersede county ordinances enacted pursuant to rulemaking authority granted under any chapter of ARS Title 11 than Chapter 6. Indeed, the sole basis for Rosemont's argument is the language found in subsection 11-812: "[n]othing contained in any ordinance authorized by *this chapter* shall . . . [p]revent, restrict or otherwise regulate the use or occupation of land or improvements for . . . mining . . . purposes." A.R.S. § 11-812(A), *emphasis added*. Section 11-812 is found in A.R.S. Title 11, Chap 6; Section 11-251(35) is found in A.R.S. Title 11, Chap. 2. By the plain language of subsection 11-812(A), it does not apply to any regulatory authority granted to Pima County under A.R.S. Title 11, Chap. 2.

Pima County recommends that the ROD be amended to recognize Pima County's authority to regulate Rosemont's lighting design and lighting operations. Furthermore, if the mine is unable to comply with the County lighting code, night-time operations should be prohibited.

Objection to Forest Service's Failure to Recognize FCD Permitting Authority

Pima County and FCD previously commented on this issue in their June 30, 2011 comments concerning the ADEIS. These comments include:

a. Floodplain Use permitting must be added to Table 2-Permit for authorizations applying to the proposed Rosemont Copper Mine. In Chapter 3 of the DEIS, Rosemont recognizes the authority of RFCD to regulate flooding, erosion and riparian habitat for private land in Pima County. However, in Chapter 2, no permits are being requested from RFCD. According to statutes above Flood Control District has authority to

   1.) regulate floodplains on private land with discharges > 100 cfs.
   2.) regulate structures that divert, retard or obstruct flood water.

   Furthermore, RFCD may not regulate tailings dams and waste disposal areas connected with mining.
   Since water is being diverted on private land, and Rosemont's surface hydrology model prepared by
   TetraTech indicates a 100-yr discharge exceeding 100cfs, all drainage on private land that is not tailings dams or waste disposal is subject to jurisdiction of RFCD and applicable permitting. The following should be added to Table 2.

Agency	Permit or Authorization	Purpose
Pima County Regional Flood Control	Floodplain Use Permit	Regulate floodplains on private land with discharges > 100 cfs (16.08.600) Regulate structures that divert, retard or obstruct flood water (16.12.020)

   Private parcels on which structures are proposed to divert, retard or obstruct flood flow in the proposed alternative and for which Rosemont's hydrologic model indicates a 100-yr peak flow exceeding 100 cfs include, but are not limited to, Tax IDs:

   30564008A
   305640040
   305640060
   305640020
   305640050
   305640070
   305640030
   30562012C
   30562012A

   County June 2011 ADEIS comments, Jurisdictional Required Comment Form, p. 11

b. Hydroriparian and Mesoriparian habitat are subject to the same regulations under the Pima County Floodplain Management Ordinance. No regulatory distinction is made between the two classes. These stream reaches have intermittent flow, a criteria of mesoriparian habitat. If an applicant seeks to amend the riparian classification, plant surveys and documentation will be

required and is subject to Pima County review and approval to issuance of a Floodplain Use Permit (FPUP). County PAFEIS comments, p. 83.

c. Even simple requests were ignored, such as our repeated requests the the Regional Flood Control District be listed as a permitting agency . . . . County June 2011 ADEIS comments, p. 2.

Despite those comments, the FEIS makes no reference to the District's authority. Further, the ROD does not make floodplain permitting a condition of MPO approval.

The District has authority, pursuant to A.R.S. § 48-3609 and Pima County Code § 16.20.010, to regulate activities and construction if those actions divert, retard or obstruct the regulatory floodplain. The District's jurisdiction includes "incorporated and unincorporated areas of the county, including public lands . . . ." A.R.S. § 48-3601(1). Regulated actions may include features such as water supply pipelines, roadway construction, channel construction, etc. Included in this permitting would be the evaluation of disturbance of regulated riparian habitat and mitigation if necessary. State law excludes permitting and prohibition of mining-related tailings dams and waste piles from District authority. A.R.S. § 48-3613(B)(3). However, the District has the authority to require information filings on those activities.

The County and District object to the Forest Service's failure to recognize the District's authority to regulate floodplain activities related to the Rosemont Copper project. The FEIS must include recognition of that authority and the ROD must condition approval of the MPO on compliance with the District's floodplain regulations.

Two Draft Objections to FEIS and ROD

February 11, 2014 mk

OBJECTION 1

Significant surface waters from the western and southern portions of the mine site should be released in perpetuity for downstream discharge

Rosemont Copper still intends to capture and retain surface water from an approximately 1 square mile watershed to the west of the mine pit and along the southern perimeter of the waste rock disposal area. This water should be released downstream into Trail Creek in perpetuity as part of the site water management plan.

Prior Written Comments and Relation to Objection

Prior written comments can be found at: *Pima County Comments - Rosemont Copper Mine Preliminary Administrative Final Environmental Impact Statement*, August 14, 2013, pp. 161-162, figure p.163

This objection and the prior written comment address the same subject matter.

Description of Aspects of the Proposed Project Addressed by the Objection

As shown in the PA DEIS (Chapter 2, p57, Figure 19 – Barrel Alternative Stormwater Concept) and on Figure 13 (Barrel Alternative Landform) of the CDM Smith *Preliminary Reclamation and Closure Plan* (July 2012), two Perimeter Containment Areas (PCA2 and PCA3) are to be located along the southern boundary of the Waste Rock disposal mound. The PCAs are stormwater retention basins, intended to capture and hold all incoming surface water, with no release to downstream drainages.

Objection Figure 1 (February 2014) is based on Figure 13 (Barrel Alternative Landform) of the CDM Smith *Preliminary Reclamation and Closure Plan* (July 2012). As shown on Objection Figure 1, stormwater which is intended to be collected and retained in PCA2 and PCA3 includes contributions from: the lower slopes of the Waste Rock mound and adjacent upper slopes of the Barrel Canyon watershed (Area 1), and the entire upgradient watershed area associated with the Pit Diversion Channel (Area 2). Area 1, comprising the area which is not planned for downstream drainage between the Waste Rock mound and the upper Barrel Canyon watershed divide, has a surface area of about 335 acres. Area 2, consisting of a mountainous watershed which sheds surface water to the Pit Diversion Channel for transfer into Area 1, has a surface area of about 240 acres with an approximate 100-yr discharge of 1800 cubic feet per second. Combined, Areas 1 and 2 have a watershed surface area approaching 1 square mile in size.

As noted in the FEIS Volume 2, Chapter 3 of the DEIS under *Barrel Alternative-Stormwater Management after Closure*, p. 425 "The diversion channel west of the pit would collect precipitation in stormwater retention ponds along the southern toe of the waste rock facility and would be allowed to infiltrate as aquifer recharge, but it would not be able to flow downstream as surface water due to topography".

The "topography" referenced here is simply the geometric result of construction of the waste rock pile onto the existing slopes of upper Barrel Canyon (the resultant surface of the large graded pile superimposed on hilly topography nearby the upper watershed boundary). As a result of construction, stormwater collecting in Area 1becomes trapped between the lower slopes of the Waste Rock mound and the existing, undulating upper slopes of the head of Barrel Canyon. As noted above, in addition to the capture of all waters from the Area 1 watershed, all water collected from the Area 2 watershed and transmitted by the Pit Diversion Channel is also captured and held without release in these two large surface water trapping areas.

Stormwater retained in PCA2 and PCA3 is problematic both during mining operations and throughout the post-closure period. Retained stormwater will reduce the quantity of surface water which is released downstream of the mine site. This represents a significant, permanent reduction of a valuable downstream surface water resource, with associated adverse impacts to habitat and riparian resources, and downstream recharge.

In addition, stormwater ponded against mounded waste rock to depths of up to about 50 ft may cause leaching of contaminants as the ponded water moves laterally into and through the waste rock mound. The infiltration of ponded water from PCA 2 and PCA 3 through the waste rock materials may also infiltrate tailings materials deposited downstream within the Barrel Canyon channel, with the potential to cause additional contamination of surface water and shallow groundwater downstream of the mine site.

<u>Suggested Remedies to Resolve the Objection</u>

Surface waters collected in Areas 1 and 2 certainly do <u>not</u> have to be captured and held in PCA2 and PCA3. These waters can, and should, be collected and transferred via a continuous perimeter drainage channel, and released downstream into the Trail Creek - Barrel Canyon drainage system as a fundamental stormwater management component of the facility operational and postclosure condition.

The Forest Service should require Rosemont Copper to professionally design and construct a stormwater management channel along the southern perimeter of the Waste Rock mound to collect and transmit surface waters from the Pit Diversion Channel (Area 2 on Objection Figure 1), and the lower side slopes of the Waste Rock mound and adjacent upper Barrel Canyon watershed (Area 1 on Objection Figure 1). The stormwater management channel would transfer these surface waters into the FEIS Wrap-A-Round channel alignment located at the east end of Area 1 (Objection Figure 1). From this point, the collected surface waters

could then be transferred around the eastern side of the Waste Rock mound for release downstream in perpetuity into Trail Creek at location SW-2, the outlet of the Wrap-a-Round channel.

There is sufficient grade for a continuous perimeter stormwater channel from PCA2 all the way around to the Trail Creek outlet at location SW-2. As shown on Objection Figure 1, the Waste Rock mound perimeter distance from Point SW-1 (elev ~ 5220 msl) to Point SW-2 (elev ~ 4820 msl) is about 20,000 ft, with a corresponding elevation drop of about 400ft. This corresponds to an average slope of approximately 2% for the perimeter system.

Construction of a stormwater management channel through the Area 1 zone could be accomplished by integrating and implementing the following operations:

A. Design the stormwater channel per standard engineering state of the practice, including minor modifications to the geometry of the southern Waste Rock mound side slopes to facilitate passage of perimeter stormwater.

B. Per the final design, perform the necessary excavations and fills through the hilly topographic slopes of upper Barrel Canyon adjacent to the Waste Rock mound, in order to obtain the required width and channel grade of the perimeter stormwater managment system.

C. Utilize abundant waste rock materials for construction of the perimeter stormwater management channel, including placement of waste rock materials within the channel area between the Waste Rock slope and the upper Barrel Canyon slopes. Utilization of waste rock as a construction fill material will reduce the volume of excavation required into the existing side slopes.

Design and construction of a continuous perimeter stormwater system is doable, has real benefits to the community and environment, and factually constitutes a minor part of these primary planned mining operations:

- Excavation and disposal of 1.9 billion tons of waste rock and tailings
- Creation of a permanent 4.5 square mile waste disposal landform on Federal and State lands

OBJECTION 2

Significant surface waters from the northeast portions of the tailings mound should be released in perpetuity for downstream discharge

Rosemont Copper still intends to capture and retain surface water from an approximately 75 acre watershed area on the lower side slope of the northeastern portion of the tailings mound. This water should be released downstream into Barrel Canyon as part of the site water management plan.

Prior Written Comments and Relation to Objection

Prior written comments can be found at: *Pima County Comments - Rosemont Copper Mine Preliminary Administrative Final Environmental Impact Statement*, August 14, 2013, p. 163 and figure on same page

This objection and the prior written comment address the same subject matter.

Description of Aspects of the Proposed Project Addressed by the Objection

As shown on Objection Figure 1, there is no collection channel planned to transfer water collected at the base of the Area 3 sideslope interval. An additional wraparound or perimeter channel should be constructed at this location along the northeastern side of the Tailings mound. Instead, stormwater collecting from this approximate 75 acre watershed side slope simply ponds along the base of the sideslope, within three main tributary areas below the adjacent north-trending ridgeline. This situation is similar in nature to the trapped water in PCA 2 and PCA 3 as described above in Objection 1.

Stormwater retained in pools against the waste rock buttress at this location is problematic, both during mining operations and throughout the post-closure period. Retained stormwater will reduce the quantity of surface water which is released downstream of the mine site, both from the approximate 75-acre mound side slope area and also the adjacent hilly sideslope to the crestline. This represents a significant and permanent reduction of a valuable downstream surface water resource, with associated adverse impacts to habitat and riparian resources, and downstream recharge.

In addition, stormwater ponded against the mounded waste rock may cause leaching of contaminants as the ponded water moves laterally into and through the waste rock buttress. The percolating water may also may also reach and infiltrate tailings materials deposited downgradient within the Barrel Canyon channel. Fluid contact with waste rock and/or tailings materials includes the potential to cause contamination of surface water and shallow groundwater downstream of the mine site.

Suggested Remedies to Resolve the Objection

The Forest Service should require Rosemont Copper to professionally design, and construct, an approximate 5000 ft long stormwater management channel along the northeastern perimeter of the Tailings mound to collect surface waters from the lower eastern side slope (Area 3 on Objection Figure 1). Surface waters collected along the base of this slope should be routed to the tailings mound side slope stormwater channel shown at location SW-3, for transfer into the northern Wrap-A-Round channel and release in perpetuity at the channel outlet into downstream Barrel Canyon.

The Forest Service should require Rosemont Copper to professionally design and construct the stormwater management channel at the base of the 75-acre tailings mound side slope. Construction of the stormwater channel could be accomplished by integrating and implementing the following operations:

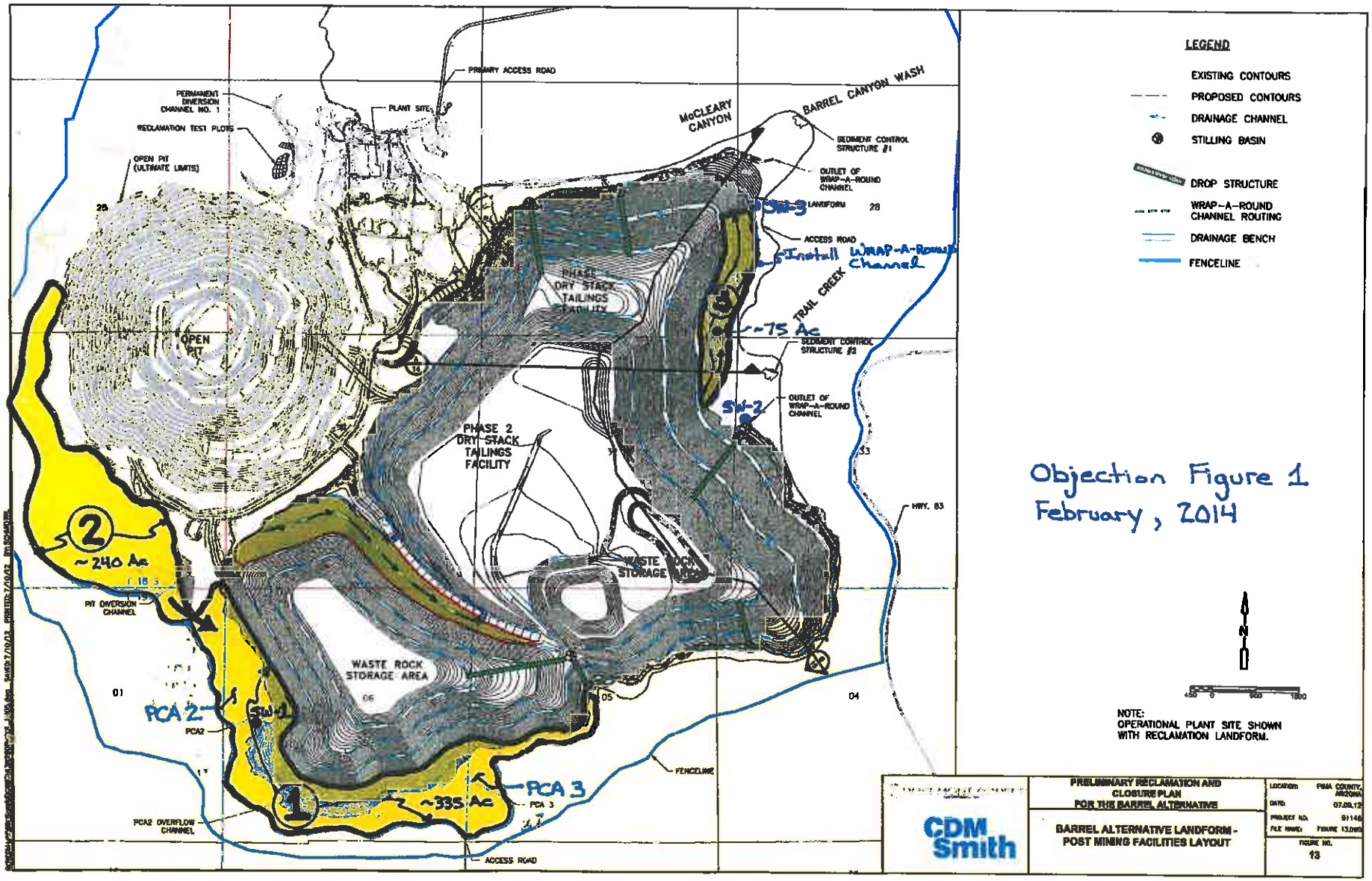
A. Design the stormwater channel to transfer collected water per standard engineering state of the practice.

B. Per final design plans, perform the necessary excavations through the hilly topographic slopes of upper Barrel Canyon adjacent to the base of the waste rock buttress on the perimeter of the Tailings mound, in order to obtain the required width and channel grade of the perimeter stormwater managment system.

C. Utilize abundant waste rock materials for construction of the perimeter stormwater management channel where advantageous, including placement of waste rock materials within the channel area between the waste rock slope and the eastern upper Barrel Canyon watershed slopes. Utilization of waste rock as a construction fill material will reduce the volume of excavation required into the existing side slopes.

Design and construction of a stormwater management channel at this location is doable, has real benefits to the community and environment, and factually constitutes a minor part of these primary planned mining operations:

- Excavation and disposal of 1.9 billion tons of waste rock and tailings
- Creation of a permanent 4.5 square mile waste disposal landform on Federal and State lands



Objection Figure 1
February, 2014

Objections to the FEIS and ROD for the Proposed Rosemont Mine

Groundwater Flow, Groundwater Quality and Associated Mitigation Measures

<u>Objection 1</u>: Downstream Replenishment of downgradient streams with groundwater from the dewatered pit was not addressed.

Pima County in comments from C.H. Huckelberry on August 14, 2013 on the PAFEIS (p. 133) made specific comments regarding Mitigation and Monitoring for pit dewatering issues. Specifically, the comment stated:

> An additional mitigation measure that will significantly contribute to downstream sub flow and spring and seep restoration would be controlled discharge of the pit water downstream of the mine. Based on Tetra Tech's modeling, the pit water is predicted to be of good quality and the dewatering wells should be of better quality. In addition, good quality groundwater from the Upper Santa Cruz Basin is scheduled for use at the Mine. If additional makeup water or dust control water is needed, then the Upper Santa Cruz water should be used since the pit water was originally intended for eventual down-gradient movement to the Davidson and Cienega Creek Basins. This mitigation would be fundamental in providing the wet water so critical to the downstream riparian areas and to restoring an already reduced base flow on Cienega Creek.

Additional comments were made previously and not addressed in the ADEIS and DEIS:

> *<u>County DEIS comment, No. 294</u>*
> *On a real-time basis, this water should be released down-canyon to the Davidson Canyon watershed to mitigate anticipated loss of shallow groundwater to riparian vegetation and down-gradient wells. Groundwater removed adjacent to or from the pit should be monitored for water quality to insure suitability as replenishment water to down-canyon areas. The groundwater replenishment operation could be included within the Forest Service NEPA Record of Decision.*
>
> <u>County DEIS comment, No. 277.</u>
> **Use of pit water as mitigation not addressed.** The DEIS indicates that Rosemont would replace human-made water supply structures lost related to the mine. This mitigation does not address loss of numerous spring and wells and loss of shallow groundwater which in turn will result in loss of habitat. **The mitigation plan falls way short of compensating damages to lost springs, stock and domestic wells and lost habitat due to dewatering of shallow groundwater areas.**

Thus, the EIS and ROD does not address the proposed Pima County mitigation measure mentioned several times during the review process to discharge pumped pit dewatering well water and pit water from sumps to downstream reaches. Mitigation at the Pantano Dam area and at ranches in other watersheds does not address the long-term loss of surface and sub flow that will damage the riparian vegetation, loss of springs and loss of sub flow immediately downstream of the area of immediate impact at the mine.

The total dewatering of the Rosemont basin area over the 20-year mining period will exceed 15,000 acre-feet. Based upon Meyers (2008) estimates of 650 af/yr of recharge for the Rosemont Watershed, almost all of the water recharged to this area will be lost. This water currently provides sustenance for down-canyon shallow groundwater riparian areas and meso- and hydro-riparian areas.

Solution: Implementing this mitigation measure will partially address immediate downgradient impacts of pit dewatering. An adaptive management scheme can be developed to pump the pit water downstream over time to store water in advance to replenish areas that would become dewatered as a result of the pit. Downgradient wells could also benefit from this mitigation measure. An AZPDES permit will needed to meet Federal and AZ WQ standards.

Objection #2: Misrepresentation of and minimization of impacts to groundwater, years 20-200 and beyond.

Pima County in comments from C.H. Huckelberry on August 14, 2013 on the PAFEIS (p. 75) made specific comments regarding the misrepresentation of and minimization of the impacts of the proposed mine between years 20-200 on groundwater pit evaporation. Specifically, the comment stated regarding PAFEIS Page 64, line 19-24 and table 67:

> This discussion appears to be very down played. Equilibrium is over 1000 years away. What really needs to be emphasized is the loss from years 0-20 and 20-200. These impacts are far greater than at equilibrium and will affect the downstream well users and riparian vegetation. Tetra Tech estimates at year 200 that 517 AF is evaporated and lost at the pit and that amount will rise as the pit lake grows. Over the 20-year mining period as much as 925 AF/year is lost due to pit dewatering. These are the amounts that need emphasis, not at equilibrium when the current generations are gone. In addition, little discussion regarding water availability for the downstream riparian community is mentioned. This needs elaboration and is an omission.

Table 67 and the above narrative in the EIS does not explain the evaporation and net loss to the system, and an explanation of losses at mine closure and beyond would allow the public a full disclosure of the impacts during a period that is more meaningful than 1000 years after the mine closes.

In addition, confusion abounds regarding what is actually being represented in Table 67. Table 74, p.387 indicates lake evaporation would be 517 AF/yr at year 200. The expanding lake size over the ensuing years would increase evaporation and that would be more like 650 AF/yr at equilibrium (Montgomery, 2010). Precipitation falling on the pre-mining area would either runoff or infiltrate. Granted, some of the infiltrated water would be lost to evapotranspiration to support native vegetation. However, none of this was explained in the narrative on Table 67 regarding what is actually lost to the system. Is this amount evaporation or a net loss based on a water balance?

Pit inflow is not the only input lost to the system. Rainfall that would otherwise runoff and infiltrate on the pre-mining pit area is mostly lost from the pit since evaporation is typically 50 inches/year in the area and rainfall 20-22 inches/year. Thus, all rainfall is lost through evaporation in the pit and only a portion of it is lost in pre-mining conditions, depending on rainfall intensity and roughness factors. Thus, Table 67 is a gross misrepresentation of what is lost to the hydrologic system, by claiming water loss is only the groundwater loss to the system. Rainfall falling on the pit would be totally lost through evaporation while only a portion of the evaporation falling on the proposed mine pit area would be lost in pre-mining.

Solution: Provide a realistic pit water-loss hydrologic estimate, including losses from lost precipitation

from pit evaporation vs pre-mining and lost groundwater from pit inflow. These losses should be evaluated from mine closure (20 years), 200 years, 1000 years and at equilibrium.

<u>Objection 3:</u> The Forest Service Failed to consider impacts on individual wells, Chapter 3, p 293.

<u>What the FEIS says regarding Issue:</u>

FEIS, p 293-294: As previously mentioned, the Coronado reviewed available data sources and determined that insufficient information was available to assess impacts on individual wells. In order to fully predict the impacts to an individual well, the following information is needed: well depth, perforated interval, current water level, pump setting, and the response by water levels to pumping conditions. Of these characteristics, well depth and perforated interval are commonly available through public databases. However, current water level, pump settings, and pumping water levels are rarely reported or regularly updated. More importantly, the groundwater models are built to predict impacts in the regional aquifer; for many individual wells, the connection to this aquifer is not known, as these wells often intersect small pockets of alluvium or localized fracture systems. The geological information needed to assess this connection for an individual well is largely unavailable, although driller logs are available for some wells detailing the hydrologic units encountered during drilling. The Coronado remains unable to assess impacts to individual wells; therefore, the analysis essentially remains as it was presented in the DEIS, although it is presented with greater details of the progression of potential impacts in space and time.

FEIS, p 305: Given the model cell size and uncertainties concerning connection of shallow wells to the regional aquifer, assessing impacts to local wells is not feasible. Using any large-scale model to predict the impacts to individual wells with any certainty is not feasible. Furthermore, an inventory of all wells with the necessary information to assess impacts (depth, screened interval, pump setting, current water levels) does not exist and would be prohibitively costly and time consuming to create (see "Analysis Methodology, Assumptions, Uncertain and Unknown Information" part of this section). It is unlikely that any modification to the model—or any model—would be able to fully analyze impacts to individual wells.

FEIS, p 350: The greatest effects on well owners are predicted to occur in the area along Singing Valley Road west of SR 83. Modeling indicates that these well owners may eventually see up to 85 feet of water level decline, if those wells are connected with the regional aquifer that would be affected by the mine pit. In the near term (i.e., during active mining and up to 20 years after mine closure), water level declines in this area are modeled to reach up to 15 feet.
Well owners in the area along Hilton Ranch Road east of SR 83 are also predicted to experience changes in groundwater levels. Modeling indicates that these well owners may eventually see up to 37 feet of water level decline, if those wells are connected to the regional aquifer that would be affected by the mine pit. In the near term (during active mining and up to 20 years after mine closure), water level declines in this area are expected to be 3 feet or less.

FEIS, p 352: As shown in table 66, approximately 360 to 370 domestic or other production wells registered with the ADWR could eventually be impacted by drawdown in groundwater levels over 10 feet (i.e., are located within the 10-foot drawdown contour); approximately 95 percent of these are smaller domestic, stock, or exempt wells. Note that this is not considered a comprehensive inventory of wells in the area, nor are there adequate well construction and operation details to determine whether this drawdown would impact individual well performance.

PREVIOUS COUNTY COMMENTS

AGENCY REVIEW OF THE INTERNAL WORKING DRAFT OF THE ROSEMONT

COPPER PROJECT DEIS, JURISDICTIONAL REQUIRED COMMENT FORM

P 14 of 27: If specific impacts to the wells are unknown, a systematic evaluation of the 300-350 registered wells in the vicinity of the pit dewatering area is needed to assess what wells could be dewatered based upon the three model's east side results. This should be done as part of the mitigation to prepare for dewatering of local wells. Well construction will need to be evaluated to assess if the screens will be dewatered and what wells will needed to be deepened or replaced.

P 15 of 27: Mitigation on the east side must include a system of water level monitoring wells to verify the predicted changes in the water level due to dewatering. The mitigation plan should also include triggers for action if the drawdown at certain points reaches certain levels. Domestic wells in the Singing Valley Hilton Ranch Road areas will need baseline and future monitoring to evaluate the impacts of pit dewatering. There is also a need for water quality monitoring wells.

January 18, 2012 Comments on Draft EIS
No. 290: Regarding impacts of the mine on wells, the use of the word "could cause" is too tentative. Pumping of mine supply water "will" cause reduced groundwater availability to existing wells and water users. This is based on the simple relationship that the Montgomery model on the West side and the three groundwater models established on the east side: that water-level declines will occur in the tens and hundreds of feet. The EIS needs to establish what wells, based on well screening and depth, will be dewatered and need replacement. The east side wells may not be able to be replaced and the mine may have to supply water to the well owners in perpetuity. The same needs to be done for springs and spring flow. If a spring is to be buried or it is predicted that water levels will decline over one foot, then it "will" be affected. . The DEIS is tentative in evaluating the projected impacts to domestic wells in the vicinity of the proposed mine supply wells and the proposed pit despite ADWR registered well construction information, including screening, that ADWR mandates from drillers for all wells drilled in the area. We must assume worst case that the wells affected within the 5 to100 foot drawdown contours on the east and west sides of the proposed mine will lose availability to water since the DEIS is speculative at best in assessing the impacts to downgradient wells. A table is needed for the Cienega/Davidson Basin listing domestic residential and stock wells. Because of the potential fractured flow and uncertain flow pathways in this area, all wells within the one-foot contour after 20-years and 150-years should be listed as potentially affected.

No. 295: Pima County's earlier request for a well owner mitigation Plan for East side has not been addressed. Rosemont Copper needs to develop a Mitigation Plan to develop a binding residential well plan for Hilton Ranch Road and Singing Valley Road residences. By end of mining the mine pit will have caused drawdown on these residential wells to over 5-feet based on the consultant's model. The agreement should include well replacement or permanently supplying water to the residents in the event a new well is not feasible due to dewatering of the aquifer.

The FEIS lists various things not known about every well and concludes that these things are necessary consider the impacts. The overall impact is due to drawdown at that location and does not have to be an exact prediction. An assessment of model determined drawdown at each well is the request here.
The FEIS claims that groundwater models are designed to model regional aquifers but the connection of individual wells to regional aquifers is unknown. The FEIS still should disclose modeled drawdown at those locations, even with the caveats that it is not a well-specific prediction but rather an average prediction over a thick aquifer or modeled layer. All that is required is table showing modeled drawdown at well.
The FEIS discloses (p 350) that drawdown to well in the Singing Valley Road area could be as much as

85 feet. These wells should at least be assessed in detail as to how much they will be affected.
40 CFR 1502.22(b) does not allow an agency to ignore impacts that are not definitively known. It requires the agency look at the available data and make a reasonable evaluation of the impacts based on the data and generally accepted approaches and methods. That was not done here.

Objection 4: The Forest Service refuses to consider a reasonable threshold of concern for drawdown

<u>What the FEIS says concerning issue 2:</u>

> P 294: The threshold of concern with respect to impacts to water wells in the Santa Cruz Valley is a drop in water levels greater than 10 feet over any period. Note that under Arizona water laws, there is no regulatory mechanism that prescribes such a threshold. However, the 10-foot threshold is commonly used in other nonapplicable Arizona regulatory programs, such as well spacing requirements (AAC R12-15-1302), although the well spacing program only considers drawdown over the first 5 years of pumping.
>
> In the DEIS, the 5-foot contour of the expected decrease in groundwater levels was used as the threshold for assessing impacts to wells and springs. Several public comments suggested that this drawdown was too large to use as a threshold for wells and springs and that it should be 1 foot, or even 0 feet. The Coronado considered the reasonableness of the selected 5-foot drawdown threshold (Garrett 2012h; Ugorets, Cope, and Hoag 2012). There are two primary reasons for selecting this threshold: the predictive accuracy of the models used, and the natural variability of groundwater levels.
>
> The models used to predict impacts to groundwater availability have a level of uncertainty that must be considered when interpreting the model results. While the models can mathematically predict groundwater drawdown to thousandths of a foot, in reality this level or refinement is meaningless. The models were designed for the purpose of predicting the inflow of groundwater to the mine pit and the general drawdown that would occur in the regional aquifer; however, the farther the predictions are in terms of distance from the mine pit and the farther out in time the predictions occur, the less certain they become. The groundwater modeling experts contracted by the Coronado determined that the reasonable limit of certainty of the groundwater models is the 5- to 10-foot drawdown contour (Ugorets, Cope, and Hoag 2012). Within this contour, the groundwater models would be able to reasonably predict changes to wells, springs, and streams. Changes below this threshold are beyond the capabilities of the models to accurately predict.
>
> Public comments correctly indicated that impacts to springs and intermittent or perennial stream reaches could occur as a result of very small changes in groundwater level. This suggests that although these small levels of drawdown are beyond our ability to predict with numerical models, they could still cause impacts that need to be disclosed in this FEIS. However, the 5-foot threshold is also pertinent for a second reason, which is the natural seasonal variability of groundwater. Available data suggest that groundwater levels in the area naturally vary from year to year and from season to season. In a well in lower Davidson Canyon, groundwater levels have been observed to fluctuate by more than 10 feet in a single year (Pima Association of Governments Watershed Planning 2005).
>
> Two stock wells along Empire Gulch have been monitored by the ADWR for three to four decades, and the results show that water levels have varied between 4 and 5 feet. Similar stock wells along Cienega Creek show variation between 3 and 5 feet (SWCA Environmental Consultants 2012c). Two wells immediately adjacent to lower Cienega Creek were monitored between 2007 and 2009 by the Pima Association of Governments and exhibited a fluctuation in

water level of up to 5 feet seasonally (Pima Association of Governments 2010b). Montgomery and Associates conducted a similar analysis on a much greater number of wells located throughout the basin (not just near streams) and found that the average short-term fluctuation in groundwater levels was 7.1 feet and that the long-term fluctuation in groundwater levels was 19.7 feet (Davis 2010).

P 295: While drawdown of less than 5 feet could cause impacts to springs and surface waters, natural variability in groundwater levels is already causing changes of this magnitude in the vicinity of sensitive surface waters in the analysis area. This makes identification of drawdown that could be due to the mine dewatering impractical in the field because there is no reliable method for separating out ongoing seasonal or annual variation from impacts from the mine. Given this natural variability, as well as the limitations of the model to predict impacts below this level, the 5-foot drawdown contour was determined to be the appropriate threshold for predicting impacts to groundwater levels in the FEIS.

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A five-foot drawdown is too high of a limit in consideration of whether springs could be affected. The drawdown caused by this project adds to, or increases the impact of, the natural variability in water levels. If a spring is naturally dry part of the year, as little as a one-foot drawdown could cause a big difference. Springs discharging from bedrock could be significantly affected by even a one-foot drawdown, if it represents a change in the gradient controlling the discharge.

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No. 290: Regarding impacts of the mine on wells, the use of the word “could cause” is too tentative. Pumping of mine supply water “will” cause reduced groundwater availability to existing wells and water users. This is based on the simple relationship that the Montgomery model on the West side and the three groundwater models established on the east side: that water-level declines will occur in the tens and hundreds of feet. The EIS needs to establish what wells, based on well screening and depth, will be dewatered and need replacement. The east side wells may not be able to be replaced and the mine may have to supply water to the well owners in perpetuity. The same needs to be done for springs and spring flow. If a spring is to be buried or it is predicted that water levels will decline over one foot, then it “will” be affected. . The DEIS is tentative in evaluating the projected impacts to domestic wells in the vicinity of the proposed mine supply wells and the proposed pit despite ADWR registered well construction information, including screening, that ADWR mandates from drillers for all wells drilled in the area. We must assume worst case that the wells affected within the 5 to100 foot drawdown contours on the east and west sides of the proposed mine will lose availability to water since the DEIS is speculative at best in assessing the impacts to downgradient wells. A table is needed for the Cienega/Davidson Basin listing domestic residential and stock wells. Because of the potential fractured flow and uncertain flow pathways in this area, all wells within the one-foot contour after 20-years and 150-years should be listed as potentially affected.

P 189: This section (DEIS, p 210) has not been changed, and the comments still apply. Specifically, if drawdown lowers the water table below the productive zone in a well, the well will be affected. The U.S. Geological Survey recently published a modeling study predicting 1-ft drawdown in Snake Valley of eastern Nevada (Halford and Plume 2011). They utilized 1 foot so that they could demonstrate the zones of groundwater capture; lowering the water table as little as

> a foot will affect spring discharge and groundwater ET. Because springs are of primary interest at Rosemont, there is no reason to not consider 1 ft drawdown as a threshold of concern.

Despite the above comments and the available evidence, the Forest Service refuses to use a reasonable drawdown threshold when considering impacts on local wells. The FEIS rejects arguments that 1-foot drawdown should be plotted or considered for impact analysis. FEIS fails to address points and literature raised by Pima County

The FS is arbitrary and capricious in rejecting it because it has been used in other EIS's and studies and because the FS fails to address the comments, instead the FS simply falls back on natural variability.

The gist of the FS argument is that it is not reasonable to consider drawdown that is less than natural fluctuations, which could be annual or seasonal. However, drawdown caused by the project would not vary. If the project causes a 5-foot drawdown, the mean level around which the natural variability would occur would be lower.

The drawdown is observable in the model and if it manifests in the field, natural variability would cause fluctuation around a new average or median water level.

It is possible the model is overestimating or underestimating, so one foot is a good point to establish monitoring. Due to variability, not just in monitoring data but also in the modeling, one foot could be a gross underestimate and the drawdown would really be much more.

Drawdown can have negative impacts without actually lowering the water table. Lowering the water table even small amounts near a spring would change the effective gradient for discharge from the spring thereby decreasing the flow.

Objection 5: The FEIS relies on inappropriate groundwater model boundary conditions Chapter 3, p 299-301

<u>What the FEIS says concerning issue 2:</u>

> P 300: As a whole, it was found that the artificial boundary conditions—and particularly the western boundary—did have a quantifiable effect on the model results, but this effect was highly dependent on time. The western boundary allows water to flow from east to west, out of the model domain. At no time does groundwater ever flow into the modeled area from this boundary; however, as the cone of depression expands and encounters the artificial western boundary (about 150 years after mine closure), the amount of water flowing out of the modeled area is reduced. When this reduction in boundary outflow becomes a substantial percentage of the groundwater entering the pit, it has the potential to offset water that otherwise would have to come from elsewhere in the model. Roughly speaking, effects from the boundaries remained minimal until about 300 years after closure of the mine. After this time, the change in flow from the artificial boundaries becomes a larger and larger percentage of the groundwater entering the pit, which in turn could cause a reduction in modeled impacts elsewhere in the model domain.
>
> The quantifiable effect of the model boundaries on predicted drawdown in the aquifer was evaluated by conducting a modeling run in which the groundwater flows out of the model boundaries were fixed and not allowed to change. This in itself is not a realistic situation, but it allows the effect of the boundaries to be isolated and quantified. Rosemont Copper's groundwater

modelers presented the results of these runs, and it was found that the changes in water levels at sensitive riparian areas, while quantifiable, did not materially change the conclusions of the FEIS. For instance, the modeled drawdown after 1,000 years at Empire Gulch increased from about 3.3 feet to 3.5 feet for one model, and from about 6 feet to 7.5 feet for another model. Similarly, the modeled drawdown at Cienega Creek remained unchanged for one model at less than 0.1 feet, and increased from about 0.5 to 0.7 feet for another model (Garrett 2012g). It was generally concluded by the Forest Service specialists, the Forest Service consulting groundwater modeling experts, Rosemont Copper's modeling experts, and the Forest Service decision maker that although the artificial boundaries indeed have an undesirable effect on modeling results after several hundred years, the actual change before then is well within the uncertainty of the modeling and does not affect the overall modeling conclusions. Further, the Coronado considered an additional model provided by Pima County as an alternative viewpoint to show a range of impacts (the Dr. Myers model); this model used the more traditional boundary condition located along the ridgeline of the Santa Rita Mountains. It was concluded that the models prepared are the most appropriate tools for predicting impacts in the FEIS, provided that their associated uncertainty is fully disclosed.

P 301: One final concern with the western boundary is the inability to predict groundwater drawdown beyond (west of) the boundary. In an ideal situation, the model boundary would be located far from any stresses (such as the mine pit), and therefore drawdown caused by those stresses would be unlikely to ever reach the boundary. In the case of the Rosemont Copper groundwater models, however, based on the geology and water levels of the basin, the modelers determined the appropriate location of the western model boundary and in doing so placed the western model boundary close enough that drawdown indeed reaches and is truncated at the western model boundary. This does not affect the analysis because there are no critical areas that would be affected beyond the western boundary: the known springs on the west side of the Santa Rita Mountains fall within the model domain, with no identified springs located beyond the boundary; the primary concentration of residential wells associated with Corona de Tucson lies within the boundary; and there are no sensitive riparian areas that rely on regional groundwater located within several miles of the model boundary (SWCA Environmental Consultants 2013m). It is recognized that because of the nearness of the western boundary, the propagation of impacts into the groundwater basin west of the Santa Rita Mountains is not able to be analyzed with these groundwater models; however, it is believed that no critical areas that would be affected by groundwater drawdown have been excluded.

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P 20 of 27: These figures also show drawdown for areas west of the divide and the previous comment continues to apply. However, at these later dates when the flux from the pit lake controls the amount of water drawn toward the pit lake, allowing water to draw from west of the divide biases the result toward underpredicting the effects of the hydraulic sink downgradient in Davidson Canyon. The bias is caused by overall pit lake evaporation utilizing pit water derived from an area that in reality will not contribute flow to the pit – the area west of the divide. The bias is toward less water drawn from the down canyon direction, which decreases the predicted drawdown in that direction.

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P 193: The Tetra Tech and M&A models used the same rectangular domain with head controlled flux boundaries on most sides.

o *Most modeling guidance suggests that the boundaries of a model should be at a point where conditions are known; usually this means the boundaries coincide with a topographic divide or significant change in formation. The ideal is for the boundaries to be a flow line, except for specified inflow and outflow reaches at locations where the flow is constrained*.
o *M&A and Rosemont should implement a much more extensive analysis of the intrusive rock formations west of the pit to determine whether impacts will extent westward, or not, and whether the model boundary should be on the topographic divide.*
o *Myers had modeled the region between the topographic divides, and this would have been preferable for both Tetra Tech and M&A because it is preferable to simulate boundaries at locations where conditions are known*.

P 195: Drawdown in both the Tetra Tech and M&A models extends west of the Santa Rita ridge crest. Both the Tetra Tech and M&A models had conceptualized a connection with the west side, even though the granodiorite has low conductivity and the deeply dipping Paleozoic rock in which the pit is constructed may not be connected in a significant way to the formations on the west.
o Allowing this connection allows the dewatering and pit lake development to draw water from areas west of the ridge that may not in reality be connected to the pit. This extra water provided to the pit introduces a bias in both models and limits the distance the drawdown extends down Davidson Canyon. If the models had not included this connection, the drawdown in Davidson Canyon may have been larger.
o Myers' model did not simulate this connection because it had set a boundary at the ridgeline based on the geology and topography.

P 196: Myers (2011) expands further on these points, with the following recommendation.
☐The granodiorite intrusive rock west of the pit should be drilled to conceptualize the extent of fracturing. This would verify whether this area should be treated an impervious boundary or as a source of water to the model. Without such investigation, the model boundary west of the pit should be the ridgeline and should be no flow.

P 198, 199: If the conceptualization that flow on the west side of the mountain could satisfy pit lake deficit requirements is correct, the west model boundary would not be far enough from the mine. However, because the mountains are essentially impervious and the mine is above the valley to the west of the mountains, the boundary is misplaced; as discussed in Myers (2011), the west boundary should be a no-flow boundary to better simulate area geology. The assumption made here would limit the extent down the Davidson Canyon that the projected drawdown extends. (The conceptualization this comment referred to was that pit dewatering as simulated by Tetra Tech and Montgomery could draw water from west of the divide instead further from the east.)

P 202: The DEIS reports that Tetra Tech tested the sensitivity of their model to different types of boundary conditions on the west side, changing from constant head to general head and no flow boundaries. They found little difference between constant head and GHB boundaries, as one should expect if the GHB conductance values are similar to the conductivity in the formation adjacent to the boundary. They found the no-flow boundary "to cause conditions that could not be feasibly modeled" (DEIS, p 223). That is also, of course, correct, because a no-flow boundary only works along a flow line or at a groundwater divide, which in this case should coincide with the Santa Rita ridge crest (Myers 2011). (The highlighted portion of this comment refers to Tetra Tech using a no flow boundary instead of the constant head boundary they had used in their model. Of course it would not work – flow from above on the mountain on the west side of the divide flows across that divide and changing the boundary to no flow essentially creates a dam.

The County made numerous comments regarding the improper boundary conditions to the west of the Rosemont facility. The groundwater model should have an impervious boundary on the west at or near the ridgeline, because of the topographic divide and, more importantly, the granodiorite rock. Failure to use the proper boundary conditions means that drawdown can expand west of the divide. If the boundary is considered "no flow", some of the drawdown would be reflected to the east so that predicted drawdown down Davidson Canyon may be greater or expanded further. This applies to the Tetra-Tech and Montgomery models**.** The models should be re-run using the County's recommended boundary conditions. Consistent with the requirements of 40 CFR § 1502.22(b), the FEIS discussion should address both theories and disclose the impacts of both.

Objection 6 - The FEIS modeling of waste rock seepage and waste rock seepage is faulty, Chapter 3, p 377-379; Exec Summary, p. xxx

What the FEIS says:

> FEIS p 362: One of the most widespread comments, including comment by the EPA, questioned the prediction that precipitation would not infiltrate the waste rock or tailings facilities and cause seepage, which could potentially impact groundwater quality. In direct response to these concerns, the Coronado requested that additional modeling scenarios be conducted by Rosemont Copper for more conservative precipitation conditions. Rosemont Copper responded by conducting modeling under seven different reclamation scenarios—including a scenario in which ponding occurs on the surface of the waste rock and tailings facilities—and under four different climatic scenarios.
>
> FEIS p 377, 378: Overall, infiltration from precipitation over tailings, waste rock, or the heap leach facilities is expected to be negligible. Near surface storage is expected to be such that based on infiltration modeling any precipitation that does not immediately run off would remain near the surface and then be lost to evaporation or transpiration by vegetation. The modeling techniques used to reach this conclusion were questioned during public comment, including by the EPA. In response, the Coronado requested that Rosemont Copper conduct more extensive and conservative infiltration modeling.
>
> Rosemont Copper conducted revised modeling and provided it to the Coronado (Tetra Tech 2012a). In response to the Coronado's request for more extensive and conservative modeling, Rosemont Copper created additional variations of a series of model parameters in order to provide better assurance that infiltration of precipitation was not expected under real world and extreme climatic conditions.
> • With respect to climate, five different scenarios were analyzed: average climate conditions (which has a little bit of precipitation every day because of averaging), the 24-hour, 100-year storm event (which provides analysis of a short-duration and high-intensity event, such as observed during the Arizona monsoon season), a multiday storm event (which provides analysis of a winter frontal storm that occurs over a longer period of time during cooler temperatures), 10 years of actual measured daily data, and 50 years of actual measured daily data.
> • With respect to cover scenarios, four different scenarios were analyzed that included no reclamation cover, a mixed reclamation cover of sand and gravel, a 1-foot-thick reclamation soil cover, and a 3-foot-thick reclamation soil cover. (By design, a 1-foot-thick soil cover is expected to be used, as described in the "Soils and Revegetation" resource section.)
> • Each of the four cover scenarios were analyzed with and without vegetation present.
> • An additional scenario was run with ponding occurring on the benches of the facilities, which

is a condition that would be expected for the Phased Tailings, Scholefield-McCleary, and Barrel Trail Alternatives but not for the proposed action and Barrel Alternative.
Similar to the results described in the DEIS, none of these scenarios resulted in infiltration of precipitation into the waste rock, tailings, or heap leach facilities. With the ponding scenarios, several of the climatic conditions (24-hour, 100-year and multiday) did result in stormwater infiltrating past the surface layer of the waste rock facility, but the end result indicated that the infiltrated water is still eventually lost to evaporation.

As no water is incorporated into the waste rock, and as no precipitation infiltrates the facility even under extreme climatic and ponding conditions, no seepage is expected from the waste rock facility. Seepage from the tailings stack would develop as a result of the loss of the pore water present after filtration, as moisture content falls from 18 percent during stacking to a field capacity of 11 percent. Seepage from the tailings facility is estimated to rise to 8.4 gallons per minute over the active life of the mine. After final reclamation and closure, the seepage rate from the tailings facility would steadily decrease and is predicted to reach zero seepage approximately 500 years after closure. This seepage does not occur in a single spot but is spread over the approximately 1,000 acres of the tailings facility. Public comments requested that this amount of seepage be given some perspective. During active mine life, 8.4 gallons per minute of seepage represents roughly 0.01 gallon per minute per acre of tailings facility, or slightly less than 14.5 gallons of seepage per acre per day from the entire tailings facility. Another way of visualizing the magnitude of seepage is to imagine the depth of seepage that would occur over the course of an entire year; in this case, a year's worth of seepage would accumulate to a depth of less than a quarter of an inch over the 1,000 acres of the tailings
facility.

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Comments from August 8, 2012 PAFEIS
P 182: ***The DEIS must justify the parameters used and complete a sensitivity analysis of the parameters to demonstrate that the results of the seepage modeling are feasible; this is especially needed since there is no data to calibrate to. They must also justify ignoring preferential flow paths through the waste rock.*** The mine facility seepage analysis predicts there will be essentially no seepage through waste rock facilities, a result that is simply not feasible. The modeling used parameters in which the conductivity for relatively dry rock is six orders of magnitude less than when saturated. These parameters would allow a wetting front to move through unsaturated waste rock only very slowly; even most of a large event would be stored in the top few feet. After the storm ends, the close proximity of most of the seepage to the ground surface would allow the water to be evaporated away because evaporation would quickly establish an upward matric potential gradient.

P 189: The DEIS (p 285) repeats this error, which affects the quality of the organic constituent analyses.
It does not seem reasonable that infiltration from waste rock be close to zero because natural recharge in this area is not zero. Blasted waste rock is almost certainly more conductive than the in-situ rock. It is also unlikely that the onefoot thick cover will result in less infiltration than the natural soil and vegetation regime.
Similarly, it is not reasonable for the seepage through a leach pad to cease. Leach pads are designed to conduct flow. All water that gets through the cover will become seepage. Based on experience, the long-term seepage through heaps in more arid climates in Nevada do not

approach rates as experience has shown that waste rock dumps in much drier climates will have seepage.
These three comments refer to the estimates of infiltration through waste rock, which have been estimated to be near zero. These comments had been made without reviewing the waste rock seepage study.
P 209: The modeling is effectively water balance modeling among layers in the facility, with low between layers controlled by unsaturated flow equations, or saturated in areas where saturation occurs. Unsaturated flow modeling solves the equations of soil physics, most specifically the flow equation relating the matric potential gradient to the conductivity,
which varies as a function of matric potential. Unsaturated flow is toward the lower matric potential which occurs at the point where the media is drier, all other conditions being equal. When saturated the equation becomes Darcy's law and the matric potential gradient becomes the head gradient. Matric potential becomes negative as soil dries, so during dry conditions water from depth can be drawn to the surface and evaporated in a process known as exfiltration.

Tetra Tech utilized a two-dimensional variably saturated flow model, VADOSE/W, for this simulation (Tetra Tech 2010c, p. 20). The code solves the flow equations using a finite element routine. Two-dimensional means flow in a vertical cross section. Tetra Tech emphasizes that it "can simulate heterogeneous material, and can account for changes in material conditions due to compaction and underlying alluvial and/or bedrock formations" (Id.). This simply means that different model elements may be defined by different material property parameters and that those parameters can represent any material including compacted waste rock. The modeling presented in this Tetra Tech study is strictly based on conceptual flow models for the various materials because there are no data to which to calibrate. Material parameters depend on textbook or smallscale test values. The predicted values are not verified in any way to previously observed data.

The model simulates precipitation and evaporation, using various sequences of climate data for the simulations. Climate data provides the daily precipitation, temperature, wind speed, and evaporation. Using data from the Nogales site (Tetra Tech 2010c, p. 21) is not unreasonable, but the scenario using average daily values is not representative. TT states that the average conditions "dataset has small amounts of precipitation everyday because of the averaging of many years of data" (Id.) and call this "conservative". In a response to a review memorandum, TT (2011) responded that "[t]he average conditions dataset, as noted in previous memos, has precipitation nearly every day of the year. This is not likely to occur in Arizona, but would be a worst case scenario. Water is more likely to readily infiltrate into a facility if the upper surface is wet, so considering a climate conditions with a small amount of precipitation each day would produce such a condition and provide a result of the worst case infiltration" (TT, 2011, p. 2, emphasis added). Tetra Tech apparently considers this to be conservative, but the evaporation likely exceeds precipitation most days so there would rarely be an excess of precipitation to infiltrate. Even during winter, average precipitation may exceed the average evaporation by only a small amount, but the model would accumulate moisture in the top layers.
This modeled soil moisture may just be stored and later evaporated as conditions warm and dry in the spring. ***Infiltration through the surface zone would occur when moist antecedent conditions precede a large daily rainfall; this type of situation which would result in seepage has been ignored in the Tetra Tech study. This is not uncommon during late winter or spring snow melt and subsequent spring showers.***
The mine development periods and reclamation scenarios simulated are reasonable (TT, p. 22). Whether the parameters used for the scenarios were proper remains a question.

Tetra Tech discusses steady state modeling as a means of determining starting moisture concentrations for the transient simulations (Tetra Tech 2010c, p 37). In a system that should be event driven, steady state should never be approached, much less achieved.
The assumed parameters for the waste rock control the seepage through the waste rock facilities. The so-called permeability reported by Tetra Tech is actually saturated hydraulic conductivity (K). The values are very high, but the unsaturated values decrease very rapidly.

The figures showing the relationship of conductivity with matric suction and moisture with matric suction are poorly labeled. For example, Illustration 5.6 shows the relations for run-of-mine (ROM) rock, with saturated K equal to 174 ft/hr; the matric suction on the conductivity graph does not obviously match the axis for the moisture content, and does not have labels. Even the conductivity axis does not have labels for ROM rock.
Considering Ill 5.7 for semi-consolidated rock, the conductivity decreases over five orders of magnitude from saturated to dry (moisture 0.4 to 0.05). At the beginning of a storm with dry antecedent conditions, infiltrating precipitation increases the moisture content which increases the effective conductivity. As noted, the parameters for the surface ROM layer are hard to read, but dry (moisture about 0.16), the conductivity is significantly less than 174 ft/hr. Assuming no runoff, the ROM would rapidly saturate at a wetting front. Because of the low conductivity the wetting front would advance very slowly with conditions above the front being saturated. This means that significant amounts of ROM above a wetting front would be saturated. According to Ill 5.6, the difference between saturated and dry moisture content is the difference between 0.27 and 0.18, or about 0.09. Using these numbers, a three-inch infiltration event would be completely stored in just 33 inches of initially dry ROM, based on the available porosity between 0.18 and 0.27 being 0.09. The modeling assumes that it completely fills. Once the infiltration event ends, water would continue to seep downward, drawn by gravity and a negative matric potential. However, evaporation would begin at the upper end and, as the surface soil dries, a negative matric potential would develop on the surface and begin to counter the downward movement of the stored water.

The example just given allows the soil above the wetting front to become saturated because of the large difference in effective conductivity at the wetting front, which keeps the water close enough to the ground surface for evaporation to begin to quickly remove the water after the precipitation event ends. During summer, when the larger short duration events are most likely, the daily potential evaporation is as much as half an inch per day which means that most of the precipitation stored in upper layers of the waste rock would quickly evaporate; it is clear why the modeling does not simulate deeper seepage of water.

The figures showing water content through a model cross-section are clear (Ill 5.15 and 5.16). Near the surface, the moisture content is about 0.1 which increases initially with depth to about 0.14 but then decreases to 0.04 in the consolidated zone. This moisture content is less than the lowest moisture content presented in Illustration 5.8 for consolidated material, so the accuracy of the data is questionable. Clearly the effective conductivity at that moisture is 10-7 ft/hr (2.4x10-6 ft/d), an almost negligible conductivity.

The effective gradient due to high negative matric potential may be significantly higher than 1. Even at 1000, the water would move only about 2.4x10-3 feet in a day. These numbers should make clear why the model does not simulate seepage through the waste rock. The small amount of moisture below the unconsolidated ROM can be simulated to move only very slowly. These numbers suggest that increasing the moisture available significantly would not result in substantial differences in moisture content at depth, meaning that whether the model considers runoff accumulating at a location is irrelevant.

Many of the water balance figures, such as Illustrations 5.12 and 5.14, show precipitation entering the system and evaporation leaving the system; because the evaporation exceeds the precipitation, water leaves storage so that the moisture content decreases. These figures present a year's results, but presumably the waste rock would just become drier with time and evaporation would have to approach precipitation as stored water available to evaporate would dissipate. The figures also demonstrate that the model simulate almost no runoff.

The modeling does not account for preferential flow which can allow flow to move quickly through the piled waste rock. A preferential flow path in a waste rock dump is a pathway of larger pore spaces through which groundwater flow tends to funnel; it is similar to flow through fractures in in-situ bedrock. By ignoring preferential flow, the model underestimates seepage through any of the mine components, although waste rock would likely be most heterogeneous.

Tetra Tech's mention of preferential flow (TT, p. 20) refers to the fact that hydraulic conductivity for unsaturated flow varies with moisture content; different materials are preferentially more conductive at different moisture contents. More flow occurs through clay at low matric potential than through coarser sand because the sand is actually drier. The curves in TT Figure 5.5 may apply in a given facility but they would not apply at the same point (due to differing soil types at each point) so the flow cannot transition from on to the other.

The FEIS reports results from modeling seepage through waste rock dumps that are unreasonably low. This is because the modeler used unrealistic unsaturated parameters and used climate data from the wrong location

The FEIS responded to comments by having Rosemont consider additional scenarios. The FEIS did not amend or address the fact that the precipitation data was wrong and the ET data was from Tucson. The FEIS also does not respond to the comment about the wrong hydraulic parameters for the soil – specifically that the unsaturated conductivity was incredibly low which prevented any water entry to the waste. The FEIS did not address these problems or have Rosemont test the sensitivity of the waste rock parameters in their model.

Conclusion and Recommendations

☐**The DEIS must present data justifying the conductivity parameters.** It is not reasonable for ROM rock with saturated K = 170 ft/hr to only allow seepage to move a few feet before being removed by exfiltration.

☐**The study should be redone to include a sensitivity analysis.**

If the conductivity for high matric potential rock is set higher and there is still no seepage, then the DEIS may be able to conclude there is no seepage. Otherwise, the results of this seepage study are simply uncalibrated estimates based on very unrealistic parameters.

Myers Comment, p 13: The DEIS had predicted there would be no seepage through the waste rock dumps, essentially because any water simulated as entering the soil would be captured and stored in the surface layer. Comments by Pima County concluded that the modeling used inappropriate climate values, most especially using precipitation and evapotranspiration rates from the wrong place. In response, the AFEIS states that they considered an updated seepage model in which there were additional climate model scenarios were considered. The scenarios had to do with the length of simulation but with inappropriate climate values the antecedent conditions were never wet enough to allow additional seepage beyond the surface. The model used unsaturated conductivity values that

never allowed seepage past the surface. Even the models that considered ponding simulate the water as remaining on the surface and never entering the waste rock. As noted, the presence of seepage through waste rock all over the country including in areas much drier than Rosemont demonstrates that seepage can occur.

The AFEIS presents no discussion of the seepage model parameters, either soils or climate, and it still predicts no seepage. A brief review of the updated model shows that climate from inappropriate locations and soil parameters with such inappropriate parameter were still utilized. The AFEIS does not explain why these parameters were appropriate for use and is therefore unresponsive to previous comments. By using the inappropriate data as input, the AFEIS has not take an appropriate or hard look at the potential for seepage through waste rock.

Objection 7 - The FEIS ignores the high probability of preferential seepage flow in the tailings and waste rock piles, Chapter 3, p 378, Preferential flow of seepage.

<u>What the FEIS says concerning issue 5:</u>

There is no mention of preferential flow in the FEIS.

PREVIOUS COUNTY COMMENTS

AGENCY REVIEW OF THE INTERNAL WORKING DRAFT OF THE ROSEMONT COPPER PROJECT DEIS, JURISDICTIONAL REQUIRED COMMENT FORM

January 18, 2012 Comments on Draft EIS
P 182: ***The DEIS must justify the parameters used and complete a sensitivity analysis of the parameters to demonstrate that the results of the seepage modeling are feasible; this is especially needed since there is no data to calibrate to. They must also justify ignoring preferential flow paths through the waste rock.*** The mine facility seepage analysis predicts there will be essentially no seepage through waste rock facilities, a result that is simply not feasible. The modeling used parameters in which the conductivity for relatively dry rock is six orders of magnitude less than when saturated. These parameters would allow a wetting front to move through unsaturated waste rock only very slowly; even most of a large event would be stored in the top few feet. After the storm ends, the close proximity of most of the seepage to the ground surface would allow the water to be evaporated away because evaporation would quickly establish an upward matric potential gradient.

P 211: The modeling does not account for preferential flow which can allow flow to move quickly through the piled waste rock. A preferential flow path in a waste rock dump is a pathway of larger pore spaces through which groundwater flow tends to funnel; it is similar to flow through fractures in in-situ bedrock. By ignoring preferential flow, the model underestimates seepage through any of the mine components, although waste rock would likely be most heterogeneous.

Tetra Tech's mention of preferential flow (TT, p. 20) refers to the fact that hydraulic conductivity for unsaturated flow varies with moisture content; different materials are preferentially more conductive at different moisture contents. More flow occurs through clay at low matric potential than through coarser sand because the sand is actually drier. The curves in TT Figure 5.5 may apply in a given facility but they would not apply at the same point (due to differing soil types at each point) so the flow cannot transition from on to the other.

FEIS claims that seepage would not be concentrated but would rather be spread across the entire area of the facility. The FS rejects good science and observations at literally every waste rock seep showing that seepage discharges from a point, not spread around the base of the facility.

Preferential flow would cause seepage through waste rock (and tails) to reach the ground surface at concentrated locations rather than spread over the entire area of the facility. This is unaccounted for in the modeling and the FEIS in general. Because preferential flow has the potential to significantly impact downstream waters and habitats, the models should be re-run to account for this phenomenon.

Objection 8: The FEIS waste rock seepage monitoring plan will not result in adequate seepage impact evaluation .

<u>What the FEIS says:</u>

P B-16

Description	The waste rock facility is not predicted to allow infiltration of precipitation and subsequent seepage. Monitoring equipment (such as collection pans or lysimeters) would be encapsulated within the waste rock in order to remotely assess the moisture content of the waste rock and allow for collection and analysis of seepage if any is generated.
Source	Coronado ID team.
Purpose	Would determine whether seepage is occurring, which would be outside the effects predicted in the NEPA analysis.

P B-17

Location	Lower lifts of the waste rock facility. Monitoring would include at least two monitoring locations within the waste rock buttresses surrounding the tailings facility and at least two monitoring locations within the waste rock facility itself.
Monitoring / Reporting Action	**Implementation:** Rosemont Copper would provide detailed locations of seepage monitoring equipment and would present a detailed methodology for monitoring. **Effectiveness:** Rosemont Copper would monitor moisture content on a quarterly basis to ensure lack of seepage from water rock facility. In the event that seepage occurs, leachate would be collected and sampled on a quarterly basis.
Performance Criteria	**Implementation:** Monitoring equipment would be installed in lower lift of waste rock facility. **Effectiveness:** Moisture content of waste rock would indicate that seepage is not occurring, and sampling and analysis of leachate would be performed if seepage occurs.
Responsible Party	**Implementation and Effectiveness:** Rosemont Copper is responsible for conducting monitoring and reporting to the Forest Service on a quarterly basis.
Timing	**Implementation:** Installation would be conducted during the construction of the initial lifts of the waste rock facility. **Effectiveness:** Monitoring would begin upon installation and would continue

	throughout the active mining phase.
Applicable Alternatives	All action alternatives.

Prior County comments:

The seepage monitoring plan appears for the first time in the FEIS.

The monitoring plan calls for two points to be monitored for moisture content. The waste rock dumps cover a large area, but the FEIS suggests there will be no seepage. Objection 7 deals with the high probability of preferential flow in the piles, which means that actual seepage will likely be concentrated. Here, the mitigation plan in the FEIS calls for monitoring seepage in just two locations. Because preferential flowpaths could develop almost anywhere, there is little chance that the proposed monitoring will actually detect seepage if it occurs.

Objection to Forest Services Failure to Properly Define Permitting Strategy for Wells and Pipelines

The documents issued by the Forest Service for public comment suggest Rosemont's intent to install wells for construction and pit dewatering purposes and to install pipelines to transport the water recovered by these wells. The FEIS also identifies the route of the 20-inch water supply pipeline and with portions of that pipeline crossing Forest land. However, there is no discussion of the Forest Service's past or proposed efforts to permit these wells and pipelines. Indeed, the FEIS fails even to disclose the locations, size, and impacts of the dewatering and construction wells and related their pipelines.

During the EIS process, the Forest Service requested information of Rosemont concerning dewatering efforts. In response, two memorandums were submitted in November 2007 and July 2012. The following excerpts from those memorandums evidences of Rosemont's intent to install dewatering wells in the vicinity of the pit:

> *This memo is in response to the U. S. Forest Service's request for information regarding the dewatering for the planned Rosemont Mine. In a letter dated 19 October 2007, the Coronado National Forest requested that Augusta Resource Corporation provide a "…description of the potential for mine dewatering…" and "General information on the location of any dewatering wells."* Pratt, Nichols and Davis, 16 November 2007, p.1.
>
> *"The potential for using surface dewatering methods (vertical wells and horizontal drains) is dependent upon the permeability and well yields determined from pump tests….CNI recommends additional pump tests in the Willow Canyon Formation to properly evaluate the dewatering method appropriate for the east wall." Id.*, p.2
>
> *"In the northwest portion of the pit, dewatering will likely be required….In order to depressurize this area, vertical pumping wells will be needed…." Id.*, p.3
>
> *" CNI recommends groundwater modeling to determine the anticipated horizontal drain spacing for dewatering approximately 100 to 200 feet behind the slope face. Because of the low conductivity values, a relatively tight spacing will be required resulting in a high cost to depressurize the [south] slope…..Because of the low hydraulic conductivities determined from pump tests mentioned previously, CNI did not consider a reduction in the phreatic surface level with the use of depressurization from vertical pumping wells."* Nicholas, Standridge and Pratt, 20 July 2012, p.3.

Relevant comments filed by Pima County and the District include:

> "For the east side, it is not clear what is meant by "operational pumping area" because the dewatering will mostly occur inside the pit." County DEIS Comments, p. 183 (January 5, 2012 "Technical Memorandum" by Tom Myers).
>
> "The SEIS must disclose the assumed amount, location and effects of dewatering wells and any associated pipeline. It is unclear what assumptions have been made by the Coronado in the DEIS regarding this issue." County DEIS Comments, comment no. 250.
>
> The SEIS should state how much water will be removed from the pit via sump pumps and from wells in the mine vicinity. The disposition of both quantities of water should be identified. County DEIS Comments, comment no. 251.

> "If there is to be a pipeline to convey the water from the pit or dewatering wells, then the alignment of the pipeline relative to Forest lands should be disclosed." County DEIS Comments, comment no. 252.

> "However, the Forest Service can require reporting in exchange for the permission to use Forest land to transport the water via truck or pipeline, and in fact should require this reporting per FSM standards." County DEIS Comments, comment no. 254.

In their above-referenced comments, Pima County repeatedly asked for further information regarding these facilities but those requests have been ignored. With the exception of the 20-inch water supply pipeline, the FEIS and ROD are silent the locations and sizes of the wells and pipelines destined for placement on Forest land. Pima County requests that the FEIS be supplemented to disclose the well and pipeline information and all environmental impacts thereof. Without this information, the FEIS cannot properly disclose the environmental impact of the wells and pipelines.

Furthermore, and despite this lack of above-requested information, it appears that the Forest Service is, in the ROD, giving Rosemont *carte blanche* to install these wells and pipelines. There is no mention of the Forest Service permitting process required under FSM 2541.35, R3 supplement 2500-2001-1, nor of any intention to condition approval of the MPO on successful authorization of the wells and pipelines under that standard. This apparent permission to proceed without the necessary special use authorization is a new concern arising after the opportunity for public comment. Pima County recommends that the ROD be amended to condition approval of the MPO on Rosemont's receipt of special use authorization required by FSM 2451.35.

Objections to Forest Service's Consideration of Cumulative Impacts

CEQ regulation require that agencies consider cumulative impacts during the EIS process. 40 CFR §§ 1502.16, 1508.7, and 1508.8. Further, the Forest Service regulations require cumulative impacts considerations for past actions. 36 CFR 220.4(f).

While the FEIS contains limited considerations of cumulative impacts, those discussions are inadequate. They fail to consider significant impacts resulting from other area projects. Some are totally ignored and others have been deemed as not "reasonably foreseeable" despite the high likelihood that they will occur.

Pima County and FCD commented throughout the EIS process about these lapses. Those comments include:

a. On October 9, 2009, in response to a Forest Service request, Pima County submitted a "Catalog of Events", which included reference to the County MSCP and Stantec growth model. A copy of that document is attached as Exhibit A hereto.

b. "The analysis presented for reasonably foreseeable actions is inconsistent with information from other permit applications. For over a decade, Pima County and Pima County Regional Flood Control District have worked with other agencies and individuals on an incidental take permit to cover activities relating to urban growth that is under the jurisdiction of the Pima County Board of Supervisors (and Flood Control District Board of Directors). The incidental take permit will cover impacts to 44 species in the permit area, which includes the area around the northern Santa Rita Mountains. The Rosemont EIS should include the issuance of this permit as a reasonably foreseeable action. Of particular interest for cumulative effects analysis may be the impacts to species habitat that are projected for future urban development and the projected impacted to special elements. See Table 4.5 of the November 2012 Environmental Impact Statement (see habitat loss by alternative)." County PAFEIS Comment, p. 36

c. With regards to springs and riparian areas: "Further development in Davidson Canyon and the installation of more wells seems to be a reasonably foreseeable action that should be analyzed based on population projections for the area and the fact that there is no other water supply for future growth". County PAFEIS Comment, p. 81.

d. "Defining an event as not reasonably foreseeable just because it does not occur for a long time is inherently a flawed argument. The groundwater drawdown is expected to occur and may in fact be made worse by other events. It is not only reasonably foreseeable but imminent." This gets to the point of their not doing a good job of defining the timeframes of their cumulative effects analysis on species. County DEIS Comment, No. 482.

e. "There has been no analysis of the Broadtop Butte, Copper World, and Peach-Elgin." County DEIS Comment, No. 186.

f. "There is related exploration by Rosemont in the area for a deeper sulfide deposit—exploitation of this resource should also be considered, along with Peach-Elgin, Copper World and Broad Top. In fact the potential for development of these other prospects affected the siting of the Rosemont project facilities. All should be considered reasonably foreseeable". County DEIS Comment, No. 174.

g. "Additional claims and deposits owned by Rosemont suggest they will expand this pit within the timeframes modeled. Additional deposit extraction should be considered a "reasonably foreseeable future actions". County DEIS Comment, No. 263.

h. "This figure fails to disclose the majority of the mineral survey fractions fall in what Rosemont has defined as the Broadtop Butte mineral resource". County PAFEIS Comment, p. 148 (discussing figure in Appendix B).

i. "This cumulative effects analysis only considered other proposed projects. Doesn't really take into account cumulative effects of past and present actions that have already degraded the riparian environment in the analysis area, nor does it take into consideration the reasonably foreseeable actions of Pima County in terms of future development." County PAFEIS Comment, p. 96.

j. "In its analysis of impacts on wildlife, the direct impacts and cumulative impacts on the native wildlife species in project area were not addressed. Further analysis of potential impacts to those same species present in the adjacent project analysis area is needed". County DEIS Comment, No. 429.

k. [The] City of Tucson and Pima County have collaborated with Stantec to portray various scenarios of potential growth in our region. A scenario for cumulative growth at 2040 based on "status quo" trends is attached. This scenario does not consider future urban, suburban, or exurban growth that might be triggered through indirect or cumulative effects of the Rosemont Mine. Other future growth scenarios resulted in less growth near existing reserves than the "status quo". County letter to T. Ciapusci (in response to the Forest Service's August 14, 2009 request for comments), dated August 28, 2009, attached as Exhibit B hereto.

Objection 1

The pending grant of a federal permit for incidental take (Pima County's MSCP) is not listed as a cumulative effect. This item was not considered despite the County's submission in October, 2009 of the "catalog of events" per a Forest Service request. See comment reference "a", above. In comment "b", above, the County made further suggestions to include the MSCP in the EIS cumulative impacts analysis. However, those requests were ignored.

The MSCP is relevant to the cumulative impacts analysis because it has a 30-year term, affects the same general area, provides a basis for evaluating reasonably foreseeable events for the cumulative effect analysis, and is part of a federal action (granting an incidental take permit). By ignoring the Multi-Species Conservation Plan (MSCP) and the attendant analysis of impacts in the MSCP and the DEIS that has been issued for the MSCP, the Forest Service ignored cumulative impacts to species. Issuance of this permit is a "reasonably foreseeable action by the federal government. It is suggested that the FEIS be supplemented to include consideration of the MSCP.

Objection 2

The FEIS did not consider any of the County-provided, spatially explicit growth models for the region. The County submitted the growth model as an attachment to its August 28, 2009 letter to T. Ciapusci (Exhibit B). The failure to consider development impacts is further discussed in comment references "c", "i" and "k", above. These growth studies were compiled by units of local government, all of which have more expertise in estimating Pima County population growth and its impacts than does the Forest Service. The government bodies rely on the studies for area

planning purposes. Yet that information was ignored when the cumulative impact analysis on local population was analyzed. Failure to properly consider the data is arbitrary and capricious. The County recommends re-analysis of the County's growth reports and inclusion of the data in the FEIS cumulative impact analysis.

Objection 3

The Forest Service failed to include other future mining activity in the immediate area in its cumulative impacts analysis. The County commented frequently on this issue. See comment references "d", "e", "f", "g", "h", and "j", above. These are important cumulative effects activities that were not analyzed for any impacts because the Forest Service deemed them as not "reasonably foreseeable."

Appendix A to the FEIS discloses an intent to develop three additional deposits in the vicinity of the Rosemont Mine: "At some point in the future, Rosemont Copper Company intends to conduct further work at Broadtop, to better evaluate the mineral potential." Similar statements are included in Appendix A regarding Peach-Elgin and Copper World deposits. Mitigation measure RC-LO-01 proposes that the Coronado transfer ownership of small slivers of land to Rosemont Copper. The mineral fractions identified in the map include areas mineral fractions at Broadtop Butte and elsewhere in Management Area 16.

Given that the life of the proposed mine ranges anywhere from 20 to 30 years and Rosemont's statements, it is reasonably foreseeable that mining activity on other Management Area 16 and nearby deposits will occur within that time frame. These other mineral deposits may or may not require an EIS prior to development but will clearly, with the proposed Rosemont Mine, cumulatively impact the Santa Ritas Unit and nearby communities. To ignore these highly likely impacts just because no firm development date has been stated by the mining companies is extremely short-sighted. The County recommends that the cumulative impact discussions in the FEIS be amended to include future nearby mining impacts. The amendment should particularly focus on the air, surface water, and groundwater impacts resulting from the expected cluster of mines in the vicinity of Management Area 16.

Objection to lack of disclosure of Forest Supervisor decision to not conduct mineral validity exam

In the draft ROD and the FEIS sections on Purpose and Need for Action, Decision Space/Decision Framework, and Geology, the Forest Service states in several related statements that "Rosemont Copper is entitled to conduct operations that are reasonably incidental to exploration and development of mineral deposits on its mining claims" (ROD p.2) and "Federal Law provides the right for Rosemont Copper to develop the mineral resources it owns and to use the surface of its unpatented mining claims for mining and processing operations and reasonable incidental uses" (ROD P.11). These are just two of many similar statements in both documents. However, these statements assume that Rosemont Copper's unpatented mining claims are in fact valid claims. The Forest Supervisor made a decision not to conduct a mineral validity exam on Rosemont Copper's unpatented mining claims, even though there were multiple requests during public scoping and throughout the NEPA process. . This decision, while discretionary, is a federal action that should be disclosed in both the ROD and the FEIS. It is a significant decision that greatly impacts the purpose and need for action and the decision space.

Pima County and the Pima County Regional Flood Control District, in their January 18, 2012 DEIS comments, included the following comments:

> 25. The two Coronado Supervisors' decisions not to request a validity examination for the Rosemont claims should be disclosed and discussed in a SEIS. In response to Pima County's written requests to examine validity of Rosemont's claims, the Coronado Forest Supervisors have rejected the possibility of conducting an exam of the validity of claims on federal lands that Rosemont proposes to use for disposal of mine waste. See Forest Service letters dated Dec. 10, 2008 from Ms. Derby; Jan 7. 2009 from Robert Bushuk, and Feb. 25, 2011 from Jim Upchurch.

Federal actions should be disclosed and decisions by the Forest Service Supervisors not to request a validity exam are federal actions.

> 26. The Forest Service possesses the discretion to conduct such an evaluation, and has undertaken such examinations in the Coronado National Forest in the past that resulted in curtailment of mining operations. The Forest should conduct a discretionary validity exam. The Forest is not precluded by law from doing this. We acknowledge that this is not routine, but a validity examination would be appropriate to address the scoping concerns identified in Coronado's Scoping Report #2.

Federal actions should be disclosed and the decision by the Forest Service Supervisor not to request a validity exam is a federal action.

> 171. Text fails to disclose the decision of the Forest Supervisor to reject a discretionary validity exam, or impacts resulting from that decision.

Federal actions should be disclosed and the decision by the Forest Service Supervisor not to request a validity exam is a federal action.

The Forest Service response to these comments (and comments by others is:

> FEIS Appendix G P. G-17: The Forest Service has reviewed the comments and references provided in light of the information available, and has determined that statements about the statutory right of the proponent to access and recover their mineral resources are correct as stated

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> in the DEIS and FEIS. It is not common practice, nor is it Forest Service policy, to challenge mining claim validity, except when (a) proposed operations are within an area withdrawn from mineral entry; (b) when a patent application is filed; and (c) when the agency deems that the proposed uses are not incidental to prospecting, mining, or processing operations. This last category includes such management concerns as illegal occupancy or use of mining claims for non-mining or non-mineral processing purposes. For operations proposed in accordance with Forest Service regulations, and where the above situations do not exist, conducting a validity exam is not in line with Forest Service policy. The placement of waste rock and mill tailings on the Forest are considered to be activities connected to mining and mineral processing as per 36CFR228 subpart A, and as such they are authorized activities regardless of whether they are on or off mining claims. This reasoning also follows direction and policy per section 2800 of the Forest Service Manual concerning administration of locatable minerals on National Forest System lands.

Pima County and the Pima County Regional Flood Control District, in their August 14, 2013 PAFEIS comments, included the following comments:

> P. 1 Scoping issues—validity exam issue raised by public is not addressed in the FEIS

Federal actions should be disclosed and the decision by the Forest Service Supervisor not to request a validity exam is a federal action.

In the FEIS, Chapter 3 p.148, p.the Forest Service states that "mining claim location and demonstration of mineral discovery are not required…" This statement misconstrues the DEIS and PAFEIS comments. Pima County and the Pima County Regional Flood Control District object to the fact that the ROD and FEIS fail to disclose the decision of the Forest Supervisor to reject a discretionary validity exam and the impacts resulting from that decision. Federal actions must be disclosed. This objection can be remedied by inserting text into the ROD and the FEIS disclosing the fact that the Forest Supervisor made a decision to not undertake a mineral validity exam for Rosemont's unpatented claims and disclosing that the Supervisor's ROD relies on unexamined claims to the federal mineral estate.

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Pima County and Pima County Regional Flood Control District, Supplementary Pre-Decisional Objections (See cover letter for name, address, phone number and signature)														
2	Coronado National Forest, Nogales Ranger District, Responsible Official Jim Upchurch, Forest Supervisor, Rosemont Copper Project: A Proposed Mining Operation														
3															
4	DRAFT Rosemont EIS-County Pre-Decisional Objection Issues (Chapter 1)														
5	**Topic/Chapter**	**Objection Name**	**Objection Summary**	**Description of those aspects of the proposed project addressed by the objection**	**Previously Cited County Comment**	**Relevance of Comments to Objection**	**New Information?**	**Contrary to law?**	**Arbitrary and Capricious?**	**Inadequate Alternatives Analysis?**	**Inadequate Disclosure of Direct, Indirect or Cumulative Effects? (Specify)**	**Inadequate Mitigation (Specify)?**	**Other Considerations for the Reviewing Official**	**Remedy**	
6	ROD, Forest Plan Amendment	Competing, non-mineral values in Forest Plan are not addressed fully in the way that the Forest Plan is amended.	ROD does not address public concerns about potential for further mine expansion. Nothing in the ROD constrains further mine expansion, and in fact the proposed amendment of the Forest Plan would in essence create a new mining zone, facilitating further mineral development within a new "management area 16" . The proposed management area includes the crest and slopes of the Santa Rita Mountains as well as McCleary Canyon. The crest and slopes are part of a visual resource area in the current Forest Plan. Avoidance and minimization of impacts to these areas has been part of the alternatives analysis, but there is nothing in the ROD or the proposed Forest Plan amendments to protect these areas long-term from further impacts. Removing the existing management guidance, and deeming these areas part of a mining management area means that expansions of the mine affecting the crest and McCleary Canyon would be deemed consistent with the new Forest Plan as amended. Furthermore it ignores the scoping analysis and extensive public comments regarding the non-mineral values represented by these areas.	This objection refers to the proposed amendment of the Forest Plan to replace visual, watershed, and wildlife objectives that currently characterize the Forest Plan for this area.	DEIS 24, 28, 43, 93; Also by letter of December 20, 2012 we asked Will the mine impact the crest? Would Forest Service approve of impacts? In jan 2013, Upchurch responds that he will assure that the pit will not crest the mountains and will not be visible from west side; we also previously requested Forest Plan amendments to protect this area in DEIS comments (included in the record was a letter dated 2008.12.26 to jeanine derby re the Forest Plan asking for water quality protection for DAvidson Canyon; protection of groundwater supplies include shallow groundwater; protection of leopard frogs and native fish, conservation of special status species; preservation of cultural resources in the Rosemont Valley; and protection of TCPs. See also PAFEIS JF p. 39 midpage, and p.95 2nd comment.	Comments about the crest, wildlife and watershed values relate directly to the existing Forest Plan requirements, which are removed by the proposed amendment; comments about heritage resources are also competing public values held dearly by the community.	ROD is new	FLPMA requires Forest to address competing values in Forest Plan; the amendments do not recognize any of the competing public values expressed during years of scoping and comment and analysis.	It is not apparent why the agency did not address other resource values that were used in the alternatives analysis and in the current Forest Plan but not translated in the management area guidelines. For instance protection of visual resources for the crest, or the protection of McCleary watershed. Amending the Plan to benefit one party undermines the planning process.		Disclosed effect of Forest Amendment is to facilitate additional mining, but effects of facilitating mining as a post-clsoure land use on the human environment are not discussed.			Add restrictions on further mineral expansion in this area to protect visual resources of the crest and slopes of the Santa Rita Mountains; and to protect the McCleary watershed via a Forest Plan amendment.	
7	Alternatives	Floodplain Avoidance	The lack of differences between the impacts of the alternatives demonstrates that true alternatives have not been fully considered. ROD Decision Space suggests that the no action alternative is environmentally preferable. An environmentally preferable alterantive that also meets the purpose and need should have been developed.	This objection refers to the formulation of alternatives. Floodplain avoidance was not pursued despite the EO11988 requirment to do so.	PC DEIS Comment 6 - Lack of substantive differences between alternatives	Comments about the parameters guiding alternatives developed are directly relate to whether the EIS complied with existing law. *Alternatives cannot be so narrowly construed as to reflect only the purpose and need of the private applicant. An environmentally preferable alternative was not included. In this arid envornment upstream of a major metropolitan area where groundater is declining is overlooking this requirment is a major flaw.*	Yes, ROD rationale	Executive Order 11988 requires that agency action including both construction and decisions consider floodplain avoidance. The citation for the definition of environmentally preferred alternative (40 CFR 1508.2(b)) could not be found. 1508.2 is the defintions of "the act"	ROD states only utility construction will impact floodplains, this is false and ignores operations and reclamation.	Alternatives that avoid floodplain were not considered. Alterantives that restore floodplains by backfilling to reduce permanent tailing disposal on public land within floodplains are not considered.		Permanent Impact within floodplains on public land part of every alternative.		Require avoidance or restoration including pit backfill	
8	DRAFT Rosemont EIS-County Pre-Decisional Objection Issues (Chapter 2)														
9	**Topic/Chapter**	**Issue Name**	**Summary**	**Description of those aspects of the proposed project addressed by the objection**	**Previously Cited Comment**	**Relevance of Comments to Objection**	**New Information?**	**Contrary to law?**	**Arbitrary and Capricious?**	**Inadequate Alternatives Analysis?**	**Inadequate Disclosure of Direct, Indirect or Cumulative Effects? (Specify)**	**Inadequate Mitigation (Specify)?**	**Other**	**Remedy**	
10	Ch. 2 , but also groundwater mitigation and monitoring requirements in App B.	Two different mines: ADEQ vs Forest Service. How can you know that the Forest's selected alternative will meet gw quality standards, if the Forest's preferred alternative is different from the mine that ADEQ approved?	Barrel Alternative conclusions and mitigation for groundwater quality continue to rely on an aquifer protection permit that was issued for a different mine than the preferred alternative	Effects analysis and conclusions about meeting legal requirements	Separate letter of October 25, 2012 to Jim Upchurch from CHH	The letter points out the discrepancy between what was submitted to ADEQ and what is the preferred alternative in the DEIS	They also say this: Detention and testing of stormwater (OA-SW-01). This mitigation measure requires		Officials have been aware of the discrepancies since the APP was issued by ADEQ. It is arbitrary and capricious to assume that the conclusions based on the ADEQ submittal can be applied to the Barrel Alternative.	No, the mine design on which the APP is issued is one of the alternatives, but it is not the preferred alternative.	The existing APP will require a significant amendment to make it conform to the Barrel Atlernative. Many of the conclusions about effects and mitigation are based on ADEQ's evaluation of a different mine design than the preferred alterantive.		Proposed GW monitoring is for a different mine layout and conclusions may differ as to what ADEQ APP will specify.	Supplemental EIS with Public Notice period; new analyses to understand consequences of ponded areas agains the newly redesigned waste and tailings, along with other changes in stormwater runoff.	
11	Chapter 2	Piecemealing EIS; GV pipeline and recharge should have been an connected action	The analysis required by the National Environmental Policy Act was bifurcated by the Bureau of Reclamation's decision to treat Rosemont's Green Valley pipeline and recharge proposal as a separate action. The two should be regarded as connected actions by this later EIS because the recharge is mitigation for the impacts of the mine and would not be undertaken if Rosemont did not intend to operate mineral extraction wells.	The Green Valley pipeline and recharge component was not examined in the same EIS as the storage of water and credits. The storage of water and recharge credits referred to in the Rosemont FEIS is generated by the pipeline and recharge components in the BOR EIS.	PAFEIS, Fonseca, page 1, Chavez page 6, 46, 51. See also September 8, 2008 letter from Pima County to Sandra Eto, USDOI-BOR.	The Green Valley pipeline and recharge component was not in the same EIS as the storage of water and credits. The storage of water and recharge credits referred to in the Rosemont FEIS is generated by the pipeline and recharge components in the BOR EIS.		Piecemealing impacts. Federal law provides that actions cannot be separated unless they could occur independently; this pipeline would not be financed by the proponent if the proponent were not building a mine here. The MPO acknowledges that the pipeline is mitigation for impacts caused by the wellfield, and that the company could be liable for impacts under State law.					Not in Appendix G.	Re-do EIS so that BuRec is part of the federal actions and there is opportunity to coordinate recharge and recovery with minimization and mitigation measures and effects on San Xavier District	

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
12	Pit backfill, Chapter 2, p 104, 105	Failure to consider benefits of backfill	The FEIS considers the cost of pit backfill but does not compare that to the value of the saved water.	Refers to the pit and the alternatives analysis, and mitigation	DEIS, p 181, and others, ADEIS, page 16, DEIS attachment 1, comments 139-150. PAFEIS: Myers, page 8-9, RWRD staff, page 10-11.	Comments are related to the benefits of backfilling	Yes		Failure to consider the value of water lost from the aquifer to fill a pit and to evaporation.				Referenced in Appendix G, general.		
13	Pit lake filling, Chapter 3; Chapter 2, p 28	Failure to consider potential for through flow	The pit lake will be terminal when full, but it is possible that during lake formation water could flow out of one ore more sides of the pit. The FEIS has failed to consider this potential for degrading groundwater.	Modeling was not performed to simulate potential lake leakage as it forms.	DEIS, p 149, 182. PAFEIS: Meyers, page 56. ADEIS, page 16-17.	Comments are related to the benefits of backfilling to minimize flow through	No			Failure to analyze partial or complete backfill which would limit flow through.			Referenced in Appendix G, general.		
14	Chapter 2-Water Supply	Direct Use of CAP is a feasible alternative, and more effective.	EIS should have considered direct use of CAP feasible. FS indicates they cannot control what water supply Rosemont uses, but this is because the federal agencies bifurcated the Bureau of Reclamation's decision from the Forest Service's, and because they did not consider the CAP use in concert with groundwater and recharge in the area of hydrologic impact. Direct use would be more effective mitigation.	Alternatives analysis	8/14/2013 CHH memo to FS, p.3, item #1. DEIS, 282, 292.	The 8/14/2013 letter to Mr. Upchurch from CHH responds to Forest's rejection of the alternative due to lack of reliability. DEIS 292 asks for direct use to be addressed and discusses feasibility. DEIS 282 asks for mitigation effectivness of direct use of CAP to be compared to the effectiveness of the offsite CAP.	no	May violate NEPA	Alternatives cannot be so narrowly construed as to reflect only the purpose and need of the private applicant.	yes		Water Supply loss is not mitigated. Direct use of CAP would mitigate water-level declines in Green Valley area and leave higher quality water for potable use, and could be required to minimize impacts on Forest resources under FSM Handbook.	Referenced in Appendix G, general.	Provide Direct CAP use for mine supply water	
15	Chapter 2 -Water Supply, P353	Misrepresentation of and minimization of impacts, years 20-200	A more significant reference for table 67 is at year 20 and 200, not equilibrium. As discussed above, the largest impacts regarding water availability are years 20-200 and maybe slightly beyond because during this time period more water is drawn from the aquifer. This omission does not emphasize the more near generational impacts of water availability. Equilibrium is only a snapshot of the impact and how many years is that-greater than 1000.	Impact Analysis regarding water availability and loss of water to downgradient well users and riparian habitat due to pit lake formation and resultant evaporation at mine closure and shortly after .	8/14/2013 CHH memo to FS. PAFEIS,Postillion, page 75	Comments indicate that the executive summary and Table 67 of EIS mis-focus on evaporative pit lake losses when they should focus on overall loss to the aquifer. Focus is needed immediately after mine closure and up to 180 years later.	no	maybe	yes	no	yes. Disclosure of immediate post closure effects not stated in EIS. Equilibrium impacts stated, but that is over 1000 years post mining.This discussion appears to be very down played. Equilibrium is over 1000 years away. What really needs to be emphasized is the loss from years 0-20 (which is discussed) and 20-200 (not discussed). These impacts are far greater than at equilibrium and will affect the downstream well users and riparian vegetation. Tetra tech estimates at year 200 that 517 AF is evaporated and lost at the pit and that amount will rise as the pit lake grows. Over the 20-year mining period as much as 925 AF/year is lost due to pit dewatering. These are the amounts that need emphasis, not at equilibrium when the current generations are gone. In addition, little discussion regarding water availability for the downstream riparian community is mentioned. This needs elaboration and is an omission.	no	Not referenced in Appendix G	present finding of loss to aquifer for years 20-200 to show the effective loss of water to the system immediately after mining and 200 years beyond.	
16	Chapter 2-Alternatives Considered in Detail	Impact on Water Resources - Use of CAP water for mining operations-alternative considered but eliminated (pg 434/496)	Alternate source of water, including CAP or effluent were considered but improperly eliminated. CAP can be used directly in combination with recharge.	Alternatives analysis for direct use of CAP vs use of native groundwater not fully evaluated as per NEPA. Choice affects impact analysis and mitigation measures.	PA/FEIS CHH, Postillion page 133. 8/14/13 DEIS CHH 01/18/12 ADEIS CHH 6/30/11	PAFEIS comment requests direct use of CAP for mine operation. CNF has right to require use of another source water if impacts to the environment , including adjacent well owners, and an already over drafted aquifer shows adverse effects. Replacement wells as a mitigation is not compared to direct CAP use.	ADWR Recovery permit is now included in Table 3-Permits and Authorizations that may be applicable to RCM			CNF states the alternate was eliminated from detailed analysis. CAP source was eliminated because it requires a cistern or construction of a reservoir for water storage, a treatment plant and pipeline and water delivery system--but recharge can now provide that storage. Rosemont has supposedly committed to build recharge independent of the mine.	The degree to which CAP can reduce impacts of groundwater pumping in the area is inadequate because the exact recharge site has not been fully disclosed. Water quality difference have not been fully evaluated and impacts to domestic well water quality not assessed.	Use of CAP water credits to offset groundwater pumping is an inadequate mitigation measure because of lack of certainty that CAP water will be available and no requirement that credits can't be sold. Recharge of CAP does not offset withdrawals unless Rosemont retires long term storage credits accrued through CAP recharge. FEIS states Rosemont will balance pumping with CAP credits-- *to the extent practical* --not true mitigation. FEIS states Rosemont may purchase long-term storage credits to offset groundwater pumping and admits it doesn't result in physical recharge near the area of pumping. FEIS states CAP recharge is a voluntary mitigation measure.	FEIS does not include CWC proposed recharge in the groundwater model, so it can't be construed a connected action. Construction of CAP pipeline included as mitigation-not a connected action as determined by BOR EA. FEIS states recharge is voluntary	Direct use of CAP water for mining operations	

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17	Chapter 2-Alternatives Considered in Detail	Impact on Water Resources - NEPA Process-Additional information on mitigation measures is needed (pg 439/496)	CNF should address concerns that mitigation measures won't minimize project impacts		PA/FEIA CHH 8/14/13 DEIS CHH 01/18/12 ADEIS CHH 6/30/11		N			Groundwater models inadequate: models are based on 20-year mine life, but PA/EIA says 24.5 to 30 years. ADWR mining extraction permit allows for withdrawal of 6,000 af/y but model based on 5,400 af/f for first 8 years	Impacts to county-owned groundwater wells, and numerous other wells, have not been fully disclosed. Several wells may need to be replaced due to declining groundwater levels resulting from pumping the mine supply wells	Mitigation of impacts to surrounding wells inadequate. An unknown number of wells will need to be re-drilled due to declining groundwater levels due to pumping by Rosemont. The well user agreement available to Sahuarita Well Owners should be expanded geographically and temporally. The USACOE, in the Summary of Response to Comments on the DEIS, also makes notes of that the groundwater modeling is adequate	Referenced in Appendix G, general.	Re-run models and discolose effects; minimize effects on Forest resources due to change in mine life.	
18	Alternatives	Floodplain Avoidance	The lack of differences between the impacts of the alternatives demonstrates that true alternatives have not been fully considered. ROD Decision Space suggests that the no action alternative is environmentally preferable. An environmentally preferable alterantive that also meets the purpose and need should have been developed.	This objection refers to the formulation of alternatives.	PC DEIS Comment 6 - Lack of substantive differences between alternatives (Greg Saxe)	Comments about the alterantives relate directly to whether the EIS (method by which alternatives were identified) complied with existing law. *Alternatives cannot be so narrowly construed as to reflect only the purpose and need of the private applicant.*	Yes, ROD rationale	Executive Order 11988 requires that agency action including both construction and decisions consider floodplain avoidance. The citation for the definition of environmentally preferred alternative (40 CFR 1508.2(b)) could not be found. 1508.2 is the defintions of "the act"	ROD states only utility construction will impact floodplains, this is false and ignores operations and reclamation.	Atlernatives that avoid floodplain were not considered. Alteranitves that restore floodplains by backfilling to reduce permanent tailing disposal on public land within floodplains are not considered.		Permanent Impact within floodplains on public land part of every alternative.	Referenced in Appendix G, general.	Require avoidance or restoration including pit backfill	
19	Revegetation	Post-closure land use cannot be achieved; have not been demonstrated feasible	Post mining land uses (grazing, hunting, bird watching, hiking) are unreasonable given restoration horizons even under the most optimistic projections	This objection refers to the failure to identify adequate mitigation.	PC DEIS Comment 8 - Inadequate identification of impacts, mitigation, and bonding requirement	Comments about mitigation measure feasibility relate directly to the sufficiency of the EIS in identifying the long term impacts on public resources.	EIS removes success criteria; acknowleges uncertainty; no importation of soil will occur	Does not meet NEPA	There is no longer any foundation for assuming post-clsoure land uses are feasible.			Fails to provide for reestablishment of vegetative cover and therefore mitigation of erosive forces and recreational value.	Not referenced in Appendix G	Acknowledge permanence of impact and identify additional mitigation.	
20	Visual Resources	Preferred Alternative	FS prefers this alternative in part due to claimed decreased visual impacts	This objection refers to visual impacts of the tailings disposal in the selected alternative.	Jan 18 DEIS comments, item 60. Greg Saxe	Comments about visual resources impacted relate to specific regional economic impacts which have been underestimated and summarily dismissed. Furthermore the truthfulness of the EIS and preferred alternative.		fails to disclose impacts, bases alternative selection on erroneous analysis, defers to applicants vs stakeholder assessment.	Y		By accepting applicant's claim that landforming will block views of the pit the analysis downplays that the contoured tailings will be highly visible and this design increases visbibility of the taling pile from State Route 83 significantly.			ackowledge that the taiings pile are not a landscaped berm and that the piles not just the pit have negatiove impacts	
21	Cumulative Impacts	only positive impacts quantified		This objection refers to failure to identify negative impacts.	DEIS various, 114, 263, 429, 637, 668	Comments about impacts which have been underestimated and summarily dismissed relate directly to the adequacy of the EIS and the veracity/reasonableness of the decision.			Inconsistent illogical treatment?				Referenced in Appendix G, general		
22	Pit backfill	unsound legal argument	FS does have authority to regulate its own land. Why FS may not be able to specify manner in which spoils are removed from FS land, that requirement is certainly within their authorty.	This objection refers to flawed legal justification for use of public land.	Saxe, DEIS, 154	Comment about FS Authority relate to scope of alternatives and ROD decision space.			Legal argument presented in paragraph 1 and 2 of the May 8, 2012 letter to Jim Upchurch from Kathy Arnold stating that requiring backfill would amount to a taking is absurd. It claims that the FS cannot regulate fee lands and therefore cannot require backfill. Still FS can prohibit dumping on public land. Need lawyers to look at Multiple Use Mining Act to see if as Upchurch claims in ROD this is allowed, I don't see it.				Referenced in Appendix G, general	require FS land be used only temporarily and relcaimed to orginal contours.	
23	Bonding	dereliction of duty	FS reply states they have authorty to reject cooperator requests for further study. While procedurally correct this ignores cooperator agreement and best available practice standards. Procedural reliance over intent is dereliction.	This objection refers to the failure of the EIS to identfy bond justification.	Saxe, DEIS, 22 Various commenters throughout, PAFEIS, DEIS comments	Comments about bonding relate directly to whether FS has met legal and professional obligations.			y		The response to our comment states that bond amount determination will occurr later after the final Plan of Operation is in place. Our point is that FEIS fails to identify impacts and mitigation for those identified is inadequate. Adequate bond is impossible to determine wthout adequate EIS. Furthermore the response implies bond is only for on-site mitgation. While this may be true on-site mitigation should prevent off-site impacts. (Greg, can you clarify how this is violates NEPA duty to disclose effects?)		Referenced in Appendix G, general	FS should provide substantive response or SEIS	

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24	Temporary Closure__Applies to All Alternatives	Effects of temporary closure	Temporary closures have potential to significantly affect the human environment. Where is the effect of temporary closures analyzed?	Relates to the effects on resources under all action alternatives.	PAFEIS JF, page 1.	I asked about provisions for temporary closure by way of this comment. Provisions are now provided for temporary closures of at least five years each, however the effects are not analyzed. Could a pit lake form in five years? Are there significant effects that would result to resources during times of closure, and do these differ from or are they additive to effects of operation?	New information in FEIS says these can last at least 5 years each time that the company asks, and that all mitigation and monitoring will continue.					Not reference in Appendix G.	Provision is made for temporary closure, but no effects on the human environment have been disclosed. This is particularly concerning because if pit dewatering continues, then the groundwater impacts have not been disclosed and are underestimated. Only 22 years of groundwater extraction was simulated.	Consider effects of temporary closure(s) and minimize and mitigate them.	
25	Active Operations. Affected resources include air, Soil, Groundwater Quality	State ore milling trigger for NEPA compliance	Identify the circumstances under which will ore would be milled finer than what has been assumed. If milling is finer than projected, it could occur that would affect air quality, water quality and stability of the tailings. Explicit NEPA reanalysis threshold should be stated.	Milling, tailings, effects analysis across air qaulity, water quality, stability of tailings	DEIS comment 164	If milling is finer than projected, it could occur that would affect air quality, water quality and stability of the tailings. Finer milling may be instituted in order to enhance recovery. Will the milling be limited to the particle size statement on page 225 of the EIS. Explicit NEPA reanalysis threshold should be stated.	Yes, statement on page 225 of air quality that tailings can be characterized as a silt with sand, with an average maxmimum particle size of 0.419 mm and average 72.6 percent fines. Is this the NEPA trigger?				.		Not referenced in Appendix G	FEIS should set criteria for NEPA reanalysis based on assumptions relied upon for air quality model.	
26	Alternative Analysis	Analyze potential of different operational life	A serious evaluation of a operating term to reduce or increase impacts, especially in light of the 50-year lease for powerline and waterline across state land and potential for temporary closures. A 40-year operational life would have lower daily production rates and reduced impacts on annual basis, if not cumulative; a shorter term than 20 years could reduce total impacts. But the FEIS instead lengthened mine life without analyzing impacts.	Alternatives analysis	DEIS 31 and PAFEIS comment on p. 3	DEIS asked for a lower rate of production (smaller mill) which would reduce instantaneous impacts like energy demand and air quality. PAFEIS asks for varying length of time at same operational intensity.	FEIS responds that while technically feasible, it is not practical. FEIS says it would not reduce majority of landscape-level environmental impacts, but also redefined mine life since DEIS to include a longer term of operation without disclosing impacts. Also see p. 54 mgt during temporary cessation; and explicit mine life statements for each alternative which are now more like 30 years. The rejected this alternative on basis on environmental impacts, but with tempoary closures the operating mine life will be more like 40 years.	The response to our comment states that bond amount determination will occurr later after the final Plan of Operation is in place. Furthermore the response implies bond is only for on-site mitgation. While this may be true on-site mitigation should prevent off-site impacts.	It is A&C to rule out longer mine life because it would not decrease impacts, while at the same time extend operation without analyzing impacts.				So, will they prohibit a 40-year mine life? It is unclear what are the NEPA triggers for the 30 year mine life, especially if mine production is cut short for other reasons.		
27	DRAFT Rosemont EIS-County Pre-Decisional Objection Issues (Chapter 3)														
28	**General**														
29	Language	language vagueness	DEIS and ROD uses vague language including "may" and "could cause" to describe known impacts	This objection refers to failure to characterize impacts and inclusion of misleading information.	Saxe, DEIS 5, 290, 334, 482	Comment on language relate to a pattern of misinformation, the appearance of a conflict of interest and the failure of the process to meet the obligation to accurately assess the impacts.			y		Fails to accurately characterize impacts		Referenced in Appendix G, general		
30	Groundwater, Biological Resources, Visual, Socioeconomics	pattern of misinformation	impacts are understated and mitigation success overly optimistic, for example exec summary says may, text says could and will. Page 149 FEIS falsley says all local laws apply. Mining is exempt from zoning. They paint a picture of compliance but ignore our involvement.	This objection refers to failure to characterize traffic and habitat impacts.	DEIS, Saxe, 4, 478, 480, 482, 497, 516, 518, 533, 656	Comment on misinformation relate to the failure of the process to meet the obligation to accurately assess the impacts.			y and contrary to cooperator agreement				This pattern continues in responses. Issues raised left out (traffic safety, PCRRH). Comment responses have no numbering system to facilaitate finding and responding to prior comments. The summary table is 79 pages long with many comment responses per page and therefore very difficult to reference or use in formulating objections. Furthermore in several places the responses indicate that the FS provided expanded public review time. It should be noted that the intial releases all occurred during holiday periods including Christmas and Independance Day. Both times when desert dwellers vacation. The times were expanded upon appeal. The response makes it sound as though the FS proactively did so. There is a pattern of factual mispreperesentation, bias and obsfucation.		

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31	Direct Impacts on various resources	Impacts Identification	By concluding that an impact is relatively small and therefore is insignificant belies the intent of NEPA which is to identify impacts and alternatives in order to avoid or mitigate those impacts. This fatal flaw occurs in economic and traffic safety sections as well as others.	This objection refers to failure to characterize riparian, traffic, visual and economic impacts.	Saxe, PC DEIS Comment 7, 389 & 649 - The relative impacts rational for determination of no significant impact	Comments on impact characterization relate directly to the flawed statistical criteria by which they are summarily dismissed.		Does not meet NEPA	Y		Y	Road improvements and provison of emergency response equipement do not mitigate for loss of life and injury associated with the project. Direct impacts on flora and fuana and related secondary impacts on cultural practices, recreational activities and economics are not mitigated.	Referenced in Appendix G, general	Supplemental EIS with additional analysis and baseline assessment	
32	**Geology**														
33	Ch 3 geology	induced seismicity	Effects analysis	Effects on resources	Scoping comment: what is the stability of project features….in event of an earthquake?	The comment was responded to by acknowledging the potential for induced seismicity in the FEIS.	The comment was responded to be acknowledging the potential for induced seismicity in the FEIS. The FEIS says it is possible but should not exceed design magnitude! Nothing about frequency. This is new and troubling information. The FEIS also presents NEW information in the Appendix about the challenge presented by pore pressure and the difficulty with dewatering. Could seismicity trigger rock bursts, especially if there are problems with pore pressure?				EIS must address significant effects to the human environment. FEIS discloses that induced seismicity is expected. Analysis of effects of induced seismicity was limited to direct impacts to the mine, not to surrounding land uses or forest resources, or indirect such as changes in aquifers.			Disclose expected frequency and analyze for effects outside the mine, direct, indirect and cumulative.	
34	Ch 3 geology	Characterize faults	Get more information into DEIS	Preferential directions of flow, effects to groundwater-dependent resources including water quality, riparian	Fonseca, DEIS, 165 requested SEIS, 166, 169, 177	Poor characterization of the fault situation near the pit means that preferetial flow paths were mis-characterized.	Faults added to updated geological map and overlay added of preferred alternative in PAFEIS; faults displace Tertiary unit. Faults are complex (geotechnical text on p. 166). Additional characterization "would not provide any additiona understanding of the local or regional hydrogeologic framework."				They acknowledge there are faults but don't consider how changes in flow caused by the mine might interact with the fault system. This explicit discussion will be important later when water levels are interpreted and recalibrated. Should have been considered in the development of the groundwater model.		Referenced in Appendix G, page G-21.	Clearly identify all of the faults that are assumed to be barriers to movement in one place and use as a reference for NEPA reanalysis of model.	
35	Geology	Pit pore pressure monitoring not just slope stability monitoring	Forest should require monitoring and mitigation of referenced pressures for stability of pit, with standards based on the pit configuration that is actually approved by the Forest in the approved Mine Plan of Operation. This requested monitoring and mitigation measure is different than and in addition to FS-SR-04.	Pertains to monitoring and operation of the mine, especially slope stability and design slope and therefore pit dimensions, worker safety.	Fonseca, PAFEIS, page 40	This requested monitoring and mitigation measure is different than and in addition to FS-SR-04.	There is new information in the FEIS Appendices about the difficulty of reducing pore pressures by vertical pumping.						Not referenced in Appendix G.	Forest should require monitoring and reporting of referenced pressures for stability of pit	
36	**Noise, Bandwidth**														
37	Ch. 3 noise, wilderness and other topics	Military air travel	what are the effects on military air travel and other resources if military air travel is affected?	Transmission line, communication towers (if any, see below) and electromagnetic emissions	DEIS 642, map of military air space, SEIS for impacts to air space.	Will flight paths be altered and if so, will altered flight path significantly affect the human environment?	No				They failed to analyze or disclose whether there are effects of any changes in air travel due to mine		Referenced in Appendix G, page G-8	Disclose impacts; mitigate; Establish threshold for NEPA re-analysis if impacts occur	
38	Electromagnetic Emissions	bandwidth	disclose bandwidth impacts especially in relation to military (Buffalo Soldiers electronic testing area). It is unclear what electromagnetic emissions may be emitted by the alternatives, let alone the effects.	Communications and SCADA systems associated with the mine	DEIS 642, bandwidth encroachments	Requests disclosure of bandwidth encroachments that affect other users, including military					Disclose impacts to human environment from mine, transmission line		Not referenced in Appendix G.	Establish threshold for NEPA if impacts occur	
39	**Air Quality**														
40	Air; Socioeconomic	mitigation of ozone	FEIS should recognize that not all of Rosemont's contributions to ozone can be abated, and Rosemont would "eat up" some of the region's capacity for maintaining the standards. The FEIS should disclose that required actions might cause socioeconomic impacts if ozone std is exceeded; we wanted a photochemical model to be used; we wanted replacement of all internal combustion engine involved in pumping water and tailings with electricity to reduce air pollution due to ozone (July 29, 2009 letter to Jeanine Derby from CHH)	Air quality impacts, socio-economic impacts, transportation impacts	DEIS 647; July 29, 2009 letter to Derby; Sarah Walters PAFEIS comment about Table 12	Each comment connects Rosemont individual contribution to the larger issue of the region meeting the ozone standard, and the effects on others outside the mine					There are broad socioeconomic impacts if ozone standard is exceeded; the potential for exceedance is unacceptable	Inadequate treatment of ozone and socioeconomic effects. Rosemont FEIS shows that the mine will increase ozone precursors, but FEIS does not address indirect or cumulative effects on ozone or ozone compliance. There is no requirement to use electrical supply on Forest lands as an alternative to diesel, and no mitigation on haul trucks.	Referenced in Appendix G, G-25	we wanted replacement of all internal combustion engine involved in pumping water and tailings with electricity to reduce air pollution due to ozone (July 28, 2009 letter to Jeanine Derby from CHH)	
41	**Socioeconomics and Environmental Justice**														
42	Ch. 3 - Socioeconomics	Taxes and Revenues Indirect Revenue Impacts during operational phase of mine	U.S.F.S. states "there would be minimal demands on the local housing supply during the operational phase of the mine" (pg. 1101). The Service then states Indirect Revenue Impacts would be "approximately $107.6 million for State and local governments over the life of the mine" (pg. 1104). The $107.6 million Indirect Revenue Impacts cited are based on the study by Applied Economics (2011, Figure 10, pg. 14), which included $58.2 million of NEW city and county property tax revenues in the $107.6 million. The Applied Economics study derives the $58.2 million for property taxes because it assumes newly constructed housing to satisfy all of the indirect-related impact of the mine. If the Service assumes minimal demands on local housing, then the amount of city and county property tax revenues must then be reduced accordingly.	Effects analysis	Horn, August 14, 2013, Cooperative Agency Review, Pg. 101.	The objection and comment are the same	No	No					Generally referenced Appendix G, G-59	Revise the effects analysis	

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43	Socioeconomics Employment	job losses & pattern of misinformation	This objection refers to failure to accuratley assess job losses.	This objection refers to failure to accuratley assess job losses.	DEIS, Saxe 654, 656 & 657	Comments on job losses relate directly to the economic impacts.			y inconsistent standards applied to job losses vs job creation		fails to accurately characterize job losses		Generally referenced Appendix G, G-59	increase mitiation to include lost recreation opportunity replacement	
44	Socioeconomic	spending calculation	This objection refers to failure to characterize job loss impacts. Methods used to calculate spending for lost jobs is different than that used for jobs created	This objection refers to failure to characterize job loss impacts.	Saxe, DEIS 658, 659 & 661	Comments on jobs lost relate directly to the economic impact of the project.			y		fails to accurately characterize spending		Generally referenced Appendix G, G-59	supplemental SEIS	
45	Socioeconomics: Property Values	Property Value impact	impact on property values underestimated and based on unsubstantiated conclusions	This objection refers to failure to characterize impacts on property values.	DEIS, Saxe, 660.	Comments on property values relate directly to economic impact of the project.			This conclusion contradicts FS Plan and DEIS cited studies asserting that there is positive relationship between proximity of the Coronado and property values in the study area.				Referenced in Appendix G, G-59		
46	Socioeconomic	Community Values and Level of service	Pima County has exceptional open space values not typical levels of service. Inclusion of tribal trust land as public open space is incorrect.	This objection refers to characterization of the existing level of service.	Saxe, DEIS 654 & 666	comment and objection are the same.			contrary to cooperator agreement, incluson of trust land specifically prohibited by The Multiple Surface Use Act		includes false information		Not referenced in Appendix G.	acknowledge OS value as exceptional and exclude trust land from OS calcs	
47	**Surface Water Quantity/Quality**														
48	Surface Water Quantity-- (GS)	Citing of Hydrologic Studies to support FEIS Conclusions	The naming scheme for referenced studies is inconsistent, arbitrary and capricous, so evaluting the claims in the FEIS leaves an unfair burden on people providing comment. For example, the 'Golder Model' is repeatedly referenced in the FEIS (e.g. p 402). However, it is not available under 'Golder' in the referenced studies on the EIS website. Instead, by looking at other memos, I was able to determine that the referenced study on the EIS website is most likely, (but not assuredly) 'Baxter and Patterson, 2012.' However 'Baxter and Patterson, 2012' is not cited in the FEIS. The USFS is being arbitrary and capricious in citing supporting evidence sometimes by the name of the consulting company and sometimes by the name of the individual writing the study for the consulting company.	The understanding of the mine's hydrologic impact and the public safety are dependent on the modeling effort.	Canfield. The Golder Model report is not available as supporting data on the EIS report or the rosemonteis.us website. Therefore, the conclusion that the 'Rosemont Copper modeling is reasonable and appropriate...' is unsupported by the analysis presented (08-14-13 letter).	If the public and jurisdictions are unable to follow the line of reasoning presented by the mine because of confusing naming schemes, they are effectively preventing from the opportunity to provide effective comments.			Y				Not reference in Appendix G	The FEIS should adopt a consistent naming scheme that is used in the FEIS, so that readers can follow the supporting documentation. A revised FEIS should then be re-issued, and new comment period allowed.	
49	Surface Water Quality	water body monitoring	monitor for new water bodies inadvertently created and when detected, monitor for surface water compliance	Monitoring plan	DEIS-321, 387. ADEIS 8-1-2011 page 14,	Comments request monitoring of surface water quality at water bodies, including those inadvertently created by mine	There is no discussion of this in the body of the text nor appendix B. There is some discussion that addresses the compliance point dam and how it will not impact WQ, but it is unresponsive to our comment, which was not about the compliance dam: Cooperating agencies have commented on the potential for unregulated discharge of stormwater that has been in contact with ore bodies and mine processing facilities in the event that the compliance point dam is overtopped and destroyed, which could happen with some frequency. This concern is based on a misunderstanding of the purpose of the compliance point dam. The stormwater reaching the compliance point dam is not halted or permanently retained by the dam in any way and will flow downstream in any case. The dam allows for some settling of sediment, detains stormwater temporarily, and allows for a convenient location to collect stormwater samples. The dam does not, however, prevent stormwater from flowing downstream.					It is unclear whether the Forest Service expects there to be any water bodies in the PCAs or elsewhere due to seepage or impoundment, other than the compliance dam. The expectations need to be clear, and if there are inadvertent water bodies created, disclose the impacts on other resources, such as biology.	No mitigation is provided.		Provide for visual identification and water quality monitoring new water bodies in unplanned locations.	
50	Ch 3 water quality	standards for As and U	APP does not set limits for U and limit for As will be state's less stringent standard.	Effects analysis	DEIS comment 318, standards set in APP will not protect groundwater quality for drinking water use.	Objection and comment are the same							Generally referenced in Appendix G, page G-36.	FEIS should should set criteria for NEPA reanalysis that are more stringtent than states. FS-GW-02 does not address these constituents. Even if it did, it allows Rosemont to set the criteria for thresholds and suspension of sampling. Forest Service should set the standards for As and U reanalysis.	

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51	Ch. 3 surface water quality	Suspended sediment concentration in AAC 18-11-109D or narrative standards at Aac R18-11-108 from sw runoff from waste or tailings	statement that waste and tails are not anticipated to exceed SW quality stds does not take into account possibility for dsicharge to exceed numeric standard for suspended sediment concentration in AAC 18-11-109D or narrative standards at AAC R18-11-108.	Effects analysis	DEIS comment 319	Comment and objection are the same	Yes, new information that TSS for Barrel can be as high as 34,000 ppm, and that exceedances of metails in stormwater is observed.						Outstanding Water is downstream.	Disclose potential for exceedances and revise effects analysis if warranted.	
52	**Seeps, Springs, and Riparian Areas**														
53	Effects on waters and streams	Ephemeral streams with shallow groundwater	Definition of ephemeral fails to consider where depth to water is shallow, and relationship to vegetation. Definitions and stream classification still does not distinguish ephemeral streams from those underlain by shallow groundwater areas. By relying on Westland veg mapping, FEIS fails to recognize the significance of shallow groundwater in creating conditions for wetland species that may not occur now but can be present given climatic and sediment transport variations that characterize our watercourses.	Effects analysis for riparian vegetation and by extension wildlife habitat features that may include shade, thermal shelter etc. and by extension ecosystem functions such as subsurface storage of water and contaminant transport	PAFEIS comment on p. 6 and elsewhere in Chapter.PAFEIS p. 85 and 86, p. 91 Fonseca; p. 94-95 Fonseca	Comment p. 6 connects definitions to conclusions of effects.PAFEIS p. 86 points out shallow groundwater tables; p. 85 points out EIS discounts springs as evidence of regional aquifer; p. 85 also points out that many ephemeral streams have shallow water tables; p. 91 provides a map of shallow water tables that was provided by E. L. Montgomery to Rosemont and discusses more problems with the FEIS approach; p. 94 and 95 provide information about intermittent streams in the area that have been classified as ephemeral in the FEIS.				Results in underconsideration of the effects on wetland and riparian vegetation and stream function. FEIS discounts the effects of the mine on ephemeral stream systems that possess shallow water tables; and discounts the significance of this stream type to stream functions and plants that utilize the moisture gradients provided by shallow water tables.			Revise effects analysis	
54	Seeps and Springs	Mischaracterization of Pima County riparian maps; incorrect citation	FEIS says purpose was to identify corridors of wildlife habitat, but we also characterized HM vegetation based on water availability. RRH maps and IRA designations do not rely on the classification of Johnson et al 1984 as cited on p. 495.FEIS continues to mischaracterize stream conditions in the area, and the basis for the County riparian habitat mapping. Hydroriparian classification can result from EITHER vegetation species OR vegetation structure OR presence of shallow groundwater. Thus the differences between the vegetation maps produced by Westland and the riparian habitat maps by Pima County Regional FLood Control District are NOT the result of inaccurate vegetation mapping.	Effects analysis for riparian vegetation and by extension wildlife habitat features that may include shade, thermal shelter etc. and by extension ecosystem functions such as subsurface storage of water and contaminant transport	PAFEIS comment, problem is still uncorrected in FEIS p. 493.	Comment is about text error, and other relates to the effect analysis because some of the designations are because of the presence of riparian vegetation streucture or water availability				Results in underconsideration of the effects on wetland and riparian vegetation			Revise effect analysis to include Pima County evidence of intermittent flow and shallow groundwater and species composition used in RRH HM classifications, and correct mistaken references to Johnson 1984 classification system in relation to our ordinance.	
55	chapter 3, seeps and springs	Table 108, summary of effects	Effects table does not take into account past, present and future losses of water table; development-related loss of riparian areas. We provided information to substantiate lowering of water table, we offered spatially explicit losses of riparian due to the Section 10 permit (MSCP) and passed along USGS documentation of loss of vegetation that has already occurred on Davidson.	Effects analsyis	PAFEIS 87 and 93 Fonseca	All three comments on page 87 and on p. 93 relate to the deficiences with respect to the No Action Alternative.	FEIS discusses some of the references but no changes were made to the table and not all of the information was obtained or utilized.							The effects of the action alternative should be superimposed or added to the losses from the No-Action alternative, projected out 30 years.	
56	chapter 3, seeps and springs; HHMP for Waters of US	Functional assessment	Has a Corps-approved function/condition assessment been performed for the mitigation projects? I don't see any information. The Corps developed a hydrogeomorphic model that was used for six different locations in the Gila River basin, including the Santa Cruz watershed.	Mitigation	PAFEIS p. 93	Comments and objection the same								Evalute mitigation projects with the Corps-approve HGM model.	
57	Chapter 3, seeps and springs, HHMP for Waters of the US	Temporal losses of aquatic resources	Discuss and provide offsets for any temporal losses of aquatic reosurce functions that could be caused by this project and the replacement of aquatic resource functions at the compensatory mitigation sites	Effects analysis, mitigation	PAFEIS. P. 93; PAFEIS p. 95 and 96 with regard to sever-and-transfer	Comments on p. 93 asked for disclosures relative to NEPA. If there are temporal losses, they must be compensated by Corps. Comment on p. 95 and 96 discusses potential for sever and transfer to be delayed.								Disclose temporal losses in the FEIS. Assure compensation.	
58	Seeps, Streams and Groundwater Quantity	Changes in recharge	FEIS does not discuss changes in recharge due to changes in ephemeral flow. Mountain front recharge is primarily the recharge of ephemeral flows and should be considered as such. FEIS also has not considered how the changed location of recharge affects drawdown or pit refill, as requested previously.	Effects analysis	PAFEIS p. 85 Myers line 1	Comment and objection are same.								consider the impacts and revise the effects analysis.	
59	**Cultural Resources**														

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60	Chapter 3 Cultural Resources	Heritage loss to TON and other tribes	The enormous scale of the impacts from the Selected Action on significant cultural resources will result in the unacceptable loss of cultural heritage by the Tohono O'odham Nation and other concerned Tribes from the great number of archaeological sites, contemporary sacred sites and important places, cultural landscapes, especially, the Ce:wi Duag Traditional Cultural Property, that will be utterly destroyed and forever lost. Foremost among these losses will be an as yet unknown number of human burials that will be destroyed, in spite of the archaeological data recovery sampling employed, required by Section 106 of the NHPA, which is outlined in the MOA, and detailed in the HPTP, human burial remains, associated grave goods, and funerary objects are bound to be missed by the mitigation treatment. A similar scale of loss of Euroamerican heritage resources will occur, including the potential loss of human burial remains, from the obliteration of so many historic sites representing historical land use (ranching and mining) and lifeways (townsites). The heritage values of all Pima County residents are threatened by the Rosemont Mine MPO.	Requirement to address adverse effects of the undertaking on historic properties and cultural resources, under NEPA, the National Historic Preservation Act, Section 106 (36 CFR 800), the State Historic Preservation Office, the Arizona Antiquities Act, and the Arizona Historic Preservation Act.	June 30, 2011 DEIS Jurisdictional Comments Chapter 3,Cultural Resources/ Mitigation Effectiveness and Remaining Effects, p31 lines 41-43; p31 Section 106, NHPA; and Irretrievable and Irreversible Commitment of Resources, p22 lines 1-21	Pima County continues to share the concerns of the Tohono O'odham Nation and other concerned Tribes about the sheer scale and extent of destruction to significant cultural resources, sacred places, and other culturally and historically important places, and that these massive impacts will forever negatively alter the cultural landscape of the Santa Rita Mountains, destroying or permanently damaging sacred places and human burial remains. The County especially objects to these impacts occurring on public lands, where in this case the Coronado's mandate to preserve and protect cultural and natural resources withinn the Forest appears to be an unwarranted presumption. The County comments illustrate the magnitude of the adverse effects from the MPO on cultural heritage of the Tohono O'odham Nation and the Euroamerican community. Pima County supports and shares the concerns expressed by the Tohono O'odham and other consulted Tribal representatives; the value of the proposed mine to the people of Pima County is extremely limited, but the short- and long-term costs and permanent losses are immense and simply cannot be justified.										
61	**Chapter 3 Cultural Resources**	Loss of scientific knowledge about Archaeology and History	The enormous scale of the impacts on significant cultural resources from the Selected Action will result of the immense and irretrievable loss of scientific knowledge about prehistoric and historic sites and significant cultural resources, sacred places, and other culturally and historically important places and the social and economic lifeways they represent is similarly unacceptable. Foremost among these losses will be an as yet unknown number of human burials that will be destroyed, in spite of the archaeological data recovery sampling employed, required by Section 106 of the NHPA, which is outlined in the MOA, and detailed in the HPTP, human burial remains, associated grave goods, and funerary objects are bound to be missed by the mitigation treatment. A similar scale of loss of Euroamerican heritage resources will occur, including the potential loss of human burial remains, from the obliteration of so many historic sites representing historical land use (ranching and mining; townsites) and lifeways. These massive impacts will forever negatively alter the cultural landscape of the Santa Rita Mountains, the Ce:wi Duag Traditional Cultural Property, destroying or permanently damaging sacred places and human burial remains, and removing the archaeological and historic resources forever from the reach of scientific inquiry.	This comment addresses the scientific information potential these resources possess and the potentuial to lose the information even though archaeological data recovery will be done, per Section 106 of the NHPA, and according to the project MOa and HPTP.	January 1, 2012 DEIS Comments, Chapter 3 Heritage Resources: Comments 602,	F. This comment concerns the scientific information potential these resources possess and the objective of mitigation treatments to recover as much of the information as possible through archaeological data recovery and other archaeological and historic investigations. Recovery of scientific information mitigates effect, but at the proposed scale of loss, too much information will be irretrievably lost, preventing present and future researchers from ever addressing archaeological or historic questions about these resources. This represents a significant scientific loss and is inaccurately termed unavoidable, because selection of the No Action Alternative would result in no negative effect or information loss.										
62	**Chapter 3 Cultural Resources**	TCP cultural and sacred loss to Tribes	Pima County shares the concerns of the tribes about the scale of potential damage and extent of destruction to significant cultural resources, sacred places, and other culturally and historically important places, of the Ce:wi Duag and Huerfano Butte Traditional Cultural Properties, and that these massive impacts will forever negatively alter the cultural landscape of the Santa Rita Mountains, destroying or permanently damaging sacred places and human burial remains, and removing the archaeological resources and sacred sites forever from the cultural universe of the living Tohono O'odham communities and the other Tribes for whom the TCPs are sacred. The County especially objects to these impacts occurring on public lands, which are supposed to ensure the preservation and protection of cultural and natural resources. The Coronado is failing its moral obligation to preserve lands held sacred by the Tribes.	These comments concern the Tohono O'odham Nation's recognition of the Santa Rita Mountains as the Ce:wi Duag Traditional Cultural Property and the Huefano Buttem TCP. They consider the TCPs in terms of the requirement to address adverse effects of the undertaking on historic properties and cultural resources, under NEPA, the National Historic Preservation Act, Section 106 (36 CFR 800), the State Historic Preservation Office, the Arizona Antiquities Act, and the Arizona Historic Preservation Act. The Santa Rita Mountains are important for the plants, animals, springs, ancestral homes, ancestral burials, and ancestral religious places that are embedded within this natural landscape, all of which have tremendous present day cultural and religious importance to them.	January 1, 2012 DEIS Comments, Chapter 3 Heritage Resources: Comments 603, 604, 606. June 30, 2011 DEIS Jurisdictional Comments Chapter 3, Cultural Resources/Consultation with Tribal Governments, Results of Consultation, p18 lines 33-43; p19 lines 1-8; PAFEIS p. 97 Fonseca with respect to springs	Pima County supports the the Tohono O'odham Nation in recognizing and obtaining NFS and SHPO agreement that the Santa Rita Mountains encompass a cultural landscape that is extremely important to the Nation, the Ce:wi Duag Traditional Cultural Property. The Ce:wi Duag remains inadequately inventoried and assessed to identify its true cultural, social, economic, and spiritual value to the Nation. This means the effects and proposed mitigation treatments of the Rosemont MPO on the TCP are inadequately defined and will not be appriopriate or adequate mitigation of adverse effects to the many culturally and economically important components and sacred places of the TCP.										
63	**Groundwater Quality/Quantity/Geochemistry**														

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64	**Groundwater Quality**	Groundwater quality: Carbon disulfide, xanthates	Evaluation should not be limited to ore that is processed. Should also evaluate fate of miling process chemicals and their breakdown products. Of particular importance here are xanthates and carbon disulfide. Carbon disulfide is regulated under ARS 49-243(I) so that the applicant must limit discharge to the maximum extent practicalbe regardless of cost.	Effects analysis	Jim DuBois, ADEIS additional comments, 2011.08.01	Objection and comment are the same					At a minimum, disclose effects to Forest resources.		Not addressed in Appendix G	State whether or not there are significant effects to the human environment	
65	Pit lake, Chapter 3, throughout	Failure to analyze water saved due to backfill	More than 90,000 acre-feet of water will reside in a full pit lake, and 100s of af will evaporate each year. This is a loss to local aquifer system that the FEIS does not consider.	Alternative analysis, effects analysis	DEIS, Meyers p 181, and others, PAFEIS, Meyers, page 8	Comments provide more technical detail about the objection	No		Failure to even consider the loss of water from the aquifer	Failure to analyze partial or complete backfill which would save most of this water.			The FEIS specifies creation of a pit lake is good for groundwater quality. This may be true, but the amount of water creates a huge deficit in the local groundwater system.		
66	Chapter 3 - Groundwater Quantity (TON SAWRSA)	Impact on Water Resources - Adverse Impacts of mine supply pumping on tribal water resources	CNF basis with conclusion of consistency with ARS 27-2711 is not apparent. should revise the EIS to address the direct and indirect impacts to tribal water resources, and to add a NEPA trigger for reanalysis and mitigation	Effects analysis, monitoring	PA/FEIA CHH 8/14/13 DEIS CHH 01/18/12 ADEIS CHH 6/30/11	Comments asked for disclosures relative to SAWRSA obligations	FEIS states based on groundwater modeling it appears Rosemont will not violate ARS 45-2711, but does not show ADWR's analysis or determination. Groundwater wells in Sahuarita area already drilled and were reviewed and approved by ADWR. FEIS states that based on modeling to support the FEIS, it does not appear that impacts from Rosemont water supply pumping would intersect with the Nation boundary in a way that would violate statutory restrictions--10-foot drawdown just touches the boundary of the Nation after 20 years of pumping. FEIS also discloses that mine life is 30 years, not 20, so now model is not reflecting the need for 30 years of pumping.	ARS45-2711	It is arbitrary to state that there will be no violation if the information is not available or is inconsistent with the years of mine life.		Figure 49 does not show the boundary of the Tohono O'Odham Nation	No information about how groundwater impacts to the TON will be mitigated, or if there is a mitigation trigger, or who is responsible, or a monitoring plan.		We ask for an analysis based on 30 year mine life, or stipulation that the well field will only be used 20 years.	
67	Chapter 3 - Groundwater Quantity	Impact on Water Resources - Potential for Subsidence not addressed (pg 454/496)	CNF should revise the EIS to include additional information on the potential for subsidence	KC: This objection refers to the potential for subsidence to occur as a result of project groundwater withdrawal. The incremental withdrawal for the mine water supply would contribute to the overall groundwater withdrawal and land subsidence in the Sahuarita area.	PA/FEIA CHH 8/14/13 DEIS CHH 01/18/12 ADEIS CHH 6/30/11 (Fonseca, pg 39)	KC:Comments about subsidence relate to the adverse impacts that will result from groundwater pumping to support mining operations. The potential for subsidence in the Cienega Valley was not addressed outside the mine operations area (8/14/13 PA/DEIS comments from CHH). Groundwater models were inadequate as they are based on a 20-year mine life, but the PA/EIA Says 24.5 to 30 years. CNF did not fully analyze impacts to county-owned wells, individual domestic wells and numerous other wells, therefore the potential for subsidence was not adequately evaluated (1/16/14 Initial Review of FEIS to BOS from CHH)	FEIS says incremental withdrawal for mine water supply would contribute to the overall groundwater withdrawal and land subsidence in the Sahuarita area. Land subsidence is likely to continue			Analyzed in Chapter 3, but CNF believes it is speculative to assign a specific amount since groundwater pumping for the mine water supply is 14-18% of net groundwater pumping in GV area			Addressed in Appendix G, G-32		
68	**Groundwater Quantity**	reporting water used annuallly in relation to NEPA. This issue is different than OA-GW-07 which is reporting water pumped from TAMA, and it is different from the objection about disclosing the specific locations of wells or other water-related facilities on Forest land.	FEIS is based on a limited amount of water being removed from groundwater system by dewatering. Reporting is essential to determine when the NEPA assumption has been exceeded.	Monitoring and reporting in relation to NEPA re-analysis	DEIS comments, Fonseca: "However, the Forest Service can require reporting in exchange for the permission to use Forest land to transport the water via truck or pipeline, and in fact should require this reporting per FSM standards." "According to US Forest Service groundwater management policy, annual reporting of withdrawals on Forest land in cubic feet of water is required. The Coronado should require reporting of pumped water on Forest lands, and reporting of water in pipelines authorized for the transportation of water across Forest land."	Comments request reporting; reporting is needed to understand when NEPA trigger is met.	"A much smaller amount of water would be obtained from storwmwater ….and pit dewatering…"p. xvii. More specifically, a total of 13,000 to 18,500 af from pit dewatering. Page xxx. Used in processing or dust control (p. 43).	For new authorizations, care should be taken to assure that the appropriate provisions are included to apply the regulations at 36 CFR 251.56(B)(v). Continued monitoring of water developments on NFS lands is necessary to verify that their operation remains in the interest of the affected public.					Not referenced in Appendix G	They addressed the disclosure of volume we requested. But reporting requirements are needed as part of mitigation to detect when NEPA re-analysis is needed.	
69	Groundwater Quantity	reporting gw used on Forest land in relation to Forest resources. This issue is different than OA-GW-07 which is reporting water pumped from TAMA, and different than the objection above.	Require reporting of gw pumping volumes and change of water levels to FS as a condition of use of Forest land: the Forest Service can require reporting in exchange for the permission to use Forest land to transport the water via truck or pipeline, and in fact should require this reporting per FSM standards.	Monitoring and reporting	DEIS comments, Fonseca about failure to conform with Forest groundwater policy and reporting	Comment relates reporting to Forest stewardship responsibility	P. 41: During construction of the water supply pipeline, water would be drawn from existing wells in and around the project site in order to supply construction activities." p.44-45 groundwater control by BADCT during operation (p. 45) There is also a requirement for monitoring of certain existing wells, but not any new wells on FS land.	2541.04c - Forest Supervisors Maintain and update annually the Forest's water uses, requirements, and rights inventory. For new authorizations, care should be taken to assure that the appropriate provisions are included to apply the regulations at 36 CFR 251.56(B)(v). Continued monitoring of water developments on NFS lands is necessary to verify that their operation remains in the interest of the affected public. The proposal to pump or transport water must not impair NFS resources (FSM 2702 & 2541.34).					Not referenced in Appendix G	Require reporting of volumes transported and volumes pumped.	

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70	Groundwater Quantity	Groundwater modeling	Correct errors, omissions and misstatements in the FEIS about County groundwater model and the County's review of the other two models	Effects due to groundwater drawdowns and changes in gradients	DEIS 245, 246, 259, 260	Comments are the same as the objection			DEIS concluded County method was not peer reviewed. It was. Further county requested FS conduct its own peer review. Furthermore response misrepresents cooperator involvement by stating we "reviewed" their models. It should be noted that upon review we found them grossly inadeaquate and reccomended using PC methods.					use county model in SEIS effects analysis	
71	Groundwater Quality/Geology/ Geochemistry, Appendix B	TENORM	Set threshold for NEPA compliance and mitigation	Monitoring and mitigation Plan	DEIS, 162, 163	Original comments have been addressed in FEIS by saying TENORM will not happen, but FEIS response does not identify a threshold at which NEPA review would be needed.	Yes, the prediction is that tailings will not concentrate radioactive materials, but no explicit threshold is identified.						There is no implementable response or NEPA trigger	Set threshold or trigger for NEPA compliance and mitigation	
72	**Visual Resources**														
73	Transporation Rt 83 Scenic Quality	response inadequacy		This objection refers to visual blight of the "Rosemont Lanform".	Saxe, DEIS 60, 497, 503, 510, 521, 524 comments pertaining to visual resources, analysis, and impacts	Comments about visual resources impacted relate to specific regional economic impacts which have been underestimated and summarily dismissed. Furthermore the truthfulness of the EIS and preferred alternative. Most significantly this comment relates to the complete mischaracterization of the selected alternative and therefore the flaws in the EIS and ROD. This alternative was selected so that Rosmeont could mine future claims this is stated as a reason the Sycamore Aletrantive was not.			Y	FS response suggest visual analysis and adot criteria indicate no impact of preferred alternative. This is absurd. The visual blight created by miles of rill eroded tailing piles blocking the view of what was once a ridgeline is pure whitewash and indicates the lack of reasonablenes of the analysis and conclusions			Generally addressed in Appendix G, G-46	FS summarily dismisses need to improve 83 by stating ADOT does not intend to widen it to four lanes. Obviosly there are other measures which could be considered. Another indication the Supervisor is acting without adequate information or understanding. SEIS required. Further the argument by the proponent that there is no legal access across their fee lands is incorrect. Historic roads whether or not county maintained are legal by adverse posession and historic use. As a "fence out" state in Az landowners including Augusta must provide an alternate route for historic roads it closes.	
74	**Transportation**														
75	Traffic Safety	increased fatality and accident rates	fails to identify impacts and issues	This objection raises the fact that while fatality rates increases are calculated the population basis is flawed and they are weighed against too large of a pool.	Saxe, DEIS 547, 579, 580, 701	Comments on traffic safety relate to public safety. Comments on biased modelling relate to validity of conclusions		Y			use of population instead of traffic for fatality rates is unnacceptable		Generally discussed in Appendix G, G-53.		
76	Transportation/Access and Traffic Safety	Sahuarita Road Traffic Impacts	Traffic impacts to Sahuarita Road not disclosed, nor mitigation proposed.	Impacts and Mitigation	PAFEIS p. 105-106, Crowe	Multiple comments state failure to disclose traffic impacts to Sahuarita Road.	No	NEPA requires full disclosure of all environmental impacts		Traffic analysis is inadequate	Traffic analysis is inadequate and does not fully disclose direct and indirect effects (traffic impacts) to Saharita Road.	No mitigation is proposed to address impacts to Sahuarita Road.		Provide additional traffic analysis and quantify impacts to Sahuarita Road, then propose mitigation measures to address those impacts such as repaving and repairing Sahuarita Road.	
77	Transportation/Access and Traffic Safety	State Route 83 traffic safety impacts	Mitigation not sufficient to address safety concerns.	Impacts and Mitigation	PAFEIS p. 102, 105, 106, 107, 112. Crowe	comments question traffic analysis and raise concerns regarding traffic safety on SR 83 and lack of adequate mitigation	No	Highway Capacity Manual 2000, pages 20-21, "… all grades of 3 percent or more with a length of 0.6 miles or more must be analyzed as specifid upgrades or downgrades"		Traffic analysis is inadequate	Traffic analysis does not disclose traffic and safety impacts of truck traffic on SR 83.	Proposed mitigation for State Route 83 is inadequate to address traffic safety concerns related to increased traffic impacts.		Provide additional mitigation measures including, but not limited to, truck passing lanes on State Route 83 and roadway shoulder reconstruction.	
78	Chapter 3	Transportation/Access impacts	Adverse transportation impacts are anticipated on county roads but are not disclosed and mitigated. County roadways include but are not limited to Sahuarita Road and Santa Rita Road.	Effects analysis	Crowe, DEIS and PAFEIS	Comment and objection are the same	N	Yes, NEPA, which requires discussion of all environmentally adverse affects.			The analysis is inadequate for direct, indirect and cumulative impacts to county roadways, including but not limited to Sahuarita Road and Santa Rita Road.	Proposed mitigation does not address anticipated impacts to county roadways including, but not limited to, Sahuarita Road and Santa Rita Road.	Generally discussed in Appendix G, G-53.	Traffic study should evaluate anticpated impacts to county roadways including but not limited to Sahuarita Road and Santa Rita Road.	
79	**Soils and Revegetation**														

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80	Soils and Revegetation / Chapter 3	Soil availability for final reclamation and post-closure revegetation period	Soil calculations based on a nominal 12 inches of soil thickness for reclamation of the total waste rock and tailings mound results in a significant underestimation of the actual soil needed, due to: placement of soil onto irregular waste rock surfaces, the need to replace soils during concurrent reclamation due to soil loss prior to vegetation establishment, and the need to replace soils during the post-reclamation period due to soil loss prior to vegetation establishment and slope stability.	Volume of soil needed for concurrent reclamation, final reclamation, and post-reclamation slope rehabilitation operations	Krieski - PA draft FEIS, pp. 158 - 160	Comment and objection are the same					Not sure on the category for this - Without the determination of realistic volumes of soil which will be needed for reclamation of the waste rock and tailings mounds, Rosemont Copper may run out of soil and be unable to satisfy the requirements of the final Reclamation and Closure Plan. As a result, revegetation of the upper landform sideslopes and upper surfaces may not be possible without the development of new off-site soil borrow areas and associated reclamation projects.		Generally addressed in Appendix G, G-72	The Forest Service should require Rosemont Copper to perform professional calculations of the volume of soil which will be needed to achieve a minimum 1 ft thickness for total mine reclamation operations on waste rock surfaces. The calculations must specifically account for the irregular rock surface, soil loss prior to revegetation success both for concurrent reclamation operations and the post-reclamation period prior to full revegetation establishment and associated soil stability.	
81	Soils and Revegetation / Chapter 3	Soil availability for final reclamation and post-closure revegetation period	Two soil stockpile locations (#3 and #4) are planned on the surface of the Tailings and Waste Rock disposal mound at the end of Year 15. However, the volume capacity of these two soil stockpiles is greater than 2M cubic yards short of the soil material needed for final reclamation of the site, and for use during the post-closure period until revegetatin is determined to be successful.	Availability of adequate soil reserves to complete final site reclamation and successful revegetation	Krieski - PA draft FEIS, pp. 156 - 157	Comment and objection are the same					Not sure on the category for this - impacts of not having soils needed for final reclamation include inability to properly revegetate the site as stipulated in the FEIS and Final Reclamation and Closure Plan, and an inability to replace soil loss during the post-reclamation period until such time the revegetation operation is determined to be complete by the Coronado Forest Service.		Generally addressed in Appendix G, G-72	The Forest Service should require Rosemont Copper to clearly demonstrate how on-site soils will be managed throughout the mine life. Demonstrate soil availability for final reclamation of the Waste Rock and Tailings mound still required at the end of Year 15. If some 600,000 cy of stored soil per the FEIS, where will the additional > 2,000,000 cy of soil be found for final reclamation and post-reclamation soil needs?	
82	Soil and Revegetation/Ch. 3	Lack of vegetative success critera	FS decided to pull the vegetation success criteria from the FEIS. There is no basis for comments	Reclamation plan	Fonseca, PAEIS, page 42, See also "Rosemont Monitoring Comments_BFP"	comment is the same as objection	Pulling of success criteria is new		The FS wrote: "Species-specific predictions of revegetation success over time have been removed from the FEIS, since there was inadequate information available to support those predictions. Predictions of revegetation success and monitoring requirements will be addressed in a final revegetation plan, to be approved by the Coronado prior to approval of the final MPO" If there is inadequate information now, how will waiting achieve a different outcome?			Because the performance measures and methods are not included, we cannot judge if it is inadequate. Pulling of the criteria was despite the fact that the FS had conveened an expert panel to discuss these issues during the summer of 2012. The forest produced draft outline of standards and ideas, some of which were never brought forward to the FEIS	Generally addressed in Appendix G, G-22	Develop reclamation plan prior to the finalization of the EIS and provide cooperators and others sufficient time to review and change	
83	Ch 3	soils characterization	Performance standards for soil on the reclaimed landform should be disclosed and required of the applicant. The soil properties approach should be used in developing those performance standards.	Reclamation plan; Mitigation of effects	PAFEIS p. 41 referring to p. 14;. P. 41 referring to 15 and ff; p. 42 referring to p. 27; p. 43 all comments; p. 45 Kimoto	PAFEEIS p. 41 calls for a soil depth and particle size standard, and asks how much topsoil as opposed to bedrock is needed; PAFEIS p. 42 requesting soil depth standard; p. 42 asks for more details about soils. P. 45 Kimoto asks for soil moisture and erosion details.	The FEIS kicks the can down the road to the MPO. Only a desired veg condition is specified, and some goals. No measurable std for soils.	FSM2250 FS must use soil properties to assess condition and potential of effects on soil while planning. FSM 2840 reclamation is to reclaim consistent with Forest Plan, measurable performance standards required. But no measurable performance standards are included in this FEIS. And FS has not used "soil" properties of mining landform in planning effects.			Can't analyze effects of reclamation on soils, watershed function, biology if there are no measurable soil specifications or soil performance standards in the EIS.		Not specifically addressed in Appendix G.	Impose specifications /standards for soil on waste-tailings pile in the FEIS. Specifications should include soil properties.	

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84	Biological Resources/ Chapter3	Chiricahua leopard frog impacts analysis	Range of impacts from groundwater drawdown is not expressed in impacts analysis	Analysis of impacts		Impacts assessment and mitigation has not been updated to reflect new models	FEIS states new data about impacts that will occur to Empire Gulch. An important population of Chiricahua leopard frog occurs on this site, but no analysis or mitigation is given				The EIS impacts analysis for the Chiricahua leopard frog appears to be based on the listing decision in the BO, which is itself based on information that does not reflec the uncertainty of the groundwater models and effects on seeps and springs of the area. For example, the data that the FWS used is dates to 2010 and there the impacts to Empire Gulch do not reflect the range of possible impacts	The loss of the Empire Gulch population is not considered in mitiation; given the importance of this population, additional mitigation is needed.	Not discussed in Appendix G	Reanalyze using new data and provide more mitigation.	
85	Biological Resources/ Chapter3	Mitigation inaddequate	Use of camera traps for mitigation	Mitigation	PAFEIS, page 139, Powell	comment same as objection						Use of camera traps and/or dung-sniffing dogs to monitor jaguars can not reasonably be considered mitigation	Not discussed in Appendix G	Eliminate camera program and invest in more meaningful mitiation measure	
86	**Biological Impacts**														
87	Biological Resources/ Chapter3	Mitigation inaddequate	Use of camera traps for mitigation	Mitigation	PAFEIS, page 139, Powell	comment same as objection						Use of camera traps and/or dung-sniffing dogs to monitor jaguars can not reasonably be considered mitigation	Not discussed in Appendix G	Eliminate camera program and invest in more meaningful mitiation measure	
88	Biological Resources/Chapter 3	Underestimation of impacts	Document consistently downplays impacts to biological resources. They need to be more honest in their assessment and provide threshold for impacts that would be considered significant	Impacts analysis	DEIS, Powell, comment 427, 428, 429, 430. See also "Rosemont_Bio_Mitigation_Monitoring_Recommendations"	Information provided does not allow for proper analysis of impacts		Yes. The Forest did not cite "§ 1502.22 Incomplete or unavailable information. "When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking".	The FEIS consistently states that " The mine and ancillary facilities could result in a loss or alteration of habitat for numerous plant and animal species." We have repeatedly said that they need to be more forthcoming. By their own addmission, they are loosing thousands of oaks, hundreds of thousands of agave, so how could it be that they the mine "may", "could", "might" result in the loss of habitat? For vegetation they state: "have the potential to permanently change vegetation" This is not acceptible		The FEIS consistently states that " The mine and ancillary facilities could result in a loss or alteration of habitat for numerous plant and animal species." We have repeatedly said that they need to be more forthcoming. By their own addmission, they are loosing thousands of oaks, hundreds of thousands of agave, so how could it be that they the mine "may", "could", "might" result in the loss of habitat? For vegetation they state: "have the potential to permanently change vegetation" This is not acceptible	They cannot mitigate what they do not account for	Generally discussed in Appendix G	Provide more realistic assessment and state that some impacts simply will not be mitigated	
89	Biological Resources/Chapter 3	Reports missing	Can not evaluate report that is not provided.	Information		comment same as objection	Yes				Numerous reports that are cited in the document are not on the FS website. This includes 6 reports (by SWCA and SWCA and the FS) that are cited on page 576 and elsewhere (.e., 587), No management indicator species report. These reports have not been provided to cooperators, therefore it is not possible to evaluate the information contained therein		Generally discussed in Appendix G, G-17	Provide cooperators access to citations that are missing and provide ample time to review	
90	Biological Resources/Chapter 3	Inadequate species information	Cited a host of species that will be covered under County MSCP, but they chose not disclose impacts.	Information	PAFEIS, page 28, Powell	comment same as objection					Did not analyze impacts on a host of Species of interest to Pima County, but more importantly, the SWCA 2013c report cites the need to analyze additional species (such as the Bell's vireo), but there is no current Management indicator species report available for review		Not discussed in Appendix G	Reevaluate list of species and analyze impacts for species that were indicated as needing assessment	
91	Biological Resources/Chapter 3	Population viability	Coronado claims that their definition of population viability is more narrow that traditional definitions	Impacts analysis	PAFEIS, Powell, page 31	Inadequate analysis			The FS made a determination that the loss of the population of Coleman's corralroot would not impact population viability. They the cite "FS guidance" which gives a defination of PV that relates to the "distribution of the species on the Coronado and not other areas" What guidance is this?			No off-site mitigation promised for this species.	Generally discussed in Appendix G-41	Provide more realistic assessment of the impacts to the species' population and get outside assessment of methodology used to make determination. Provide greater protections to populations elsewhere.	

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92	Biological Resources/Chapter 3	Impacts to species	Over and over and for many plant species, the EIS states that no impacts to certain species would occur.	Impacts analysis	PAFEIS, Powell, page 31. Also see "Rosemont_Bio_Mitigation_Monitoring_Recommendations"	Comments same as objection	Yes. The Forest did not cite "§ 1502.22 Incomplete or unavailable information. "When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking".		Yes, for some species there is sufficient information about impacts and mitigation, while for other species there is not. No discussion about why this might be or if there is some type of threshold used for analysis.		They use language such as "Direct impacts (i.e., crushing, clearing, trampling, etc.) to this species are not anticipated because there are no documented occurrence records for this species within the project area or the footprints of the connected actions." However, no surveys have been conucted, so how can such a conclusion be drawn? The issue of pausity of information was covered in "Rosemont_Bio_Mitigation_Monitoring_Recommendations"	In FS-BR-18, they say that they will go do pre-construction surveys ahead of the clearing crews. Why not require this now so that impacts can be evaluated and it can be determined if salvage is possible.	Generally discussed in Appendix G.	Pre-construction surveys should be done well ahead of the impacts to allow for appropriate salvage and collection	
93	Biological Resources/Chapter 3	Lack of mitigation to species	Impacts analysis are performed, but for almost all species analyzed (with the exception of a few T&E species), mitigation is not addressed	Mitigation	PAFEIS, Powell, pages 137, 139, 140, See also Rosemont_Bio_Mitigation_Monitoring_Recommendations (Dated July 12, 2012)	Cited inadequate mitigation efforts						Dozens of species were analyzed for effects, but mitigation analysis is missing for most species. Even for the mitigation parcels that are being proposed, there is just a list of species that might be present, but no quantification of the amount of habitat		More thorough assessment of the role of mitigation parcels and what species would they count towards mitigation. Provide a more honest ledger of habitat lost and mitigation for all species analyzed.	
94	Biology, Mitigation	Disclose how much mitigation land would be needed to meet CLS guidelines of local plan.	FEIS discloses that project is not consistent with local plan, SDCP CLS guidelines, but does not explain how much it would take to make it consistent, and why it is not consistent	Relates to mitigation	DEIS, PAFEIS (Powell, Fonseca, others); PAFEIS comment p. 35 dated August 14, 2013 provides the data to the Forest Service.	Comment provides the acreage for the FEIS, but the FEIS does not include this or an explanation why it cannot be met.	The FEIS included disclosure that the project is not consistent with the SDCP, but no discussion about the acreage of the deficit or why the applicant cannot provide mitigation land in the CLS to meet the guidelines.	This from the EIS: "Conflicts with Regional, State, and Local Plans, Policies, and Controls NEPA at 40 CFR 1502.16 directs, "Statements shall discuss (c) Possible conflicts between the proposed action and the objectives of Federal, regional, State, and local (and in the case of a reservation, Indian tribe) land use plans, policies and controls for the area concerned. (See 1506.2(d).)" Title 40 CFR 1506.2(d) states, "To better integrate environmental impact statements into State or local planning processes, statements shall discuss any inconsistency of a proposed action with any approved State or local plan and laws (whether or not federally sanctioned). Where an inconsistency exists, the statement should describe the extent to which the agency would reconcile its proposed action with the plan or law." On page 1148 the EIS discusses the SDCP, but does not mention the CLS.					Not discussed in Appendix G	Up to 12,900 acres of mitigation in the CLS	
95	Species impacts/Ch.3	Impacts to Coleman's coral root and avoidance	Barrel Alternative was chosen, in part, to avoid a population of Coleman's corralroot, but they are proposing to put a fense around most of this large population of plants and call such an action avoidance, but it is so close of the process facility that fire, dessication, invasive species, etc are sure to impact the species	Impacts and Mitigation	PAFEIS-Powell, page 139, 28	Inadequate analysis			On page 870 it says that climate change is likely to contribute to oak mortality, but again, they do not consider that changing the hydrology of MCLeary canyon will impact the host species of the corralroot.	There is not attempt to look at design alternative that would avoid impacts to the three population of this species	Yes. If you look at the plan of operations, there is a diversion dam directly upslope of the largest known population of the Coleman's coralroot known in the world. This fact is not disclosed.	Coleman's coral root populations rely on oak trees and the coral root biology is not well known. The FS is suggesting that saving the oak trees in McCleary from plant siting will save the orchid but the presence of the plant and activities there, even post-closure activities, are likely to serverely impact the species. This is not acknowledged. Also changes in hydrology at plant site- this is not acknowledged. Finally, the chance for fire to impact the species is not acknowledged. They must develop a mitigation plan for this species, but this is not in Appendix B. In fact, in the text of the document, they say that they will put a fense around the population in McCleary, but that provision did not make it in Appendix B.	Generally discussed Appendix G-43	Develop mitigation plan for this species	
96	Wildlife Xing	Corrogated Pipes Inadequate	Better design needed	This objection refers to failure to identify appropriate design.	DEIS, Saxe 37	Comments on wildlife xing design relate directly to the violation of the cooperator agreement and failure to use best available practices.				failed to respond			Not discussed in Appendix G.	Use sandy bottom box culverts	
97	**Recreation**														
98	Recreation	pattern of misinformation	Fails to identify users and resources	This objection refers to failure to characterize impacts and inclusion of misleading information.	DEIS Saxe 530 - 532, 653, 665, 670	Comments about impacts which have been underestimated and summarily dismissed relate directly to the adequacy of the EIS and the veracity/reasonableness of the decision.		Fails to identify users and resources				Generally discussed in Appendix G	terminology internally inconsistent	add users and resources cited in SEIS	
99	**Hazardous Materials**														
100	Hazardous Materials	unsubstantiated conclusions	fails to identify impacts	Impact analysis	DEIS, Saxe541	Comment and objection are the same			y				Generally discussed Appendix G-50	SEIS with plan for release control prior to development of hydrologic sink	
101	**Land Ownership**														

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102	Chapter 3 Land ow	Selling mineral fractions to Rosemont Copper	Disclose the conveyance of mineral fractions as a federal action or remove it entirely; it is not as mitigation. Analyze the effects of conveying mineral fractions that include part of another deposit that is not proposed for mining at this time : Broadtop Butte. Disclose that the intent of this EIS would be to provide NEPA for conveying the mineral fractions to Rosemont.	Purpose and Need; Disclosure of federal actions in ROD; Cumulative Effects; Indirect effects	Ch 2 DEIS p. 15, PAFEIS p. 15, p.148.	PAFEIS comments p. 15 ask for clarifications relating to the federal action and the effects of conveying them to Rosemont; PAFEIS comment p. 39 requests acknowledgment of loss of federal mineral estate; PAFEIS p. 148 comments ask for dislosure.	They clarified that no exchanges would occur, but they proposed in the PAFEIS selling the mineral fractions to RCC, and identified RCC as willing to acquire them. They say this would avoid the impact of increased difficulty in managing these parcels after they become integrated in the mining facilities. Citation to RC-LO-02 and Forest Plan amendment, but this is not in LO-02 in FEIS or mentioned in Forest Plan amendment. Letter of August 20, 2010 from Rosemont about Broadtop in Appendices says that Broadtop Butte Deposit has potential as a smaller satellite area of production.		They examined only the advantages of selling mineral fractions from an administrative standpoint, but not whether there are any disadvantages from relinquishing administration. They also failed to analyze the effect of amending the Forest Plan to allow for land acquisition, even as they talk about the difficulty of obtaining a restrictive covenant on the private lands. The stricken portions of the old Forest Plan included provisions for acquisitions of private rights!		They need to examine and dislose effects of selling fed land fractions of Broadtop Butte and reducing federal land interests in general. Rosemont disclosed that they intend to conduct at least $12 million worth of drilling and engineering when funds are available, at least 5 years to carry out this work. So, if the mineral fractions are sold, there is no Forest Plan opportunity for NEPA or mitigation of impacts to Forest resources. We disagree that effects are non-significant of amending the forest plan and selling Broadtop Butte mineral fractions. Is it legally sufficient to do post facto NEPA on mitigation measures? Then it is too late to consider the effects.		Generally discussed G-14	Don't sell mineral fractions. Or if you must, then disclose the federal action and analyze all of the effects.	
103	**Public Health**														
104	Authority to Abate public nuisances	Acknowledge ARS 36-602	Pima County has a responsibility to abate public nuisances that is not acknowledged. ARS 36-6-2 would apply where groundwater essential for domestic cleanliness and drinking water purposes is no longer available or polluted.	Public Health: Relevant Laws	PAFEIS page 113 Fonseca	Comment cites the entirety of 36-602 and the objection								Acknowledge County authority	
105	**DRAFT Rosemont EIS-County Pre-Decisional Objection Issues (Appendices)**														
106	App B, Mitigation FS-GW-01	Monitoring for unplanned water bodies	The monitoring plan should include frequent visual surveys for seeps or other unplanned water bodies.	Monitoring	PAFEIS p. 77 Fonseca refers to unplanned surface water bodies; PAFEIS p. 143 says Forest should use visual evidence of seepage as a monitoring measure. PAFEIS p. 144 re inadvertently formed surface water bodies within the mine perimeter.	Comment on p. 77 relates to detection of unplanned water bodies. P.143 requests visual monitoring of features relating to seepage. Comment on p. 144 of PAFEIS connects this to state surface water quality standards. The monitoring plan calls for two points to be monitored for moisture content. Considering that any seeps would follow preferential flow paths, there is a very low probability that such monitoring would detect a seep.	Yes. Mitigation plan for two proposed seepage detectors within the waste landform. But these do not address our previous comments.					Yes, there are many places where seepage could accumulate, or surface waters are blocked. Unplanned water bodies will be used by wildlife.	The two proposed seepage detectors within the waste landform are essentially useless mitigation.	For one, there should be frequent visual surveys for seeps around perimeters of waste and tailings, and less frequently within the entire fenced area. Detection of unplanned water bodies should trigger wildlife observations and surface quality sampling for conformance with water quality standards.	
107	Appendix B	Public Access to information	Provide public access to monitoring and compliance information by posting to a website.	Monitoring and mitigation	PAFEIS Fonseca, page 5 dated August 14, 2013	Comment and objection is the same.	There is a process for sharing information with a committee that would include outside agencies, but this does not address posting of the monitoring data. The summary report prepared by the applicant will also not address our objection.						The NEPA process had shown that there is an enormous interest in the details of mine operation, and that there are numerous people in the communnity who have the expertise to understand technical information. That community should not have to rely on an increasingly congested Freedom of Information Act process to obtain the data required by law from the applicant. Consider that in the end, only the public can hold government and private actors accountable.	Post monitoring and compliance information received by the Forest to a website.	
108	App B, Mitigation	Deed restrictions on site--See also Forest Plan amendment	Deed restrictions to prohibit valley fills elsewhere in watershed	Mitigation Plan; also relates to the topic of avoidance and minimization	DEIS, page 27	Comment relates placement of deed restrictions to reduction of impacts						FS-BR02 and 03 rely on avoiding impacts through alternation of design, but will be ineffective if there is later valley filling due to changes in the MPO.		Add deed restrictions or protective covenants that would make avoidance effective over the long-term	

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109	ROD, Surface Water Quality Monitoring, Groundwater Quality Monitoring, Biological monitoring	FS-SSR-02; FS-GW-02, FS-BR-22	Pima County agrees about the necessity of monitoring the OAWs, and that Rosemont should fund the monitoring, This mitigation measure depends on access to the OAW located on County and District lands. This mitigation measure should recognize local authority. It should specify that the data for all aspects of the OAW will be collected by parties acceptable to Pima County who would report the data through Pima Association of Governments and Arizona Department of Environmental Quality. In addition, Pima County will need to approve all analytes and methods used in the OAW. Recently, Rosemont submitted to ASLD an application to site groundwater and surface water quality sampling devices on State Trust land; this sampling site is not located on the OAW.	Monitoring plan	We have previously advised Forest Service of our land ownership, we have not previously commented on the specific issues relating to landowner permission to cite facilities on our properties.	Pima County owns the land in the OAW, therefore must issue a permission to place any monitoring device there.	In Table 100, EIS, presents WestLand Resources water quality data for Davidson for which Pima County's Kerry Baldwin has issued no access permit; New data also in that the monitoring is no longer considered voluntary but it is required as part of the BO.	No, however, after being advised, it would be contrary to law to assume that Pima County will provide access on the terms cited by the applicant's proposed groundwater monitoring plan after being advised of the land owner's preferences. NEPA at 40 CFR 1502.16 directs, "Statements shall discuss (c) Possible conflicts between the proposed action and the objectives of Federal, regional, State, and local (and in the case of a reservation, Indian tribe) land use plans, policies and controls for the area concerned. (See 1506.2(d).)" Title 40 CFR 1506.2(d) states, "To better integrate environmental impact statements into State or local planning processes, statements shall discuss any inconsistency of a proposed action with any approved State or local plan and laws (whether or not federally sanctioned). Where an inconsistency exists, the statement should describe the extent to which the agency would reconcile its proposed action with the plan or law."				It would be inadequate to site some of the surface water and groundwater monitoring facilities on state trust land, because the site on state trust land is outside the OAW reach. Please work with Pima County on monitoring the OAW, which is located on our lands.		Work with Pima County on accurate description of the mitigation measures that recognizes local authority.	
110	App B, Mitigation FW-GW-02	Additional monitoring of groundwater quality	The monitoring plan calls for additional wells and springs to be sampled, but the wells listed include only one proposed well. Any proposed wells on National Forest land should also be monitored, at a minimum, plus any new production wells that supply on-Forest uses.	Groundwater monitoring; Also relates to location of wells on Forest land, which is a related disclosure issue	DEIS 107, 108; Scoping attachments cite FS' national groundwater policy	107 asks for groundwater quality moniotring and remediation plan; 109 explains why Forest can't rely on APP monitoring alone; National GW policy sets expectations for Forest to manage and protect aquifers.	Yes, mitigation plan.	Forest is required to monitor wells on FS lands;			The FS should choose locations and require addition new wells to be constructed.	Forest is required to monitor wells on FS lands.	Rosemont has stipulated to additional monitoring per the terms of Pima County's appeal of the APP.	Stipulate that any new wells on NF land will be monitored; also ask for monitoring of new production wells that supply on-Forest uses of water.	
111	App B, Mitigation FW-GW-02	Disclose water quality constituents	The EIS and mitigation measure fails to disclose which water quality constiuents will be monitored. The mitigation measure should specify constituents and disclose what actions the Froest is prepared to take if standards are not met.	Groundwater monitoring; Also relates to mitigation effectiveness	PAFEIS, p. 143	Comment and objection are the same		Forest is required to monitor wells on FS lands;				This disclosure is needed not only for anyone to understand what is being monitored and whether the mitigation can be effective in measuring compliance. I	This disclosure is also needed to quantify cost of the mesure for bonding.	Specify what constituents will be monitored relative to narrative and quantitative standards for aquifer uses in the Forest (livestock and wildlife, primarily). Disclose what action the Forest will take if standards are not met.	
112	Appendix B	Monitoring vigor of Coleman's coral root host plant is important	Monitoring the health and number of oak trees in Coleman't coralroot population area in McCleary is critical.	Biological monitoring	PAFEIS, Powell, page 138	Additional monitoring needed to test FS assertions of the success of avoidance measures						As part of the avoidance of Coleman's coralroot plants, it is imperative that the host trees be monitored for vigor and condition; if they die, so too will the orchids. Specify what contingencies would be put in place if the plants are impacted.		Do not assume avoidance will be successful. Monitor vigor of oaks	
113	Appendix B	Cave resources	Having Rosemont police themselves after the discovery of palentological and cave resources is not realistic.	Paleontological and cave resources	DEIS, 159, 176	Requesting improved cave and paleontological monitoring						Page B-7. Cave, mine and paleontogical resources will be monitored by Rosemont. Same language about stopping work, but no assurance that this will be done. Independent monitor is the only way to ensure this. This comment was not accepted. FS review within 24 hours is not reasonable.	Generally discussed G-21	Designate independant observer/advisor to oversee	
114	Appendix B	Reclamation	Lack of performance criteria for review	Reclamation; effects to soils and vegetation and wildlife and water	PAFEIS, Fonseca page 142. See also "Rosemont_Bio_Mitigation_Monitoring_Recommendations"	Requesting performance standards						Page B-9. Final MPO will have vegetation/soil performance criteria, but those are not available for review. To help in this process, the FS invokes adaptive management to "set and refine techniques". The FS fundamentally does not understand what adaptive management is and how it can be employed. For example, it is not used to adjust objectives. Though additional information has been provided for soils and vegetation, this is still a flawed premise		Provide vegetation and soils reclamation plan and allow review before finalizing EIS	
115	Appendix B	Reclamation	No information about the number of plots for establishing reclamation success.	Reclamation success	PAFEIS, Kimoto page 154. See also "Rosemont Monitoring Comments_BFP"	Need for additional information and clarity to ensure success of efforts						Because we have not been able to see the specifics, they did not address comment about how many monitoring sites/plots need to be established to demonstrate success criteria have been met. We need to have confidence that this will happened and we do not	Generally addressed in Appendix G-23	Provide vegetation and soils reclamation plan and allow review before finalizing EIS	

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116	Appendix B	Reclamation	Lack of link between failure to meet success criteria and action to correct or mitigate	Mitigation	PAFEIS, Powell. See also Rosemont Monitoring Comments_BFP" (These were conveyted to Forest Service)	Need for additional information and clarity to ensure success of efforts						We have not been able to see the MPO, so there is no way to know, but a key question raised previously is what will happen if vegetation success criteria are not met? What about off-site mitigation?		Provide vegetation and soils reclamation plan and allow review before finalizing EIS	
117	Appendix B	Reclamation	Little to no informatin has been provided regarding the financial assurances to be provided by the project propoent to offset costs that would be incurred by the federal taxpayer if the project causes air and/or water oluution that endangeres the public health. No discussion has been completed that established any type of performance to assure mitigation and remediation of impacts should the project proponent fail to perform the mtiigatin or restoration actions stated....Significant and substantial financial assurances must be provided...	Financial assurances	PAFEIS cover letter by Mr. Huckelberry dated August 14, 2013	Comment and objection is the same. We understand that the Forest does not have to provide this in the EIS, but remind you that this was one of the scoping concerns expressed by Pima County as well as others. In light of the past history of defaults, bankruptcies and inadequate reclamation bonding, we had hope to see more information in the EIS about this topic.								Provide public an opportunity to review all of the components of bonding and the release schedule, if not the actual amounts.	
118	Appendix B	Lack of triggers to ensure success of reclamtion efforts	Each section in the Appendix B contain Performance criteria (or at least an outline of criteria), but what happens when these have been exceeded? What threshold would let us know if exceedance occurs? What actions would be taken?	Reclamation success	PAFEIS, page 154 (Kimoto), page 42 (Fonseca), page 44, 135, 136 (Powell). See also "Rosemont_Bio_Mitigation_Monitoring_Recommendations" and "Rosemont Monitoring Comments_BFP"	Need to be sure that reclamation actions and monitoring trigger a process if success criteria are not met						Without ties to thresholds and contingency plans, there is no confidence in the performance criteria process. In addition, for most of this appendix there is too little detail to be able to determine if the monitoring or mitigation efforts are sufficient. Instead, the analysis/process for developing is put off to beyong any comment period. As an example of treshold, consider rocky slopes within and adjacent to the , which would be remotely monitored for movement." Monitoring is good, but the document fails to identify what measures would be put in place if movement does happen. Aside from obvious human safety issues, there are also biological concerns, such as impacts to talus snail habitat. Bonding should be identified for potential slope movement.		Provide vegetation and soils reclamation plan and allow review before finalizing EIS	
119	Appendix B	Woody debris	Woody debris is suggested to " be used on the reclaimed growth medium surfaces to provide stability, organic matter, and microhabitats for seed germination, invertebrates, and small vertebrate species."	Mitigation effectiveness	PAFEIS, Powell page 135	Need for additional information and clarity to ensure success of efforts						This may not be realistic for more than a few years out from the initial vegetation clearance action because these woody elements will decompose. What, then, will be the plan for woody components at the time of mine closure?		Provide vegetation and soils reclamation plan and allow review before finalizing EIS	
120	Appendix B	Invasive species	No invasive species plan	Mitigation	PAEIS, Powell page 137	Lack of information						Executive order 13112 requires that the Forest Service consider invasive species in its actions. It is stated that an invasive species plan will be developed with "specific measures", but the Rosemont Invasive Species Management Plan (2012; cited) lacks any details or have any firm committments. The EIS only cites this document once and there is no section in the EIS that give any "Specific measures" with regards to invasives. Therefore, specifics about targets, actions plans, and planning processes for the development and implementation of the invasive species plan must be included in the EIS. Simply leaving those decisions to post-acceptance of the MPO will likely result in a plan that is long on promises and vague on specifics. Consideration of adjacent and downstream lands that will be affected by the mine's operations must be included in this plan. Finally, a plan and assured and sufficient funding for post-mining monitoring and treatment actions must be part of any invasive species plans.		Develop invasive species monitoring and management plan and provide opportunities for review prior to finalizing EIS	
121	Appendix B	Agaves	The plan does not call for staggering then planting of agave pants over time so that not all agaves will bloom at the same time after mine closure	Mitigation	PAFEIS, Powell page 138	Better mitigation design needed						This will result in most of the agaves blooming at the same time		Develop plan that would stagger agave planting so as to have flowing spread out. Also, promote grassland restoration actions elsewhere that would promote agaves	

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122	Appendix B	Monitoring approach	For all proposed monitoring, there is not sufficient information to evaluate success and to link results back to management actions	Monitoring and mitigation	Rosemont Monitoring Comments_BFP	To ensure success of monitoring and management actions						The white paper "Rosemont Monitoring Comments_BFP" was provided to the Forest Service in June 2012. It outline an approach to monitoring that all Rosemont monitoring actions should follow. Unfortunately, Appendix B does not have enough information to determine if there recommendations are being followed. This must be done before EIS is finalized so that comments can be made by cooperators			
123	Appendix B	ORV mitigation	Money will be given to the Coronado, but they are ignoring displacement of ORVs onto County lands	Mitigation	Saxe DEIS, 532. PAFEIS, Anderson page 144, 18,	Comments provide details on the reason for the objection.						The Rosemont site is a very popular place for off-highway vehicles, which are likely to be displaced to other lands nearby. The EIS calls for money to go to the FS for managing OHVs on their land, but in reality, OHVs will be displaced to other, non-FS lands such as Las Cienegas National Conservation Area and the County's Bar-V ranch. This should be acknowledged and funding should be available for other land owners/managers to recieve compensation	Appendix G-49	Study pattern of ORV use in area, establish baseline use, then divide moneys based on the data.	
124	Appendix B	Caves	The EIS should include additional details on what will occur after a cave, sinkhole, or underground drainage is found. Sufficient time must be given to proper assessment and inventory of resources and particular attention must be paid to biological resources, especially invertebrates. Currently, there is a 24-hour turn around for this actitity. Should be a threshold for additional NEPA review.	Mitigation	PAFEIS, powell page 134; DEIS 176	DEIS 176 asks for documentation of cave features in a detailed protocol that is disclosed in a SEIS; PAFEIS p. 134 asks for an independent entity to conduct the work, and identifies the need for more time.						The mitigation proposed in the FEIS is unrealistic in terms of the timeframe, and there are no deliverables specified.		The EIS should include additional details on what will occur after a cave, sinkhole, or underground drainage is found. Sufficient time must be given to proper assessment and inventory of resources and particular attention must be paid to biological resources, especially invertebrates. Currently, there is a 24-hour turn around for this actitity. Should be a threshold for additional NEPA review.	
125	Appendix B and Chapter 3	Grazing	Proposed to continue grazing on reclaimed areas should be analyzed, and effects on reclamation disclosed	Reclamation plan; effects analysis	PAFEIS, powell page 136	Comment and objection are the same.					Has not been analyzed as it relates to impacts of grazing on revegetation success criteria. What impact could grazing have on reveg efforts? This is not addressed, but the document does say that impacts to grazing may take effect if the new Forest Plan is put into place.		Generally addressed in Appendix G-45	Disclose impacts and how it will be addressed	
126	Mitigation Appendix B	Downstream replenishment not addressed	Mitigation measure that will provide relief to downstream sub flow and restore flow to the immediate downstream reaches of the affected areas. And monitor the quality of pit dewatering to ensure it meets state standards for discharge--this should be possible given FEIS belief in Tetra Tech's gecohemical model predictions.	Mitigation	8/14/2013 CHH to FS. PAFEIS, Postillion, page 133; PAFEIS Postillion. P. 99	Comments ask for replenishment of downstream waters to mitigate surface water and ground water effects.	no	no		yes		Mitigation measure to discharge pumped pit dewatering well water to downstream reaches not addressed. Mitigation at Pantano Dam area and at ranches in other watersheds does not address the long-term loss of surface and subflow that will damage the riparian vegetation, loss of springs and loss of sub flow immediately downstream of the area of immediate impact at the mine.		Evaluate and implement mitigation measure. An AZPDES permit is needed to meet Federal and AZ WQ standards.	
127	Biology, Mitigation	Mitigation Fund for cienega creek	Pima County should be included	Mitigation	PAFEIS, Fonseca page 37	Comment and objection are the same	No.					Bonding has not been determined for the project yet, but the level of uncertainty about the mine's impacts to Davidson and Cienega Creek warrant a mitigation fund for Pima County that can be used for future mitigation actions	Not referenced in Appendix G		
128	Appendix B	Stream water quality monitoring	Forest should monitor streams around facility and in NF to protect Forest resources, and collect baseline information, toassure the mining operation meets applicable surface water quality standards.	surface water monitoring and protection of Forest resources	PAFEIS p. 149, Fonseca	Comment requests surface water monitoring at specific locations listed in the comment.	The EIS presents new information about the sw quality at Barrel Canyon					The proposed measure FS-GW-02 does not address intermittent streams located on Forest lands. In mineralized areas, it is critical to collect such baseline daata so that impacts during operation and post-closure may be distinguished from pre-mining ambient conditions. For instance, there is already some indicate of elevated metals at Barrel. Surface water quality monitoring is requested at specific springs or intermittent flow reaches listed in the comment, including on the mitigation lands offered by Rosemont.		Add monitoring and management triggers if sw quality stds are exceeded.	

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129	Appendix B	RC-SW-01	Clarify purpose of the "surface water flows" monitoring. This gage is upstream of an intermittent flow reach of Barrel Canyon and cannot be used to monitor changes in the intermittent flow reach. But the gage could be usedful for understanding overall volumen and magnitude of floods, if properly equipped. The mitigation measure disclose what data will be collected and how it will be used by Forest Service.	Stream gage monitoring	PAFEIS p. 97	Comment requests additional information about the monitoring in order to understand the purpose						Unclear how this relates to Forest Service obligations, and what the costs would be. There are many different kinds of stream gage flow monitoring that could be provided.		Specify what flow data will be collected at the gage, how Forest Service will use the data.	
130	Appendix B	Stormwater effectiveness monitoring (Appendix B)	Forest should assure construction of all stormwater facilities in the final MPO is done in a timely mannner	Monitoring of stormwater facilities; water quality effects	PAFEIS p. 147, Fonseca	Comment and objection are the same		forest has an obligation to protect Forest resources (see Forest Service manual)			If stormwater controls are not built timely, effects on surface water quality can result. Carlota is an example.	The FEIS does not explain why effectiveness monitoring is not warranted.		Add effectiveness monitoring	
131	Appendix B	Mitigation for visual resource impacts to the crest	Mitigation and monitoring for visual impacts to crest or west side of the Santa Ritas due to cuts, fills or collapses.	Mitigation	PAFEIS, p. 147 Fonseca; CHH letter dated Dec 20, 2012; see also letter from Jim Upchurch dated Jan. 2, 2012: " I share your concerns for possible impacts on the west side of the ridgeline."	PAFEIS comment and objection are the same; Our letter of Dec. 20, 2012 concerned mainly the pit, but said "in consideration of the likely construction footprint required to achieve the revised pit configuration, some impacts to the crest and west side seem likely." and encouraged careful consideration of constructability.	Induced seismicity is now expected	Forest service has an obligation to protect visual resources (see Forest Service manual)			FEIS does not explain why visual impacts will not be affected by cuts/fills/collapses.	FEIS does not explain why monitoring and mitigation for wests-side or crest impacts is not warranted. There are activities on west-side; there is induced seismicity and blasting; the pit is very near the crest. The Forest Supervisor has stated his intent to protect visual resources associated with the crest.		Analyze effects on crest and west side; add mitigation and monitoring	
132	Appendix B	Pit lake monitoring	Forest must require post-mining water quality monitoring	Mitigation and monitoring; Effects analysis	PAFEIS p. 146 Fonseca	Comment and objection are the same		Forest Service has an obligation to protect Forest resources and comply with Migratory Bird Treaty Act; FEIS predicts a pit lake with compromised water quality; FEIS notes that ADEQ does not have regulatory authority			FEIS discloses water quality impacts that are expected	FEIS does not explain why water quality of pit lake should not be monitored		Add post-closure pit lake water quality monitoring	
133	Appendix B	Groundwater quality protection via abandonment prior to operations	Require proper abandonment of unused drill holes, existing shafts and adits on Forest lands and on Rosemont's lands within the pollutant mgt area before operations bgin.	Mitigation	PAFEIS p. 143	Comment and objection are the same		Forest has an obligation to protect Forest resources (see Forest Service manual); Forest must identify actions to be bonded. Forest should have disclosed any previous abandonments.				FEIS does not explain why this prevention measure cannot be undertaken		Add this prevention measure	
134	Appendix B	Groundwater quality protection via mine closure	Require proper abandonment of unused drill holes, wells and piezometers as part of reclamation and closure plan	Mitigation	PAFEIS, p. 143	Comment and objection are the same		Forest has an obligation to protect groundwater quality through proper closure and through CFR 144.				FEIS does not explain why this prevention measure cannot be undertaken		Add this prevention measure	
135	Appendix B	Wellhead protection	Evaluate all existing wells for proper wellhead protection; rectify deficies	Mitigation	PAFEIS p. 143	Comment and objection are the same		Forest has obligation to protect existing and future uses of wells				FEIS does not explain why this prevention measure cannot be undertaken	National Groundwater Policy, which we cited at Scoping Attachment 1-8, says that Froest is to comply with wellhead protection, sole-source aquifer, and UIC requirements of CFR 144.	Add this prevention measure	
136	**DRAFT Rosemont EIS-County Pre-Decisional Objection Issues (Biological Opinion)**														
137	**Topic/Chapter**	**Issue Name**	**Summary**	**Description of those aspects of the proposed project addressed by the objection**	**Previously Cited Comment**	**Relevance of Comments to Objection**	**New Information?**	**Contrary to law?**	**Arbitrary and Capricious?**	**Inadequate Alternatives Analysis?**	**Inadequate Disclosure of Direct, Indirect or Cumulative Effects? (Specify)**	**Inadequate Mitigation (Specify)?**	**Other**	**Remedy**	
138	**Additional Comments: 404 b1 analysis**														
139	Section 404 (b)(1) Alternatives Analysis dated Sept 10, 2013	Figure 7 Downstream dewatering effects	Does not address dewatering of other streams by dredge and fill activities, direct and indirect	Effects analysis	Impacts to Waters of the US in 2012 DEIS and 2012 Section 404 application (copied to Forest); Also see JF PAFEIS on springs dated August 14, 2012	The comments describes impacts to streams that are not addressed in the effects analysis	This figure is new in that it was not included in the PAFEIS or DEIS. There is also a new compliance dam on Trail Canyon, see comment below. There are new effects if there are new dams, and the location of the effects appears to have changed.				Barrel and Davidson are not the only streams with indirect effects.			Identify other dewatered streams.	
140	Section 404 (b)(1) Alternatives Analysis dated Sept 10, 2013	Potential waters of the US/ WUS delineation	Many other potential waters are not identified on this map; Effects analysis does not include some streams upstream and downstream and within the footprint of the projects.	Effects analysis for WUS	Comments to the Corps and Forest Service in relation to impacts to Waters of the US in 2012 DEIS and 2012 Section 404 application comments about other streams that would be affected. See for instance comments 1-3, and Appendix B and C in Jan 2012 letter to Corps, copied to Forest.	We provide in these comments evidence that there are effects which have not be considered	Reference Figure 2 . The potential WUS is revised from the DEIS to include a few more watercourses, but these were streams that were already identified by Westland in the DEIS, so the changes did not address our comments.				Undercharacterization of the headwaters streams means that direct impacts are underestimated.The modeled 10-year floodplain area was over 100 acres, so we also think that the area of effect (around 40 acres) is greatly underestimated.			Identify the headwaters streams and don't undercharacterize the widths of the jurisdictional waters. Require more mitigation.	
141	Section 404 (b)(1) Alternatives Analysis dated Sept 10, 2013	Pit dewatering	The alternatives analysis evaluated a modified pit, but rejected it because of pit diversion and dewatering requirements.	404b1 analysis for WUS	This Wasp Canyon modified pit analysis was in the 2011 DEIS.	The potential for a modified (smaller pit) to avoid impacts was originally requested, and resulted in new material being provided in the EIS, which then prompts this objection.			effects of pit dewatering is taken into account here, but not in other alternatives.		Pit dewatering is needed for all alternatives due to the shallow water table. The dewatering has indirect effects would should be acknowledged for alternatives other than those rejected by the applicant's consultant.			Identify the reductions of the shallow water table as it underlies streams as delineated by Montgomery and Associates cited in our DEIS and 404 comments.	
142	Section 404 (b)(1) Alternatives Analysis dated Sept 10, 2013	Cultural Resources	Corps analysis does not address concerns of the affected tribes.	404b1 analysis for WUS	DEIS Comment 629 or 630; 627 or 628, 586; also 404 comment 5 dated january 2012 and copied to Forest	Comments provide details on the concerns and the failure to analyze	corps' duty from FS under Section 106 of NHPA which is not adequate addressed by DEIS.				Areas of Potential Effect for 404 cultural reosurces is not identified.			Disclose the total area of indirect and cumulative impacts; postpone permit until adequate cultural assessment is made; provide TON ability to conduct their own studies.	

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
143	Section 404 (b)(1) Alternatives Analysis dated Sept 10, 2013	Project description	Project description is inaccurate	Project description	DEIS 589/590	Comment and objection are the same					Entire area of direct, indirect and cumulative effects including all future effects that would not occur but for the mine should be in the project description.			Include all direct and indirect effects of the project and mitigate.	
144	Section 404 (b)(1) Alternatives Analysis dated Sept 10, 2013	Modification of Barrel compliance point dam	Barrel Canyon compliance dam is no longer identified on figure 9--what happened? It was part of the 404 application that we commented on. Also there is a new sediment control structure on figure 9.	Compliance dams and sediment control structures; effects analysis	DEIS 396/397	Comment connects structures to effects analysis	These features have changed since the DEIS. The compliance point dam referenced on p. 46 of the FEIS is not described in figure 9, but the sediment control dam on Trail Canyon shown in figure 9 of the Corps alternative analyiss is new.	There are inconsistencies between the 404b1 project description for Barrel and the FEIS project description for Barrel that must be resolved. Furthermore, the 404 application never requested the Corps to evaluate the Trail Canyon dam that is in figure 9.			Effects of all compliance dams should be identified; it is unclear whether the calculations include the direct and indirect effects of both the Barrel and Trail dams in combination. Perhaps alternatives are needed. Our concerns at DEIS comment 396/397 have not been addressed.			Include all direct and indirect effects of the compliance point dams in the effects analysis and mitigate. Consider whether the proposed design for Barrel is even feasible.	
145	Section 404 Habitat Mitigation and Monitoring Plan	Inadequacies of mitigation at Pantano	Amounts available were far lower than 1100 acre-feet. See Powell 2013 report cited in PAFEIS; sever and transfer could cause years of delay in implementation. And County is unwilling to take on liabiity as desscribed in Mr. Huckelberry's letter to Colonel Kim Colloton.	Mitigation of impacts to WUS	PAFEIS Appendix B and seeps and springs comments on mitigation effectiveness by JF Dated August 14, 2013; "Water Resource Trends" document included in PAFEIS comments; Colloton letter dated December 30, 2013.	We provide in these comments evidence that mitigation may not be as effective or as feasible as was previously thought by Corps and others	FEIS notes that mitigation would not be effective if sever and transfer were blocked, but does not acknowledge potential for temporal loss, or actual availability of wet water, or trends in water availability at the site.							Revise mitigaiton and mitigation effectiveness statements	
146 147	**Aquifer Protection Permit Monitoring**														
148	APP / groundwater monitoring	APP settlement	Add the terms of the settlement of Pima County's aquifer protection permit appeal to the EIS	Monitoring plan	No previous comment to this effect, but it is a condition of the APP permit	Not applicable						This is agreed upon monitoring and mitigation by Rosemont per settlement approved by Water Quality Appeals Board	The settlement terms are a condition of the APP and should be recognized	Refer to the particulars in the GW monitoring discussion; Add explanation to APP permit discussion	

Cumulative Impacts Objection Exhibits A and B

EXHIBIT A

PIMA COUNTY
OFFICE OF CONSERVATION SCIENCE AND ENVIRONMENTAL POLICY
201 N. STONE AVENUE, 6TH FLOOR
TUCSON, ARIZONA 85701

MAEVEEN BEHAN, JD, PhD
DIRECTOR

(520) 740-6464

October 9, 2009

Teresa Ann Ciapusci, Cooperating Agency Liaison
Coronado National Forest Service
300 W. Congress St.
Tucson, AZ 85701

Re: **Forest Service Catalog of Events**

Dear Ms. Ciapusci:

This letter responds to your request for Rosemont cooperators to complete the Catalog of Events table for information that will support the analysis of potential direct, indirect, and cumulative effects stemming from the proposed action and alternatives. As you are aware, Pima County continues to disagree on the narrow range of alternatives presented (see attached August 28 and September 30, 2009 letters). We look forward to the opportunity to build on this initial event catalog in the event that the project alternatives are more fully developed.

Sincerely,

Neva Connolly

Neva Connolly
Senior Planner

Attachments

C: Julia Fonseca, Environmental Program Manager

	A	B	C	D	E	F	G	H	I	J	K
1	**ROSEMONT COPPER PROJECT EIS CATALOG OF ACTIVITITES**										
2											
3	**Name of Cooperating Agency: Pima County**										
4	**Year Start**	**Actual / Estimate**	**Year End**	**Actual / Estimate**	**Activity Type**	**Quantity**	**Location / Description**				
5	Ongoing	Actual	Unknown	Actual	Other	Pm10	ASARCO Inc. currently operates an open pit copper mine regualted by both Pima County DEQ and EPA Region 9. Major source of PM10. ASARCO Incorporated owns and operates the Mission Complex in Pima County near				
6	Ongoing	Actual	Unknown	Actual	Other	Pm10	Freeport-McMoRan Sierrita, Incorporated (FMSI) operate a copper and molybdenum mining and processing facility regulated by PDEQ. The facility is located at 6200 West Duval Mine Road, Green Valley, Pima County, AZ. Operations				
7	Ongoing	Actual	Unknown	Actual	Other	Pm10	Stakaer Parsons operates a concrete batch plant and crushed aggregate plant regulated by PDEQ at 18701 South old Nogales Highway, Sahuarita. Aggregate supplies for the facility will be provided from the on-site sand and gravel				
8	2010	Estimate	2040	Estimate	Other	Estimated permit area of about ~ 600,000 acres	Pima County is seeking a Section 10(a) Multi-Species Conservation Plan. http://www.pima.gov/cmo/sdcp/MSCP/MSCP.html Activites associated with this plan may include land acquisition, natural and cultural resource monitoring, land management activities, invasive species maintenance, endangered species management, habitat restoration and enhancement activities, etc.				
9	2010	Estimate	Ongoing	Estimate	Other		Conservation Plan: Activities may include acquisition of archaeological and historical sites and traditional use sites fo				
10											
11											
12											
13											
14											
15											

EXHIBIT B

COUNTY ADMINISTRATOR'S OFFICE

PIMA COUNTY GOVERNMENTAL CENTER
130 W. CONGRESS, TUCSON, AZ 85701-1317
(520) 740-8661 FAX (520) 740-8171

C.H. HUCKELBERRY
County Administrator

August 28, 2009

Teresa Ann Ciapusci
Forest Service Project Manager
Ecosystem Management & Planning
U.S. Forest Service
300 West Congress Street
Tucson, Arizona 85701

Re: **Alternative Analysis for Proposed Rosemont Mine**

Dear Ms. Ciapusci:

This letter responds to your request dated August 14, 2009 for comments about four alternatives to the proposed action as developed by the U.S. Forest Service Interdisciplinary Team (IDT). Our earlier letter dated July 28, 2009 responded to the inadequacies of these alternatives, and suggested means by which the Forest Service might develop a reasonable range of alternatives that better meets the spirit of NEPA.

Alternatives analysis is intended to examine unresolved conflicts over uses of available resources (National Environmental Policy Act, Section 102(2)(e). Few dispute the mine's access to their own lands, or the ability to actually extract ore from mining claims. At the heart of the public controversy over the Rosemont Mine is the conflict over using Forest land as the dumping grounds. Pima County and others have raised questions regarding the validity of claims to the Forest land, the right to use those claims for waste disposal, and the breadth of the Forest Service's administrative discretion to protect public resources. It is premature to analyze alternatives when there are unanswered questions regarding these fundamental issues.

The Rosemont Mine would alter Pima County's landscape irrevocably in return for 20-years (or more) of copper. Yet it becomes increasingly apparent that the necessary studies are not being conducted in time to allow for the results to inform alternatives analysis. If the issues were treated with the respect they deserve, then individual "white papers" would be written around alternatives that have the potential to dramatically reduce impacts before any would be cast aside. Discussions would be held by the Forest Service with other outside parties to develop the alternatives more fully before alternatives are weighed.

Instead, at the August 20 Cooperator's meeting, we heard again about the same four alternative disposal sites brought forth at the July meeting. These alternatives will not suffice to represent a reasonable range of alternatives to deal with the conflicts over uses and impacts.

Your agency requests that input confined to these draft alternatives and potential mitigation measures. In light of the information from the Cooperator's meeting, we re-affirm our concerns expressed in our July 28 letter and offer the following specific comments:

Regarding the Rosemont Mine Alternatives

1. Take the time to develop alternatives proposed by Forest staff and the public further before deciding on the range of alternatives for further analysis. It may be that combinations of alternatives which seem individually impossible have sufficient advantages when combined to be practicable. This will require more time. If this requires re-negotiating the Memorandum of Understanding between the Forest and Rosemont, do it.

2. One way to minimize the footprint of the mine itself would be to tunnel through the Santa Rita ridge to ship ore and waste rock along public rights-of-way to the mines in the Green Valley area to reclaim existing mining sites. Forest staff appears to dismiss alternative conveyance as infeasible because of lack of rights-of-way, however transport by rail to the Green Valley mines using public rights-of-way appears not to have been evaluated. Rail is a more efficient means of moving materials than trucks. Pima County would favorably consider granting the right-of-way needed for a rail line under these circumstances, because it could dramatically reduce roadway impacts, use of Forest lands for waste, aquifer impacts to the Cienega Basin, and it would better utilize existing infrastructure in the Green Valley area. Rail could also be used to move mining equipment and other materials into the site. Tunneling under the mountain might also provide an opportunity for underground ore extraction.

3. We are being told that a number of other alternatives are infeasible due to economic considerations, but there appears to be no way to independently examine the foundations for these beliefs. Please disclose economic assumptions used to reject alternatives or mitigation measures so that the Cooperator's and ultimately the public can understand the basis for the record of decision.

4. At the last Cooperator's meeting, we requested posting of the written communications from Rosemont to the IDT that provide the basis for the Forest Service Interdisciplinary Team's recommendations regarding alternatives to receive further study. These are dated April 22, 2009 and May 29, 2009. We have not yet received them.

5. Thus far, the proposal is simply to mine only the Rosemont prospect, and not the other ore bodies said to exist in the mining claim area. It would be feasible for the company to develop them since they control them, and they may well come back to request to do so. Please consider alternatives which initiate development of the other prospects instead of the Rosemont pit, and in addition to the pit. For instance, could the area of impact on Forest land be reduced by the company mining and completely backfilling prospects on their land first, and then obliterating their land with waste from a smaller Rosemont pit?

6. Pit configuration has been altered by the proponent over time to exploit more resources, but no alternative pit configurations have been examined to minimize impacts to Forest resources. In scoping we expressed our concern about long-term pit stability. The 2008 pit shape would also affect viewsheds. Please consider alternative pit designs. Pit design is a crucial step which has been omitted, because stability could affect the ridge outside the pit. Pit design configuration also affects the location of other mine features. A smaller pit configuration, shifted eastward, might be one option. A smaller pit would produce less waste and therefore reduce impacts to the Forest.

7. The attached map labeled Proposed Rosemont Mine shows the distribution of hydrologic soils groups as mapped by the Natural Resource Conservation Service (NRCS). Hydrologic soils groups tell us about the relative amounts of runoff that would be generated from a given storm, all other things being equal. Soils in Group D shed the most runoff per unit precipitation. Soils in Group A shed the least runoff. As you can see, Barrel Canyon is the only watershed that is not mostly Class D soils.

   As expressed in our previous letters of comment, Pima County is concerned that the mine will diminish runoff to Davidson Canyon. In general, Class D areas produce more runoff per unit area. In addition, the uppermost part of Barrel Canyon is not directly connected to the higher elevations of the Santa Ritas Mountains, which intercept more rainfall due to orographic effects. McCleary and Wasp Canyons are the drainages that convey high quality runoff and snowmelt from upper elevations of the Santa Ritas to Davidson Canyon via lower Barrel Canyon. None of the proposed alternatives seem to try to preserve watershed functions.

8. The above-mentioned figure also shows the general distribution of limestone outcrops with a stippled pattern. Limestone units can possess unique hydrologic characteristics that promote rapid infiltration of runoff to the aquifer within minimal pollutant attenuation. The alternative which utilizes Sycamore Canyon would appear to place a great deal of material over a potential recharge area to the Tucson Active Management Area (TAMA).

9. Concerning the alternatives for the waste rock and tailings, we offer several additional alternatives for consideration (see attached figures):

   a. Upper Barrel-Scholefield Obliteration with Wasp Canyon Diversion: This alternative involves placing waste rock in upper Barrel only, with a diversion channel to capture runoff that would otherwise go into the pit, and convey it to Wasp Canyon and points downstream. The tailings would go to Scholefield as you have previously considered. This alternative avoids some major cultural and riparian resource impacts (at the expense of others we probably know less about), and minimizes watershed impacts to the Barrel/Davidson Canyon by conveying runoff from the highest portions of the watershed downstream. By not obliterating McCleary for waste rock, this alternative also obviates some of the difficulty of stacking tailings next to waste rock in the adjacent Scholefield watershed. The diversion would also reduce the potential for pit lake formation.
   b. Upper Barrel Obliteration with Wasp Canyon Diversion: This alternative is the same as the preceding, except that no impacts would be allowed in Scholefield Canyon. Both tailings and waste rock would have to be limited in volume and elevation, and would be restricted to placement in upper Barrel. This alternative, or some permutation therefore, would truly minimize impacts to Forest resources by restricting the footprint and height of the use areas on National Forest lands. The company would forgo full exploitation of the ore body until and unless they devise the means to minimize impacts from the waste rock and tailings, such as partially backfilling the pit.
   c. Southeast Claim Obliteration with Wasp Canyon Diversion: This alternative is similar to "b" except that the company would be given the ability to obliterate upper Oak Tree Canyon and the unnamed tributary to Barrel Canyon with waste rock and tailings as shown in the attached figure. This alternative places waste rock and tailings on hydrologic soil groups that provide the least amount of runoff to adjacent watersheds, and avoids certain cultural resources at the expense of others.

10. The "horseshoe" alternative around Barrel Canyon was rejected because the high ground would be eliminated as a water source. This effect could be mitigated with a bypass of runoff from the Santa Rita Mountains, augmented with a groundwater drain from the mine dewatering.

11. Consider alternative locations for the heap leach operations, including material stockpiles that do not place the facility over sensitive cultural features.

12. Consider alternative places for the truck stops, blasting powder stockpile, tailings filter plant and tailings on the private land to minimize direct impact to Forest land.

13. We request the GIS shape files for the current mining plan of operation and the alternatives that will be studied further in the EIS. Rosemont Copper should be willing to release these to the Forest Service so that the Forest Service and its Cooperators can analyze them. We have previously discussed with your staff some GIS analyses that we might conduct to examine potential impacts as part of our contribution as a Cooperator.

14. Consider alternative wellfield locations. We know of two sites that Rosemont is considering. It would be feasible for them to acquire or lease additional lands for the wellfield.

Regarding Cultural Resources Preservation

15. An issue that has not been adequately considered in the formation of alternatives is whether the cultural landscape of the Santa Rita Mountains may be considered a Traditional Cultural Place (TCP) by the Tohono O'odham and other tribal groups. Traditional cultural places are important for the essential roles they play in maintaining community cultural traditions, beliefs, and activities. At what stage is consultation with Tribes?

16. The scope of all the alternatives is too large to realistically consider avoidance of sensitive cultural resources as a viable preservation option. This leaves mitigation by documentation and/or data recovery as the only option. All Alternatives have huge environmental impacts with long-term, irreversible consequences and high potential to destroy significant Heritage Resources, including prehistoric and historic sites with known human burials or high potential for human burials. If avoidance is not a viable option, then mitigation, recovery, and repatriation will be required. Alternatives with the smallest impact footprint may be preferable.

17. We strongly recommend full compliance mitigation of all impacts on National Register-eligible archaeological, historic, and multi-component sites, per Section 106 of the NHPA.

18. Barrel Canyon Alternative falsely suggests reduced cultural resources impacts. Actual impacts will be greater than suggested by SWCA representative (confirmed by NFS archaeologist).

19. One large site with a ball court (site AZ EE:2:105[ASM]) lies just outside the currently defined Area of Potential Effects (APE). We strongly recommend avoidance of this site.

Regarding other Rosemont Mitigation Measures

20. Some mitigation measures that have been previously proposed by Pima County or the public have been omitted from the draft list you prepared. Ensure a complete list is prepared.

21. Consider pit diversion options to maintain downstream flow as a mitigation measure common to all alternatives. The pit diversion features should have a design life which is intended to extend thousands of years beyond the closure, because the impacts are enduring.

22. We favor a mitigation measure which would condition issuance of the Rosemont permit on the confinement of any ancillary mining operations to the preferred alternative. It is typical for mining operations to seek expansion of operations onto adjacent lands, beyond what was originally anticipated.

23. Change the design of stormwater capture facilities in upper McCleary to minimize impacts to downstream flow during operation.

24. Reconstruct the McCleary drainage features as part of closure to assure that maximum flow-through function will endure thousands of years afterward, with little or no human intervention, to mitigate for downstream watershed impacts.

25. Designate storage credits derived from ongoing CAP recharge at locations other than Green Valley as a non-recoverable per state statutes. This would be a mitigation measure for direct and indirect impacts. Otherwise the credits can be sold on the open market to foster future municipal growth.

26. Consider backfilling as a mitigation measure common to all alternatives to reduce aquifer evaporation and water quality impacts and possibly other concerns.

27. Consider a different pit configuration as a mitigation measure to reduce slope stability concerns.

28. Consider discharge of groundwater derived from pit dewatering during and after closure as a mitigation measure for destruction of springs and riparian areas.

29. We reiterate our desire, expressed during the scoping, for off-site compensatory mitigation for unavoidable impacts to the Conservation Lands System at the same ratios that Pima County uses under the Sonoran Desert Conservation Plan.

Regarding Transmission Line Alternatives

30. We believe it is important to analyze at least one alternative, other than the no-action alternative, that does not utilize the Forest Service lands for a temporary power use.

31. The area of analysis should be expanded to include the Forest Service lands involved in constructing temporary power, as well as whatever plans the company has for its use of the Greaterville-area properties.

32. Santa Rita Road has been proposed as an alignment for the transmission line. Any construction within the right-of-way for pipeline or transmission lines would require permission from the Pima County Board of Supervisors.

33. Cultural Resources and TEP Alternatives show the Preferred alternative to be Santa Rita Road corridor. Discussion at the workshop with a representative of the consultant involved with this action (EPG), indicated a misunderstanding about the Santa Rita Road right-of-way -- it is County right of way, so any proposed utilities within the right-of-way will be subject to County permitting requirements, including cultural resources requirements. If a new easement is acquired from ASLD paralleling Santa Rita Road, state cultural resources requirements must be met as a condition of the acquisition. Santa Rita Road has not been surveyed for cultural resources; however, NFS and ASM representatives do know about potentially significant archaeological resources near and/or intersecting the road corridor, so cultural resources survey and most likely, development and implementation of a treatment plan, will be required before any ground disturbance occurs whether for the TEP line or waterline.

Regarding Future Growth Outside the Area of Direct Impact

34. At the last Cooperator's meeting, we heard various statements expressed about the potential for growth around the periphery of Coronado National Forest and the Santa Rita Experimental Range. While there are no major new planned communities immediately adjacent to these reserves in unincorporated Pima County, we do anticipate continue lot splitting and build out of existing subdivisions. The rate and extent of development could be altered by the development of the mine, increasing the amount of unmitigated habitat impacts within the Conservation Lands System.

35. City of Tucson and Pima County have collaborated with Stantec to portray various scenarios of potential future growth in our region. A scenario for cumulative growth at 2040 based on "status quo" trends is attached. This scenario does not consider future urban, suburban, or exurban growth that might be triggered through indirect or cumulative effects of the Rosemont Mine. Other future growth scenarios resulted in less growth near existing reserves than the "status quo".

Summary

In summary, we continue to disagree with the narrow range of alternatives, which are being unduly constrained by an inadequate project purpose and need statement. It is premature to analyze such alternatives when many have questioned the Forest Service administration's interpretation of its discretion in permitting mines. In addition, it appears this alternatives analysis process is being rushed to meet dates contained in the memorandum of understanding between the Forest Service and Rosemont. For a project like this that will alter the landscape irrevocably, more time and attention needs to be given to the issues raised.

Sincerely,

C.H. Huckelberry
County Administrator

CHH/dr

Attachments

c: The Honorable Chairman and Members, Pima County Board of Supervisors
Jeanine Derby, Forest Supervisor, Coronado National Forest
Melinda Roth, Forest Service Coordinator
John Bernal, Deputy County Administrator - Public Works
Suzanne Shields, Director, Regional Flood Control District
Ursula Kramer, Director, Environmental Quality
Carmine DeBonis, Director, Development Services
Rafael Payan, Director, Natural Resources, Parks and Recreation
Priscilla Cornelio, Director, Transportation Department
Maeveen Behan, Director, Office of Conservation Science and Environmental Policy
Linda Mayro, Manager, Cultural Resources
Christina Biggs, Manager, Real Property Services
Harlan Agnew, Deputy County Attorney, Civil Division
Julia Fonseca, Program Manager, Office of Conservation Science and Environmental Policy
Nicole Fyffe, Executive Assistant to the County Administrator

Southeast Claims Alternative

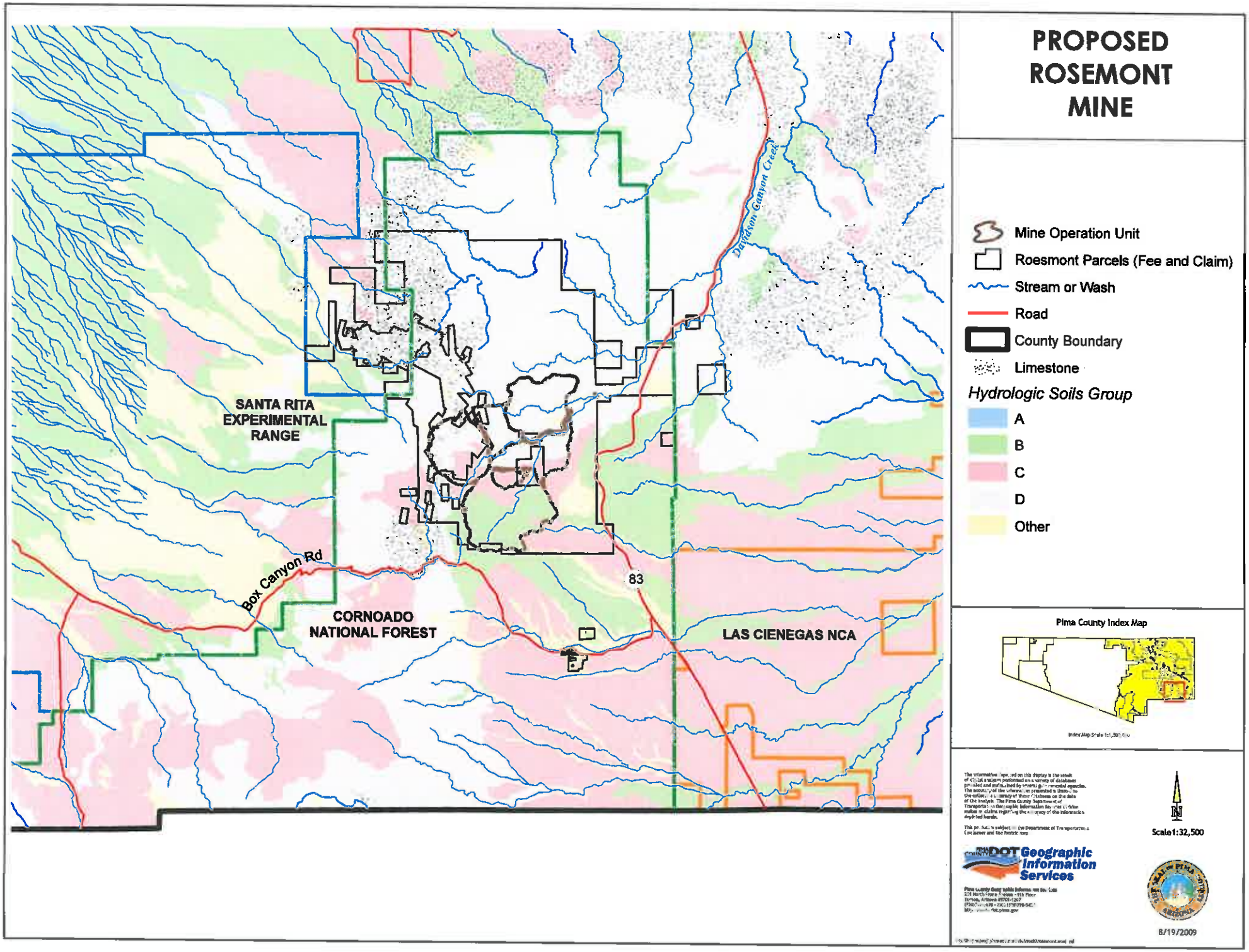
Proposed Action Waste Rock and Tailings Placement

Upper Barrel Only

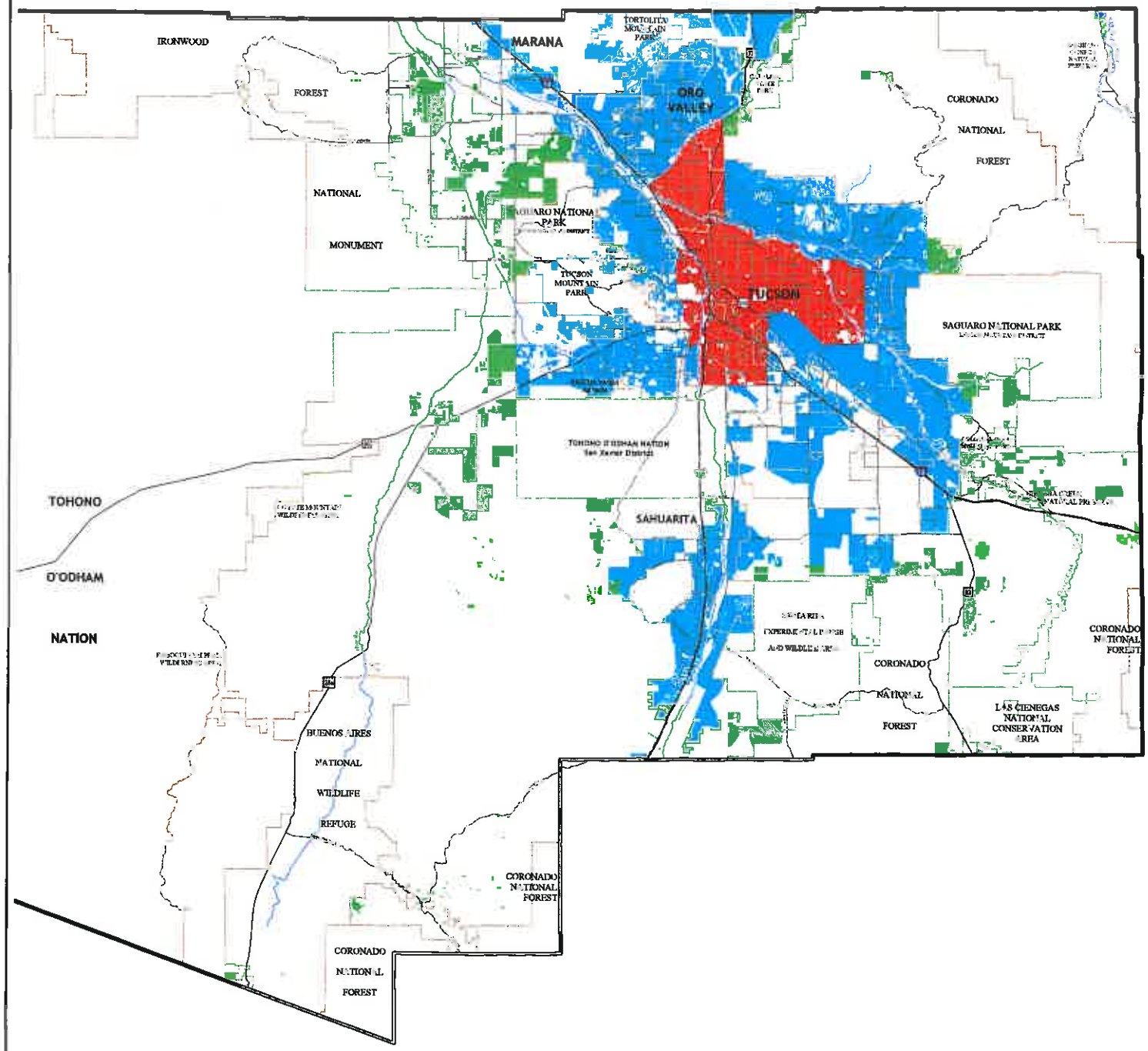
Proposed Action Waste Rock and Tailings Placement

Upper Barrel- Scholefield with diversion channel to Wasp Canyon

Proposed Action Waste Rock and Tailings Placement


PROPOSED ROSEMONT MINE
Mine Operation Unit
Roesmont Parcels (Fee and Claim)
Stream or Wash
Road
County Boundary
Limestone
Hydrologic Soils Group
A
B
C
D
Other
SANTA RITA EXPERIMENTAL RANGE
CORNOADO NATIONAL FOREST
LAS CIENEGAS NCA
Box Canyon Rd
83
Davidson Canyon Creek
Pima County Index Map
Scale 1:32,500
8/19/2009
Geographic Information Services

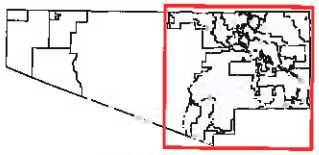
CUMULATIVE 2040 BUILT ENVRIONMENT BY URBAN FORM CLASS



Urban Form

- Urban
- Suburban
- Exurban

Pima County Index Map



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7/1/2009

City/County
Water and Wastewater Study

June 15, 2009

To: City/County Water and Wastewater Study Oversight Committee

From: C H. Huckelberry
County Administrator

Mike Letcher
City Manager

Re: **Growth Technical Paper**

Introduction

One of the goals included in the Scope of Work for Phase II of the City/County Water and Wastewater Study was for the City and County to come to agreement on population growth, water, urban form, infrastructure and land use planning. The scope states:

> *The City and County need to come to common agreement on the location of our future population growth increment to 2050. Urban form, water and infrastructure planning will directly influence where this future population growth increment will occur. Locating this future population should be done in a manner so as not to disadvantage or adversely impact existing residents. New growth must be located where it is beneficial to the environment, economy, and conservation of our resources. Large-scale infrastructure systems will be necessary to support the growth centers and integrate with the existing urban infrastructure systems that are in place. Most importantly, long-term future water supply cannot occur at the expense of our existing residents or the environment.*

Stantec Consulting Inc. and Curtis Lueck & Associates, who recently have conducted work for Pima County in the areas of infrastructure and land use planning, were hired to work with a team of City and County staff to develop the attached technical paper.

The paper does not attempt to predict if, how much, or when growth will occur, but rather attempts to answer the question: *If growth does occur, how can we accommodate it in the most sustainable manner possible?* The paper looks at both the location of growth and the form of growth, and discusses criteria that can be used to evaluate areas most suitable for future development and the positive and negative aspects of various forms of development. The next paper that the Committee receives will build off of this paper, and will deal with specific issues of integrating land use and water resources planning.

The key finding of this paper is that the City and County can plan for future development in a way that increases choice in housing types and transportation modes for both existing and future residents, increases access to jobs and services, decreases costs to tax payers, and decreases water use, energy use, and land consumption.

Technical Paper Highlights

Form of Growth

One aspect of the scope question focuses on ensuring that growth does not adversely impact existing residents, and is sited in a manner that is most beneficial to the environment, economy and conservation of resources. These issues are affected by the form that development takes. The technical paper uses the term "urban form" to describe the arrangement, appearance and functionality of a community, which relates to the pattern of the built environment. Urban form includes such things as how compact or spread out development is, the amount and types of land uses whether separated or co-located together, the amount of public open space, the size of lots, the amount and location of roads, parks, and other infrastructure, how far people have to drive, the availability of transit, the walkability of the area, etc.

The paper uses benchmark data from other regions to analyze the pros and cons of various urban form patterns from a sustainability perspective. An important aspect of urban form is density, but it is only one consideration. Density in metropolitan Tucson presently averages about 4 people per acre or 2,560 people per square mile. The paper points out that as we grow, we have the opportunity to implement sustainable development approaches including good urban design, increasing density, and integrating a mix of land uses in selected locations as many other regions have done, which can have a variety of benefits such as:

- Reduced car passenger miles
- Fewer miles of road per capita
- Lower water consumption
- Lower energy consumption and greenhouse gas emissions
- Improved public health
- More walkable neighborhoods and urban spaces
- Public services at lower cost to taxpayers
- More transit opportunities
- More types of housing choices

Future Growth Locations & Scenarios

Another aspect of the scope question refers to location of future population growth. The paper models several growth scenarios for a hypothetical doubling of our population to two million people. This represents 973,000 more people than the current metropolitan area population of 1,027,000 (2008). This population threshold was chosen primarily for discussion purposes, but is consistent with (1) the water resource availability analysis done by Sharon Megdal showing current water resources to support 1.8 to 2.3 million people and (2) a buildable land analysis done by PAG showing land available to support 2.2 million people. Although the Scope of Work for the City/County study citied a date of 2050, this paper does not try to anticipate a date for when such a population increase may occur.

This paper focuses on the Water/Wastewater Study Area defined as the Tucson city limits plus the Tucson Water Obligated Service Area, plus unincorporated Eastern Pima County, excluding other cities and towns and tribal lands. Of the 973,000 new people modeled in the growth scenarios, 238,000 (based on Arizona Department of Economic Security (DES) projections) were subtracted and allocated in lump sum fashion to the towns of Marana, Oro Valley, and Sahuarita, with the remaining 735,000 allocated to the Study Area.

Factors and constraints were identified and GIS modeling was applied to vacant and underdeveloped land in order to determine the areas most suitable for future development. Factors are defined as preferentially weighted variables such as proximity to infrastructure and employment centers, while constraints eliminate certain lands from consideration such as parks, federal lands, protected open spaces, airports, hillsides, and floodways.

Various factors were combined into four different urban form scenarios that were used to place population within the suitable areas. The four scenarios include:

1) Status quo scenario (growth continuing as is)
2) Enhanced habitat protection scenario
3) Infrastructure efficient/taxpayer savings scenario
4) Transit oriented development scenario

These scenarios are hypothetical and meant to illustrate different ways the community could grow and different results that would be achieved. The scenarios are not meant to be mutually exclusive and elements of each could be used in conjunction with each other. Note that the amount of future growth allocated to the towns of Marana, Oro Valley, and Sahuarita was held constant for all four scenarios.

The major difference in inputs to the four scenarios is the density of future growth allocated to the suburbs, outside of already planned but unbuilt or partially built communities. The exception to this is the Transit Orientated Development Scenario, which also increased densities within the urban area along rapid bus transit lines, the street car alignment, and alignments for light rail and commuter rail.

The table below describes the relative benefits of the four scenarios across various indicators, and also includes the density averages used to place development in new growth areas. The indicators show that siting future development in a way that is different from the status quo could increase choice in housing types and transportation modes for both existing and future residents, increase access to jobs and services, decrease costs to tax payers for public infrastructure, and decrease water use, energy use, and land consumption.

	Status Quo	Enhanced Habitat Protection	Infrastructure Efficient/Tax Payers Savings	Transit Orientated Development
Density within new growth areas*	2,500 pers/sq mile or 1.56 residences per acre (RAC)	3,600 pers/sq mile or 2.25 RAC	8,000 pers/sq mile or 5.0 RAC	8,000 pers/sq mile (11,000 – 23,000 pers/sq mile along urban transit lines and nodes) or 5.0 RAC (6.9-14.4 RAC)
Housing type choice	–	√	√√	√√√
Transportation mode choice	√	√	√√	√√√
Access to jobs & services	√	√	√√	√√√
Cost of services/tax levels	–	√	√√	√√
Water, resource, energy and land consumption	–	√	√√	√√√
Walkable communities	–	√	√	√√

*Outside of already planned but un-built or partially-built communities

Looking across all four scenarios, and in particular the areas that are either within the City of Tucson, or within the City of Tucson's metropolitan planning area, four possible focused growth areas emerge:

- Infill within the Existing Built Environment
- Houghton Corridor
- Southlands
- Southwest Area

These are consistent with growth areas identified in the City General Plan and identified in regional growth modeling done by Pima Association of Governments (PAG). In addition, these areas are consistent with the County's efforts to support new development in areas outside of the Conservation Lands System. What is different from one scenario to another is the amount and intensity of growth in each of these four areas.

<u>City of Tucson Considerations</u>

- In the four scenarios modeled, the population build-out for the Tucson Water Obligated Service Area ranges from approximately 330,000 in the status quo scenario to just over 500,000 in the transit-oriented development model. The Phase 1 report indicated that based on conservative (high) gallons per capita per day numbers, Tucson Water can serve 366,000 more people with currently available renewable water resources. Population build-out is a factor the City of Tucson must consider in deciding if Tucson

Water should extend service beyond its obligated area and whether additional water resources need to be acquired. It is important to also consider that more compact development forms and higher density development uses less water per capita and are less expensive in terms of water infrastructure. The issue of providing water service to future growth areas will be explored further in the July technical paper on *Integrating Land Use Planning with Water Resources and Infrastructure*.

- The City of Tucson would prefer that future growth and development take place within incorporated areas to ensure fiscal sustainability. When development occurs adjacent to but outside City limits, residents drive into the City and use City infrastructure and services but the City doesn't receive the revenues needed to pay for this. For example, non-city residents may come into the City to shop and the City does receive sales tax, however the City misses out on property tax, state shared revenue, impact fees, and sales tax from unincorporated areas. We need to look at future growth from a fiscal sustainability perspective. In recent years we've implemented impact fees which fund the initial construction of infrastructure needed to serve growth, however we must also consider how the ongoing provision of public services and maintenance of facilities are funded. We must ensure that future growth areas are self-sustaining and are not subsidized by current residents.

- An economically vibrant downtown is an important priority to the City of Tucson in any future growth scenario. The need for an urban walkable place with housing, employment and entertainment opportunities that are accessible to transit is critical to the future viability and sustainability of a community our size. As the paper points out, creating an urban walkable place is achievable given the amount of available developable land in the downtown area and the proximity of the University which is a connection that can be strengthened.

- Re-investment and revitalization of Tucson's existing built environment is a high priority for the City in any future growth scenario. Vacant and underdeveloped land exists throughout the built environment. Infill can bring investment, resources, jobs, services and transit to older and stressed areas of the City that most need it. Infill in the existing built environment is key to a sustainable future for Tucson. However infill must be well-designed and considered in context. It should help strengthen existing neighborhoods and contribute to maintaining and improving our sense of place. Future growth should benefit existing residents and improve the quality of life in the built environment.

<u>Pima County Considerations</u>

- The Conservation Lands System (CLS) implements the Sonoran Desert Conservation Plan and in doing so provides a regional framework for identifying lands suitable for development versus lands suitable for conservation. Lands most suitable for development are located outside of the CLS. Agreement between the City and County on target growth areas outside of the CLS prior to the upcoming City and County General/Comprehensive Land Use Plan updates will provide an important starting point for these planning efforts.

- During 2007, the County undertook land use, infrastructure, and employment center studies for the Southwest planning area. These studies assumed higher concentrations of housing and employment densities than the average for the County, and estimated 120,000 more people would reside in this area over the next 45 years. The studies also included cost estimates for the necessary infrastructure and services to support such an increased population. The County is currently developing financing strategies, such as increased roadway development impact fees for this area, to ensure that the infrastructure is primarily developer-funded. Assuming the City and County can reach agreement on target growth areas, similar land use, infrastructure, and financial planning efforts could occur and be reflected as part of the Cost of Development Elements of the City General and County Comprehensive Plans.

- A significant portion of the County's funding sources for providing services are property taxes, State shared revenues, and costs for services. As the State continues to decrease funding to local governments, the County must ensure that future development occurs in the most fiscally responsible manner. This includes adding value to the tax base and ensuring that affordable transportation and housing choices exist for residents such that residents can afford to continue paying for other goods and services.

- A significant amount of industrial land is located near the airport, Davis Monthan Air Force Base, and along I-10. To make these parcels "shovel-ready" as part of our regional economic development strategies, the City and County need to make sure utilities (including water, wastewater, and electricity) are planned and available for these properties.

- The County faces similar challenges to the City in ensuring that new development projects are compatible with surrounding neighborhoods and offer existing residents beneficial amenities and services that make them an asset to the neighborhood and community. Often it is the design of the new development, not the density, that results in whether adjacent neighborhoods find value in the project.

- The State statutory constraints that permit lot splitting/wildcatting in unincorporated Pima County continue to impact the ability of this region as a whole to manage growth in a sustainable manner. Dirt roads, exempt wells, and septic tanks degrade the region's environment and expose the eventual property owners to substandard health conditions in some cases. Incentives and legislative actions must be explored to prompt land owners into either rezoning land to higher densities or undergoing subdivision platting.

- With the support of voters, the County will continue funding the acquisition of natural areas for conservation, recreation, and the protection of water resources. These acquisitions help to define an urban form by acting as constraints to development.

Recommendations

- City General Plan/County Comprehensive Plan Updates and Land Use Regulations

  1. The City and County should direct future growth to areas identified as most suitable for development, outside of the Conservation Lands System, which include infill opportunities in the existing built environment, Houghton Corridor, Southlands, and the Southwest Area.

  2. The City and County should require new development and redevelopment projects to implement smart growth and sustainable urban form concepts with minimum densities, mix of uses, and open space preservation to achieve the benefits described in this paper. The City and County should implement "density by design" to focus on creating as vibrant a built environment as the natural environment that defines us.

  3. The City and County should evaluate new development and redevelopment projects proposing a land use change on their ability to provide housing and transportation choices, access to jobs and services, reduced water and energy consumption, infrastructure efficiencies, amenities offered to surrounding neighborhoods, and fiscal sustainability.

  4. The City and County should work to support the emerging regional visioning process that will ultimately contribute to reaching a broad consensus on community values, and eventually urban form as one of the potential goals.

- Capital Improvement Planning and Fiscal Sustainability

  1. The City and County should establish a joint capital improvement planning coordination process for the targeted growth areas to direct land use planning, phasing of development, timing and funding of public services and infrastructure, and construction sequencing in the targeted growth areas. City and County Capital Improvement Programs should implement City and County General/Comprehensive Plans.

  2. Future development in new growth areas should be evaluated in terms of fiscal sustainability from both the capital (initial construction of infrastructure) and operating (ongoing public services and maintenance of infrastructure) perspectives to ensure that new development is self-sustaining and not being overly subsidized by existing residents.

  3. The City and County should pursue efforts at a regional level to develop an impact fee structure that provides incentives for development in targeted growth areas, including downtown and infill redevelopment areas, and disincentives outside of these areas.

- Open Space Acquisitions

  1. Natural preserves assist in defining the urban form, as well as providing multiple benefits such as recreational opportunities, conservation of water resources and natural floodplain functions, and protection of scenic views. In some cases, purchasing land outright or through conservation easements is the most realistic way to preserve areas not suitable for development. The City and County should continue to pursue land acquisition efforts.

It is respectfully recommended that the Committee consider this report and provide input to the City and County on its recommendations.

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EXECUTIVE SUMMARY

As eastern Pima County and the City of Tucson grow, the continuing influx of people into the area presents planning and infrastructure challenges. How can we grow wisely? What limits do we face? How much can we really modify the existing pattern of growth and its probable extension, and what might that look like?

The future will change Tucson in many ways – and our choices will have a strong influence

This White Paper was intended to encourage City and County agreement on a number of planning and infrastructure policy issues related to future growth and urban form. Section 1 beginning on page 9 explains how this was accomplished and provides a brief introduction to the entire White Paper.

By examining both the form of urban growth and its location through benchmarking and land absorption modeling, our process has identified four unique alternate scenarios that can now be examined simultaneously in a blended fashion.

The study focused on examining probable outcomes if our future is focused on lower density single family residential developments being built in unincorporated Pima County – and the alternative outcomes if we choose to build more compact mixed land uses within the City core.

Section 2 defines urban form factors beginning on page 16, and then quantifies many of their effects, impacts, and costs.

We are not alone as we consider which scenario is in our best interests. Other communities across North America have sought answers to these same questions. They have made choices we can learn from. These peer communities are valuable resources that can be tapped via the benchmarking process. They have provided insight on which factors and choices lead to an urban form that serves the region well.

Page 5 Low angle photography © 2009 Curtis SW Images.

As growth occurs, the Tucson area will take on an evolving urban form – how our communities and employment centers and amenities stitch together to create the landscape of our city. There are many factors that affect this urban form. Significant dynamics include the proximity of housing to basic needs and public facilities, such as sewer, water, and roads. They also include land use mix and diversity, street layout, and housing density. Each and every choice made that changes these urban form factors leads to tangible long-term impacts to our community, and defines our options for living. How much energy and resources we consume, or the time we spend in our cars in traffic, and our ability to afford adequate housing are all real impacts of our decisions about urban form.

Some factors have a greater impact than others. The varying population densities of our future residential communities and their location with respect to today's built environment stand out as key indicators of how our region will grow. Across the board, increases in density bring the benefits of lower infrastructure costs, fewer trips in the car to meet our daily needs, and a reduction in consumed land resources. The choice as to how much we grow closer to our established environment, versus outlying areas farther from existing amenities and service, will have a broad range of effects on what our region would look like if it doubled in population.

Urban form and its design is critical

This paper provides insight into the most measurable factors that appear to highly influence Tucson's urban form, and investigates options for future growth in our region.

For example, increasing the population density of new developments to 10,000 people per square mile (up from its 1990—2000 average of about 4,400 people per square mile) would reduce annual car passenger miles traveled *per person* by *55%*, *per capita* water consumption by *45%*, *per household* municipal infrastructure and servicing costs by *20%*, *per household* energy use by *7%*, and *per household* CO_2 emissions by 2%. Of course, with this increase in density we would also consume much less land and resource materials to accommodate each new resident!

Other benefits would include improved public health, increased access to services, amenities, transportation choices, employment opportunities, and more walkable neighborhoods.

We can control and manage the impact of our future growth.

With specific goals and results in mind, we built four different population location and density model scenarios that highlight some of the options and issues facing us, our leaders and decision-makers. Section 3 describes our examination of future growth locations and alternate scenarios, beginning on page 60.

We started with an exercise examining what the study area would look like if we simply continue to make decisions according to the existing state of affairs. This first **Status Quo** scenario served as a comparative baseline. When the assumed levels of growth occurred in this scenario, the size of our community footprint grew significantly – indicating that household transportation costs would increase significantly in this future.

Growth can be directed differently to our benefit

We learned that growth will occur in predictable locations and patterns should the status quo prevail, and then we proved that both can be readily influenced and changed as we desire.

In our second scenario we modeled the effects of focusing on **Enhanced Habitat Protection** in our surrounding environs. Purchasing land for conservation also increased the density and centrality of our community. Next, we analyzed a third scenario that placed **Infrastructure Efficiency and Taxpayer Savings** at the forefront of our growth and development decisions. The model indicated that the current supply of planned but un-built or partially built land would develop first at today's lower densities, diminishing the expected benefits of this scenario. This scenario effectively reduced suburbanization while creating infrastructure efficiencies and savings.

Finally, we built a fourth alternate scenario that examined **Transit Oriented Development** by using current and future high capacity transit corridors as prime locations for locating incoming future residents. Investing in transit infrastructure and denser mixed land uses further reduced the amount of rural land loss while increasing the centrality and travel mode choices in our community. The results below are discussed in detail beginning on page 78.

Scenario	Total Population	Total Area (square miles)	Average Density (people/mile²)
Current Built Environment	919,998	336	2,737
Scenario #1: Status Quo	1,654,998	642	2,578
Scenario #2: Enhanced Habitat Protection	1,654,998	545	3,037
Scenario #3: Infrastructure Efficient/Taxpayer Savings	1,654,998	554	2,989
Scenario #4: Transit Oriented Development	1,654,998	515	3,212

Qualitatively speaking, the four alternate scenarios each provide varying levels of benefit as shown below. It is suggested that various key elements of these four scenarios could be combined to yield an optimal future growth scenario.

Comparator	#1 Status Quo	#2 Enhanced Habitat Protection	#3 Infrastructure Efficient/ Taxpayer Savings	#4 Transit Oriented Development
More Walkable Communities	—	✓	✓	✓✓
Higher Infrastructure Efficiencies	—	✓	✓✓	✓✓✓
Lower Cost of Services and Tax Levels	—	✓	✓✓	✓✓
More Transportation Mode Choices	✓	✓	✓✓	✓✓✓
More Housing Type Choices	—	✓	✓✓	✓✓✓
More Housing and Transportation Affordability	—	✓	✓✓	✓✓✓
Lower Water, Resource, Energy and Land Consumption	—	✓	✓✓	✓✓✓
More Access to Jobs and Services	✓	✓	✓✓	✓✓✓
More Easily Implemented	✓✓✓	✓	✓	✓

In summary, this White Paper has emphasized the importance of urban form factors and strong community design practices. It has also confirmed our ability to encourage optimal growth locations and forms.

Now we must choose our future wisely.

SECTION 1 - INTRODUCTION

Tucsonans have dealt with growth for at least six decades as they settled here, reacted to the growth, or commonly did both. As Pima County, the City of Tucson, and nearby municipalities continue to grow, people are becoming more and more aware of the planning and infrastructure challenges that this population growth represents. We are also keenly aware of the tangible results, both positive and negative, that earlier urban planning decisions have produced. The community that surrounds us today has been shaped by these past decisions that have been made about where to grow, how to develop, and what infrastructure to provide. Our judgements will carry the same weight. **Let us decide wisely.**

As our community develops, should we stay focused on our present course?

Deciding upon solutions begins with asking a number of questions that would benefit from common answers by the City and County. How can we grow in a way that reduces our impact on the environment and conserves resources? What limits do we face? How can we develop differently so that our standards of livability and affordability are maintained or even improved? What forms of housing should be encouraged, and where? How can the costs of new growth not burden existing residents? Should we expand further into the desert, or intentionally increase density? How can we connect land use and infrastructure planning? What effects will follow these causes?

Ideally the answers to these questions will be equally informed by what we have done well in the past, and by an awareness of where improvements are necessary and possible. We are not alone. Many cities and counties in North America are also seeking better levels of quality and choice. Lessons can be learned from examining the situation and future plans of our peers.

"A hundred years after we are gone and forgotten, those who never heard of us will be living with the results of our actions." - Oliver Wendell Holmes

It is encouraging to realize that our collective desire and ability to change and evolve is far more decisive and important than our circumstances – **our trends are not equal to our destiny.**

This White Paper identifies various factors, constraints, and inter-relationships that define the suitability of growth areas. It presents a number of alternate quantitative growth scenarios and identifies various means of simultaneously achieving qualitative development. It discusses urban form factors and their effects on infrastructure costs and other issues. Finally, this White Paper suggests ways for land use decisions to be factored into the City and County's water supply and infrastructure provision deliberations. It **confirms that solutions exist for our challenges.**

1.1 Overview of White Paper

This White Paper forms part of Phase II of the City/County Water and Wastewater Infrastructure, Supply, and Planning Study. Phase I of this Study consisted of inventorying, assessing, and conceptual planning of water and wastewater infrastructure and resources. Phase II is intended to encourage City and County agreement on a number of planning and infrastructure policy issues.

This paper is divided into five sections. Following this first introductory section, a second section documents the importance of urban form factors and describes the results of our best and emerging practices benchmarking process. The third section discusses the modeled variety of future growth locations, and the fourth section suggests mechanisms for encouraging change based on the previously presented results. The fifth and final section concludes the document with a compact summary.

The geographic scope of this document focuses on examining an area including unincorporated Pima County, the Tucson Water obligated service area, and Tucson city limits.

The primary audience for this White Paper is the joint City/County Regional Water Study Oversight Committee. Other interested parties may include community leaders, City and County administrations, and the involved public.

Figure 1 illustrates the White Paper development process and its combination of core tasks 1 through 6 and parallel tasks A through C. These tasks are described in detail on the following page.

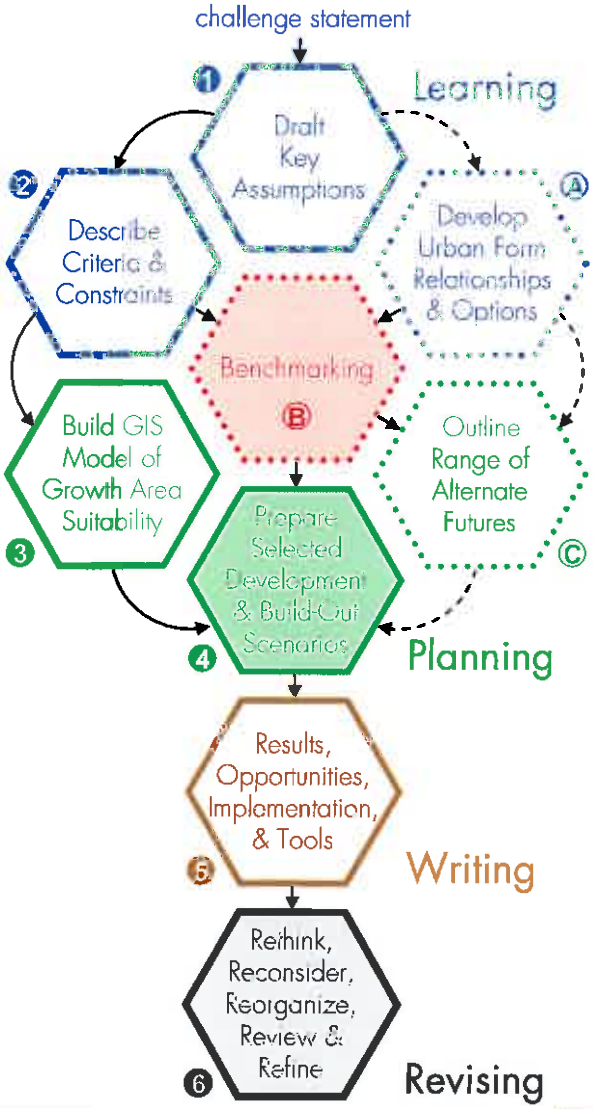


Figure 1: White Paper Process Flow

1.1.1 White Paper Development Process

The White Paper team deployed a classic analysis procedure. They prepared a challenge statement, and agreed upon clear objectives. They established a responsive plan, taking advantage of relevant research and existing work completed by others. They generated alternatives, evaluated and prioritized results based on their merits, and prepared coherent documentation. Finally, they revised their way through draft and final output iterations to build consensus. The analysis relied heavily on geographic information system (GIS) tools. The White Paper process included six core tasks, each with a simple goal:

Task 1 Draft Core Assumptions	*Goal: "Build a firm shared foundation"*
Task 2 Describe Criteria and Constraints	*Goal: "Know our limits"*
Task 3 Build GIS Model of Growth Area Suitability	*Goal: "Develop GIS layers to discretely analyze appropriateness of growth across the metro and select sub-areas"*
Task 4 Prepare Selected Development and Build-Out Scenarios	*Goal: "Pinpoint select growth areas having fewer disadvantages & more benefits"*
Task 5 Document Results, Opportunities, Implementation, and Tools	*Goal: "Record detailed results and prepare for the next steps"*
Task 6 Rethink, Reconsider, Reorganize, Review and Refine	*Goal: "Think twice to deliver polished outputs"*

Tasks 1, 2, and 3 concentrated on illuminating the transition between the reality of our existing urban form and the destination created by known criteria and constraints. It produced solid intelligence regarding advantageous locations for quantitative growth. This involved an obvious focus on our community's built environment.

Before completing Tasks 4 through 6, the team completed a stream of parallel tasks that looked outwards across North America to ensure a more complete exploration of the solution set available to Pima County and the City of Tucson. These Tasks A, B, and C had simple goals:

Task A Develop Urban Form Relationships & Options	*Goal: "Explore cause and effect interactions between urban form comparators"*
Task B Benchmarking	*Goal: "Establish best and emerging practices, create comparisons and targets"*
Task C Outline Range of Alternate Futures	*Goal: "Consider a broad range of solutions and their impacts"*

The combined outputs from Tasks 1-3 and Tasks A-C created a more meaningful analysis in Task 4. Tasks 5 and 6 finished the White Paper.

1.1.2 Best and Emerging Practice Benchmarking

Best and emerging practice benchmarking is a process in which organizations evaluate various aspects of themselves in relation to the most efficient (least amount of effort) and effective (best results) practices using specific indicators, usually within a peer group defined for the purposes of comparison. It is often treated as a continuous process in which organizations continually seek to challenge their practices in order to identify changes leading to an improved situation.

Benchmarking is more than merely identifying reference points; it also identifies existing performance in terms of average, best, and emerging practices. This range of values creates meaning and substance for the indicator, and can create awareness of improvements that are orders of magnitude beyond what is generally thought possible. Benchmarking also promotes the fact that performance ranges are valid and acceptable. This approach replaces "bad" and "good" with "opportunity" and "improvement" and triggers dynamic assessments rather than static criteria. We can always do better, and benchmarking tends to generate focus and helpful motivation.

The White Paper team first identified groups of peer communities across North America. Two groups each consisting of six urban areas were formed; the first included Tucson and those cities that were felt to be similar to our present state in terms of urban form: Colorado Springs, Colorado; Edmonton, Alberta; Albuquerque, New Mexico; Austin, Texas; and El Paso, Texas.

The second group included cities the team wanted to examine closely for emerging practices: Portland, Oregon; Calgary, Alberta; Sacramento, California; Salt Lake City, Utah; Denver, Colorado; and Vancouver, British Columbia. Urban form parameters of interest were selected and benchmarked externally using these communities.

A second round of benchmarking then looked at the internal variation of these parameters across the City and County.

Finally, a series of maps from the peer communities was obtained (where possible) to illustrate their internal urban form factor variations and patterns of distribution.

Section 2 beginning on page 16 documents the best and emerging practice benchmarking results.

1.1.3 Growth Area Suitability and Land Absorption Modeling

One of the goals of this White Paper was to map alternatives for what our future developed footprint might look like. Incorporated and unincorporated Pima County (east of the large portions of the Tohono O'odham Nation that have the same borders) covers almost 2.5 million acres of ground. Modeling and thematically mapping the relative suitability of projected growth and land absorption for such an expanse is best done at a high level and a broad scale.

The techniques used for this White Paper built upon the analytical routines and lessons learned from three previous studies completed by Pima County staff. The analysis methodology uses a grid cell format rather than more familiar map elements such as points, lines, and shapes. Because grid cells use a regular mapping unit, mathematical overlays and transformations are easily applied.

The selected modeling methodology included two distinct stages. First, a growth area suitability surface was defined across the grid cell landscape. Secondly, projected populations were absorbed by the individual grid cells using a series of rules unique to each scenario being modeled. Each acre of land was roughly equal to 4.5 grid cells.

Figure 2 displays how the growth area suitability model relies on two types of criteria: factors and constraints. Factors are preferentially weighted quantitative variables that enhance or reduce development suitability on a continuous scale. Constraints limit alternatives; they mask certain portions of the landscape from consideration.

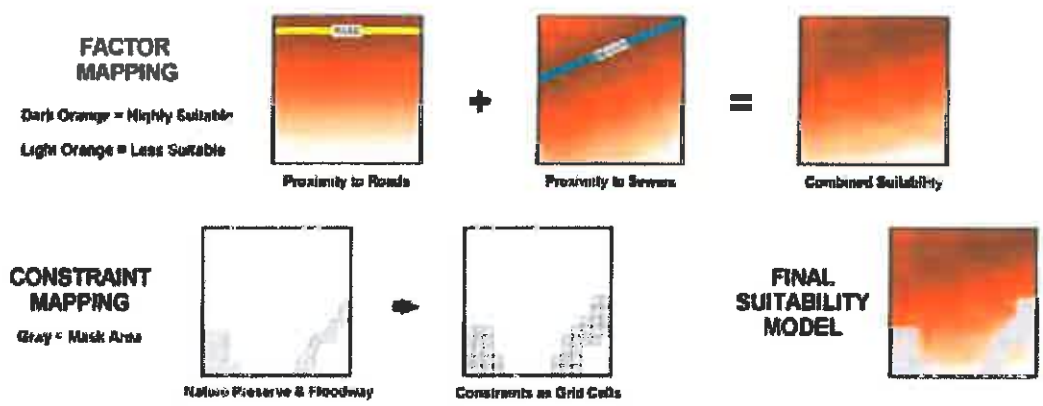


Figure 2: Growth Area Suitability Model Factors and Constraints – Example of GIS Techniques

Initially, a Status Quo model and scenario was built to examine the logical progression and extension of current growth and development practices. Additional models were then built to examine an Enhanced Habitat Protection scenario, an Infrastructure Efficient / Taxpayer Savings scenario, and a Transit Oriented Development Scenario. These later scenarios each varied one major assumption to examine its effect.

1.1.4 Key White Paper Assumptions

Examining the appropriateness of future growth and development across the metropolitan and select sub-areas required several key assumptions as shown in Table 1 below.

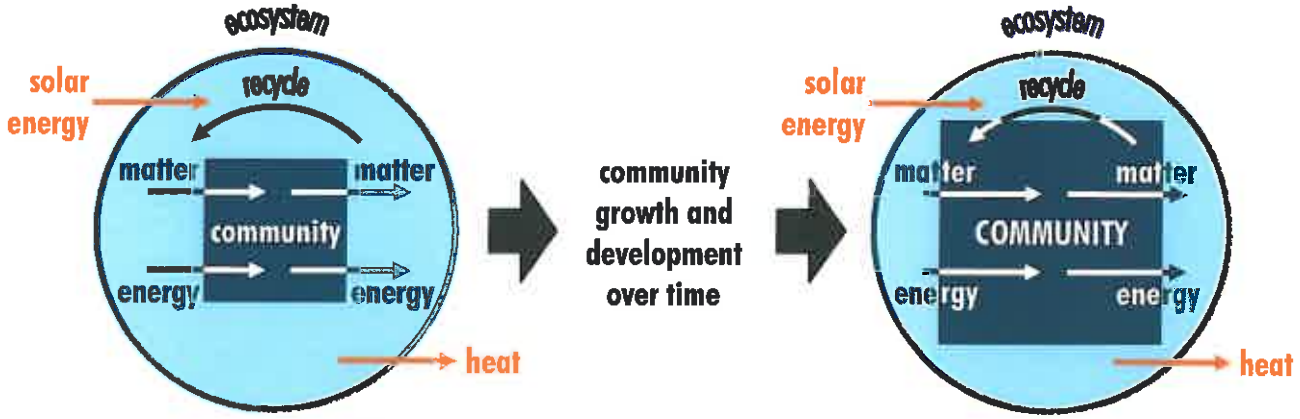
Table 1: White Paper Assumptions

Topic	Key Assumption
Study Area	Study area focuses on the eastern portions of Pima County where the City and County have land use planning authority.
Adjacent Areas of Importance	For adjacent incorporated communities such as the towns of Oro Valley, Marana, and Sahuarita; southern Pinal County; and Tribal and Federal lands – population growth was projected to follow Arizona Department of Economic Security forecasts.
Policy Domain	Envisioned scenarios can alter City and County enforced policies but do not alter or change state or federal statutes and laws.
Absolute Residential Development Constraints for Growth Area Suitability Modeling	• Land with slope over 25%. • Natural preserves (local, state, federal). • Federal lands (except Bureau of Land Management disposable lands outside the Conservation Lands System). • Urban Parks, floodways, and golf courses. • Public rights-of-way and cemeteries. • Landfills, mines and quarries. • Tucson International Airport and Davis-Monthan Air Force Base approach and departure corridors. • City of Tucson lands in Avra Valley.
Future Population	To examine growth dynamics, the White Paper allocated a total future population of two million people in eastern Pima County. No specific time period or year is assumed.
Components of Growth and Development	This White Paper focuses on gross land consumption for residential uses. Fulfilled future needs for other land uses, services, and amenities were inherently assumed.
Occupancy Rate	Future residences are occupied by 2.4 people.

Of these key assumptions, none might be the focus of more conversation than the decision to map an allocation of two million people, versus some other future population number. While long range trends and available population projections do extend towards this threshold, this White Paper assumption was primarily established for the purposes of backcasting. While forecasting is the process of predicting the future based on current trends, backcasting approaches the challenge of discussing the future from the opposite direction. It allows us to consider what needs to be done in the "here and now" in order to reach a desired end situation. As part of long-term planning, sustainable communities often look ahead three generations (about 60 to 100 years) to investigate, test, and examine their ideal end situations.

As Figure 3 suggests, the growth (defined as quantitative expansion) and development (defined as qualitative improvement) of our community occurs within the context of our natural capital and ecosystem. As a result, growth must have some optimal scale relative to our ecosystem – while development improvements can continue until some optimal situation is reached. The presence of these natural limits underlines the crucial nature of our growth and development decisions.

Figure 3: Natural Capital Limits to Growth but not Development



The White Paper team believes these natural limits are best understood and managed by examining a range of alternate future scenarios at a total eastern Pima County population of two million people. Decisions about where to grow and how to develop are amplified at this threshold, with readily apparent causes and effects. Readers who are firm proponents of a smaller Tucson community with a total population less than two million people (or a larger one of over two million people) will still derive insight from the benchmarking and alternate growth and development scenario modeling results. Scaled appropriately, they are informative at many levels.

At any threshold of development, the real challenge is sustainability.

SECTION 2 - THE IMPORTANCE OF URBAN FORM

Urban form refers to the spatial distribution and design aspects of built-up land areas. This section demonstrates urban form, its causes and effects, and describes how our community compares to other peer cities. Many choices for our future will become evident.

2.1 What is Urban Form?

The mix of land uses, density of development, and pattern of streets in an area begin to describe a unique neighborhood pattern. These patterns aggregate all the way upwards from the lot, block and neighborhood levels to the municipality and county levels. This photo shows a distinct urban form transition across N. Euclid Avenue from a historic district to the University of Arizona.

Various configurations emerge, whether they are rural, village, urban – or auto-oriented, landscape oriented, pedestrian oriented, or transit oriented. Each combination can exist with distinct land uses, at different levels of population and housing density, and at varying degrees of design success – from exceptional to average, and sometimes worse.

Urban form can be described by primary and derivative (or secondary) factors which include (but are certainly not limited to) the following:

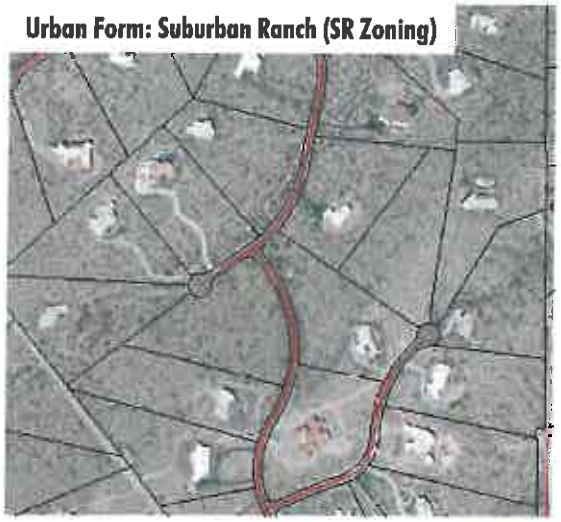
Table 2: Typical Urban Form Factors

Primary Factors	Derivative Factors
Development Location	Centeredness, Centrality
Land Area	Housing Unit Density
House, Lot, and Block Size	Floor Area Ratio
Land Use Mix and Diversity	Open Space Index
Population	Population Density
Street Layout	Walkability
Transportation Networks	Transportation Mode Splits

2.1.1 Urban Form Variety in Tucson and Pima County

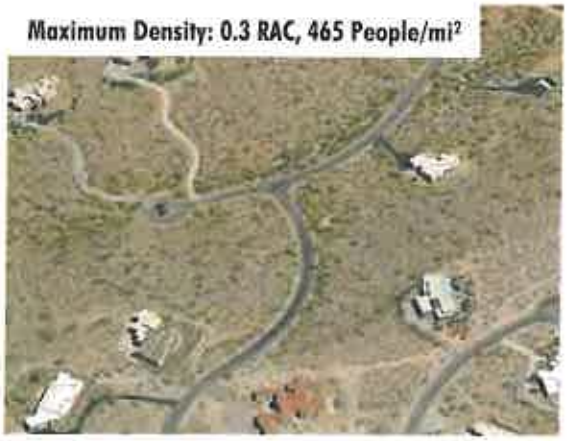
This page presents multiple views of typical lower density residential developments. These communities have a distinct look and feel given their larger lot sizes. These two examples are located in unincorporated Pima County.

Page 17 Low angle photography © 2009 Curtis SW Images.

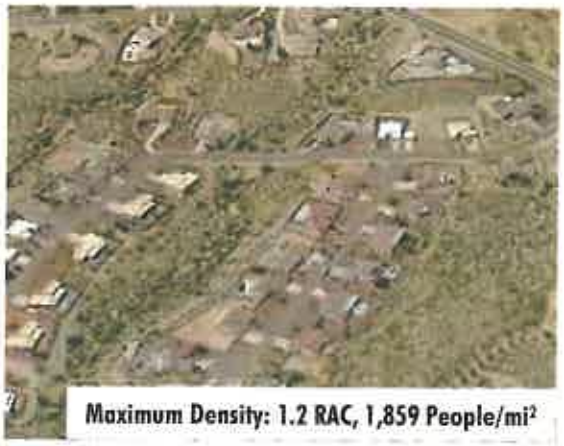


Urban Form: Suburban Ranch (SR Zoning)

Urban Form: Single Family Residential (CR-1 Zoning)

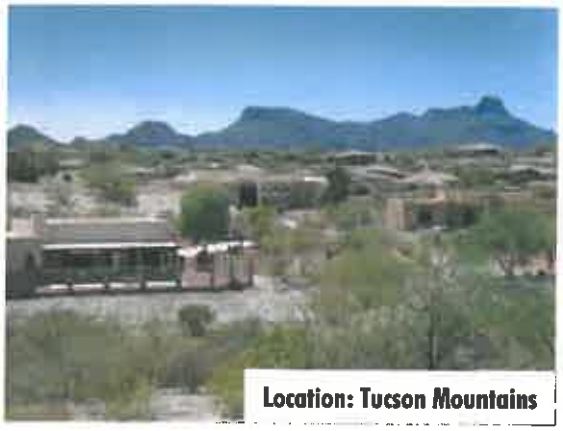


Maximum Density: 0.3 RAC, 465 People/mi²



Maximum Density: 1.2 RAC, 1,859 People/mi²

Location: Tucson Mountains



Location: Tucson Mountains

This page presents multiple views of typical medium to medium / high density residential developments. Strong design elements can readily over-come potential perceptions of crowding. These two examples are located within the City of Tucson.

Page 18 Low angle photography © 2009 Curtis SW Images.

Urban Form: Medium / High Density Residential

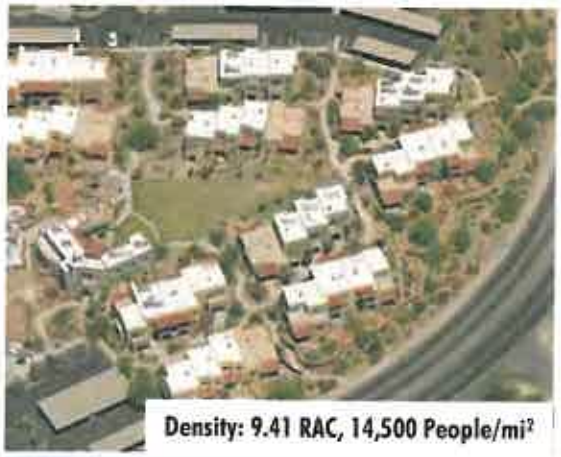
(R-3 Zoning)

Density: 7.08 RAC, 10,900 People/mi²

Location: Armory Park del Sol, S. 3rd Ave. & E. 16th St.

(R-2 Zoning)

Urban Form: Medium / High Density Residential



Density: 9.41 RAC, 14,500 People/mi²

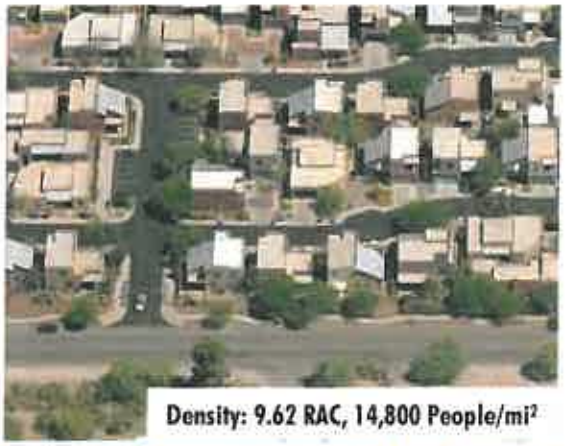
Location: Stone Curves, Stone Ave. & Limberlost Rd.

This page presents multiple views of typical medium / high to high density residential developments. Many feature open garden-type areas and additional community and landscaping amenities. These two examples are located within the City of Tucson.

Page 19 Low angle photography © 2009 Curtis SW Images.

Urban Form: Planned Area Development (PAD-1 Zoning)

Urban Form: High Density Apartments (PAD-1Zoning)



Density: 9.62 RAC, 14,800 People/mi²

Density: 22.92 RAC, 65,200 People/mi²

Location: The Presidio, Craycroft Road & E. 16th Street

Location: Williams Apartments on Craycroft Road

This page presents multiple views of typical higher density mixed use centers and employment centers. These successful developments are flourishing, in part due to their deployment of positive design principles. These two examples are located within the City of Tucson.

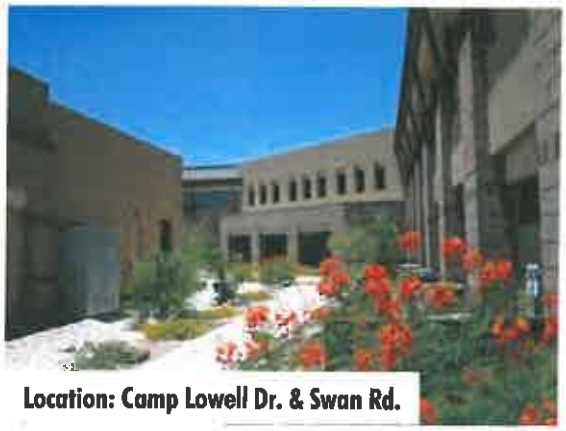
Page 20 Low angle photography © 2009 Curtis SW Images.

Urban Form: Mixed Use (OCR-1 Zoning) Office/Commercial/Residential

Urban Form: Office (O-2, O-3 Zoning)

Density: 14.06 RAC, 21,600 People/mi²

Location: Sam Hughes, Campbell Ave. & E. 6th St.



Location: Camp Lowell Dr. & Swan Rd.

2.1.2 Effects and Impacts of Urban Form

Through a number of causal pathways, urban form factors have many effects and impacts. Below, Figure 4 displays several typical examples that flow from an urban design. Although far from comprehensive, this diagram illustrates how existing amenities and infrastructure assets combine with urban form factors to influence many activities and their outputs. In turn, these outputs have a number of effects that contribute to an outcome that may or may not be the desired impact being sought.

Good urban design has a critical role in creating favorable urban forms.

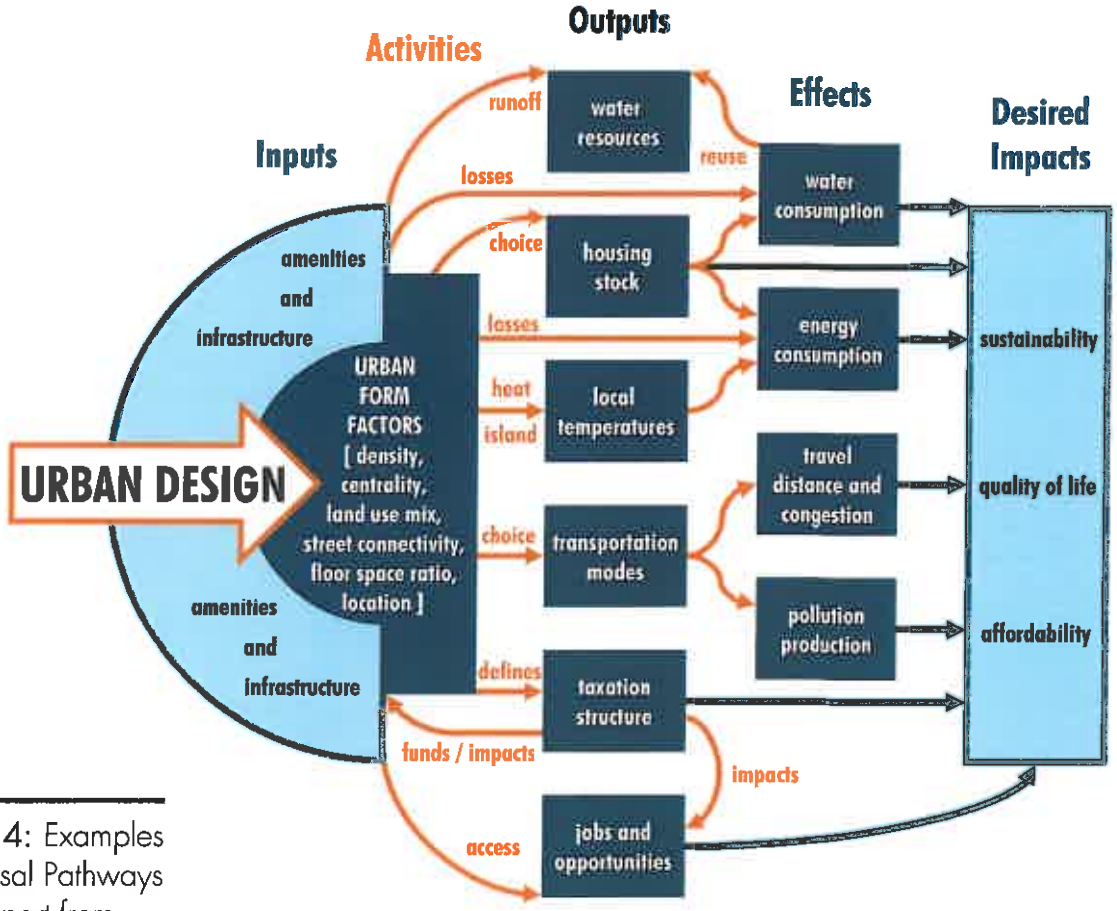
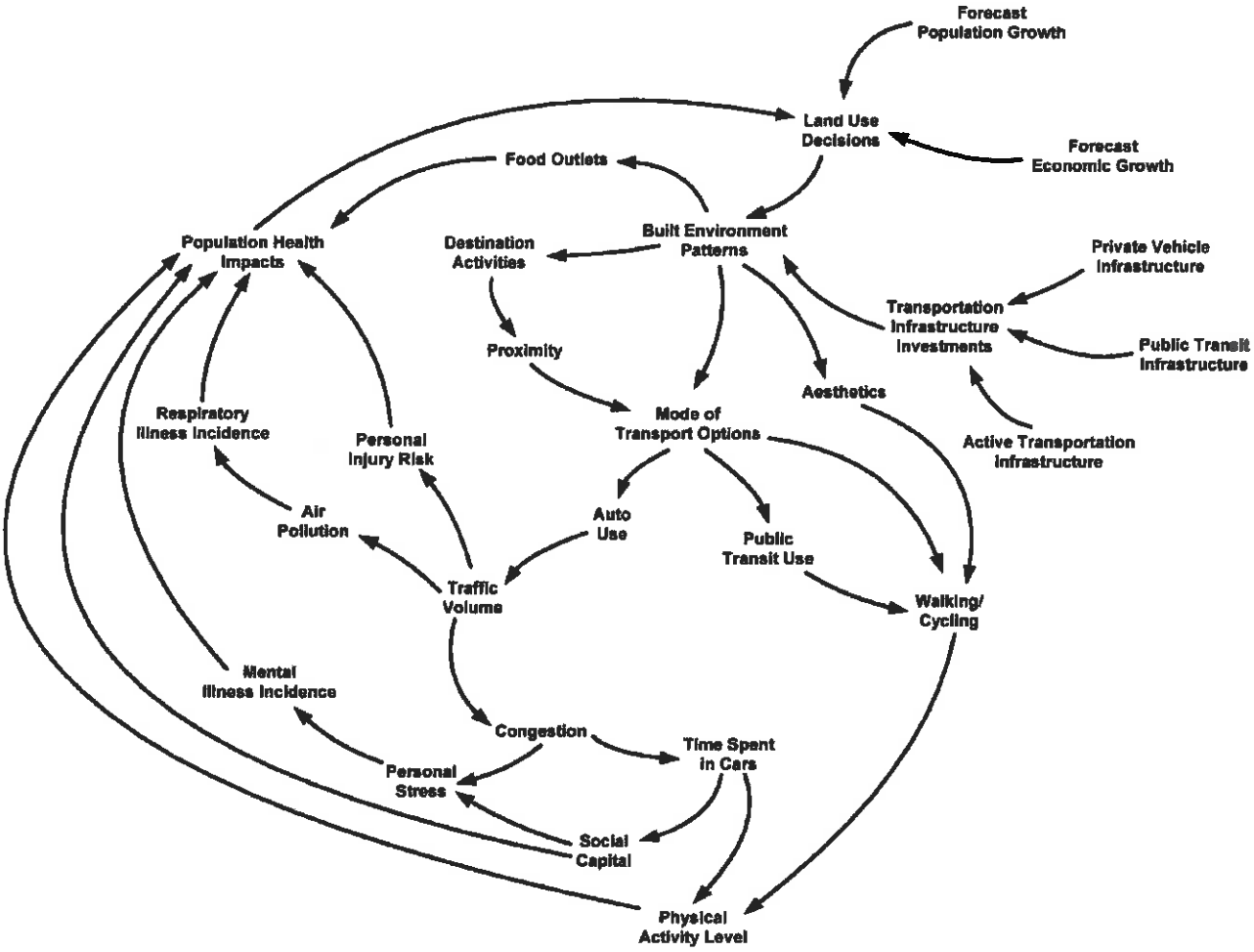


Figure 4: Examples of Causal Pathways that Depart from Urban Form Factors

Emerging research has also tied the cause of urban form directly to effects upon our own **health**. The graphic below is one of a collection of more than twenty conceptual models created in January 2008 for the Region of Peel in Ontario, Canada by Paul Conway of the Public Health Agency of Canada.

These models build from source work documented in *"From Built Environment to Health: An Evidence and Best Practices Based Review"* completed by Lawrence Frank and Company in December 2007. Other more detailed conceptual networks in this work tie together floor-space to area ratios, neighborhood design, transit service, street design, physical activity, and health impacts of obesity in much greater detail.

Page 22 Data Source and Graphic Credit: Region of Peel



Urban form factors and auto dependence are also related.

The concept of "Smart Growth" has been an important component of urban planning for several years. Indeed, Arizona statutes mandate Smart Growth initiatives for municipalities and counties. Resources are available on the Arizona Department of Commerce website, including a scorecard for jurisdictions to use. A tenet of smart growth is the deliberate inclusion in a land use plan of alternate modes within and between neighborhoods and communities. Alternate modes include sidewalks, bike lanes and transit routes within a land use plan for a neighborhood, community or sub-region.

These facilities help reduce the levels of congestion that continue to rise within our large and growing communities. This congestion is benchmarked in Section 2.3.3 on page 41.

The urban form of any community that wishes to encourage pedestrian, bicycle and transit use must have amenities for these alternate modes. To encourage transit use, there should be a strong relationship between the location of employment centers and residential areas. Employment centers need not be with an established central business district, such as downtown Tucson. Employment centers can be "sub-centers", defined by Florida's Center for Urban Transportation Research (CUTR) as a set of contiguous tracts with significantly higher employment densities than surrounding areas.

In 2008, CUTR documented the relationship between transit and urban form for Florida's Department of Transportation. This report, *"Integrating Transit and Urban Form"*, is cited in the bibliography and includes an exhaustive literature and research review of previous studies identifying the link between density, urban form and transit use. The following is an excerpt from this CUTR report:

> "The findings of this review show that there has been a shift from the study of density threshold levels that make transit cost feasible to an analysis of the effect of urban design and land - use mix on travel behavior, after controlling for density levels. The issue is no longer at what density thresholds it makes sense to implement transit, but what is the best set of policies affecting urban design and land - use mix that most influences the spatial arrangements of activity locations, so that individuals are more likely to utilize transit."

The important finding in this report is that there does not appear to be a density "trigger", per se, that can determines when, or what type of, transit service should be implemented. Rather, the study indicates that the provision of transit service should be a deliberate goal sought by urban

planners (usually within a jurisdictional agency) based on the location of activity centers (employment, entertainment, retail) within a specific urban or suburban area in a land use plan.

The following additional excerpt from the CUTR report explains why home to work distance is a major factor in transit use (or non-use):

> "Households living farther from work...use less transit, which is due to "trip chaining" behavior. Such households engage in complex trip chains and have, on average, a more dispersed activity space, which requires reliance on more flexible modes of transportation. Policies that reduce the spatial allocation of activities and improve transit accessibility at and around sub-centers would increase transit demand. Similar results can be obtained by policies that increase the presence of retail locations in proximity to transit-oriented households. Centrality and the strength of an established CBD are relevant drivers of transit use, as highlighted by the elasticity of transit demand with respect to distance from the CBD. Sub-centers also play a relevant role, indicating the need to provide services in decentralized employment and residential areas to increase ridership."

There does appear to be a relationship however between the size of a community and transit use. The 1995 "*National Personal Transportation Survey*" completed by the US Census Bureau revealed this relationship, as shown below in Table 3:

Table 3: Relationship between City Size and Transit Use

City Size (Thousands)	Residents Riding Transit Monthly
Under 250	1.4%
250–499	5.4%
500–999	6.4%
1,000–2,999	10.0%
3,000+	21.0%
Nation-wide	11.6%

For comparison, the Pima Association of Governments Regional Transportation Plan 2030 indicated that the average one-way work commute in Pima County is now 13 miles; the mode split is 74 percent single-occupant driving, 14.7 percent carpooling, 2.6 percent walking, 2.5 percent transit, 3.7 percent working at home, and 2.7 percent other modes, including bicycling. **Our transit mode split is quite low.**

The 2009 document "*Evaluating Public Transit Benefits and Costs: Best Practices Guidebook*" by the Victoria Transportation Policy Institute cites previous studies in its analysis of transit operations, feasibility and implementation recommendations. The document indicates that in for land use planning:

> "Various land use factors affect transit use... Per capita transit ridership tends to increase with city size, population and employment density, and the quality of the pedestrian environment.
>
> One study found the elasticity of transit ridership with respect to residential densities to be +0.22 in U.S. urban conditions, meaning that each 1% increase in density increases transit ridership by 0.22%. Destination density (e.g., clustering of employment) tends to have a greater impact on transit ridership than residential density. Transit ridership tends to increase if more people live and work near transit stops."

This document indicates that appropriate land use policies, transit ridership incentives and consumer acceptance are necessary to be effective. The following types of transit improvements were suggested to have the greatest positive land use impacts:

- Transit programs that are part of an overall smart growth land use program.
- Transit oriented development, which intentionally integrates transit improvements with compatible land use development.
- Transit improvements that encourage infill and redevelopment of older urban neighborhoods.
- Transit stations located at major commercial centers with large numbers of commuters.
- Transit improvements as an alternative to roadway capacity expansion.
- New urbanism, parking management and other demand management policies implemented in conjunction with transit improvements.

Transit is not a panacea, because it can also have some negative land use impacts. Rail facilities require land, can divide neighborhoods, and can be unattractive. In some situations, transit improvements can increase urban sprawl by facilitating longer-distance commutes. Accordingly it is best to plan and implement a viable transportation system concurrently with land use and infrastructure planning.

Table 4: Potential Results of Urban Form Factors

Table 4 outlines a longer list of the potential results (both impacts and effects) of urban form factors. Each of these results can vary in their magnitude. Some are positive while others are negative.

Potential Results of Urban Form Factors	
Auto Use	Traffic Congestion
Transportation Mode Split	Walkable Urban Spaces
Greenhouse Gas Production	Urban Pollutant Generation
Accessibility and Affordability	Cost of Community Services
Domestic Water Use	Wastewater Generation
Energy and Resource Use	Infrastructure Efficiency
Continuity of Development	Land Availability
Employment Density	Jobs to Housing Ratio
Infrastructure Density	Level of Infill Development
Stress and Health Indices	Opportunity Index
Housing Mix and Choice	Social and Community Ties
Effective Permeable Area	Quality of School District
Tax Assessments and Structure	Population Growth Rate
Community Sustainability	Rural and Open Space Loss

"Smart growth is preserving natural habitat by creating better human habitat." – Smart Growth America

The "Smart Growth" movement has developed many planning principles that (once customized for local application) can form a strong framework for achieving more beneficial urban forms. The State of Arizona has established its Growing Smarter legislation that will impact future General and Comprehensive Plans.

Smart growth principles have already informed the development of plans such as the County's Southwest Infrastructure Plan (SWIP) and the City's Houghton Area Master Plan (HAMP). In addition, the Tucson Modern Streetcar, downtown redevelopment, and Regional Transportation Authority (RTA) roadway planning work that integrates land use have all incorporated smart growth approaches.

Readers interested in the detailed research behind the impacts and effects listed in Table 4 are directed to the list of published articles and references contained in the bibliography.

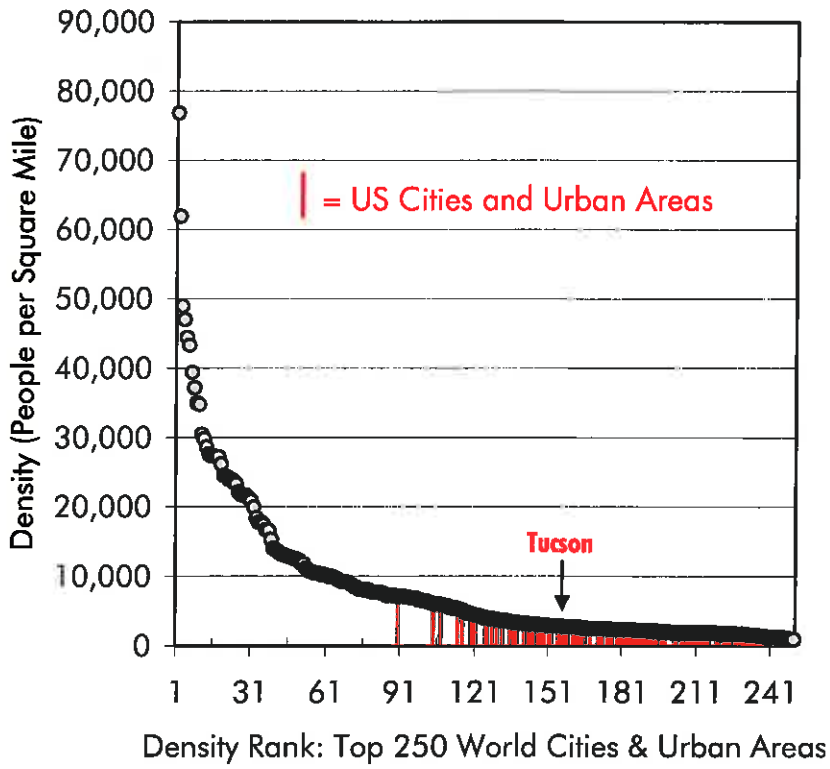
2.2 Selection of Peer Communities for Benchmarking

The White Paper team began a substantial best and emerging practices benchmarking process by identifying peer communities of note.

A successful benchmarking process begins with self analysis. This is followed by the identification of best and emerging practices among the surveyed peer group. This allows for performance differences to be quantified, and leads to the development of go-forward actions that implement the findings. The result of a successful process is narrowed performance gaps and obvious improvements.

It was important to recognize the relative positioning of our City and County within North America at the outset. Figure 5 displays the density of the Top 250 World Cities and Urban Areas, with 2000-2005 era data sourced from the United Nations and national statistical offices via www.citymayors.com.

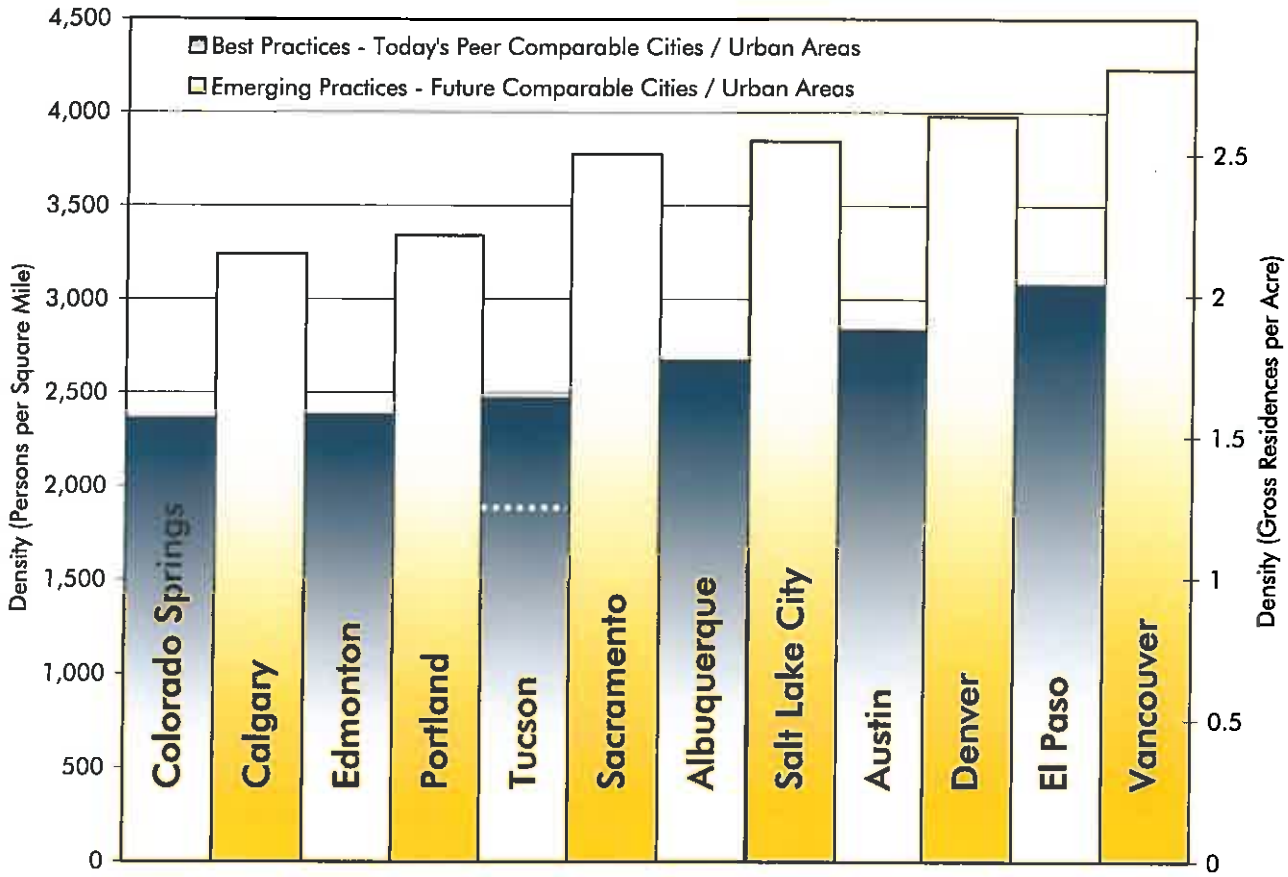
Figure 5: Context for Benchmarking Process: Top 250 World Cities and Urban Areas



The range of population densities in the United States inhabits an easily identified portion of Figure 10. The Tucson "Urban Area", defined in this dataset as 720,000 people in metropolitan Tucson occupying 291.5 square miles, lands within the middle ground of the American city and urban area range. This relative position would skew to the right if any of the hundreds of square miles of Tucson's fringe areas were included. Exact comparisons require the use of truly equivalent statistical areas.

The peer communities were initially identified solely on the basis of the White Paper team's knowledge and experience. Although one community (Raleigh, Durham, and Chapel Hill in North Carolina) was discarded as a peer, the two groups were remarkable when their relative densities were compared. Figure 6 displays how the ranked "emerging practices" comparable urban areas were each approximately 40% more dense than the identified "best practices" communities that the group felt were Tucson's closest peers.

Figure 6: Density of Selected Peer Cities and Urban Areas

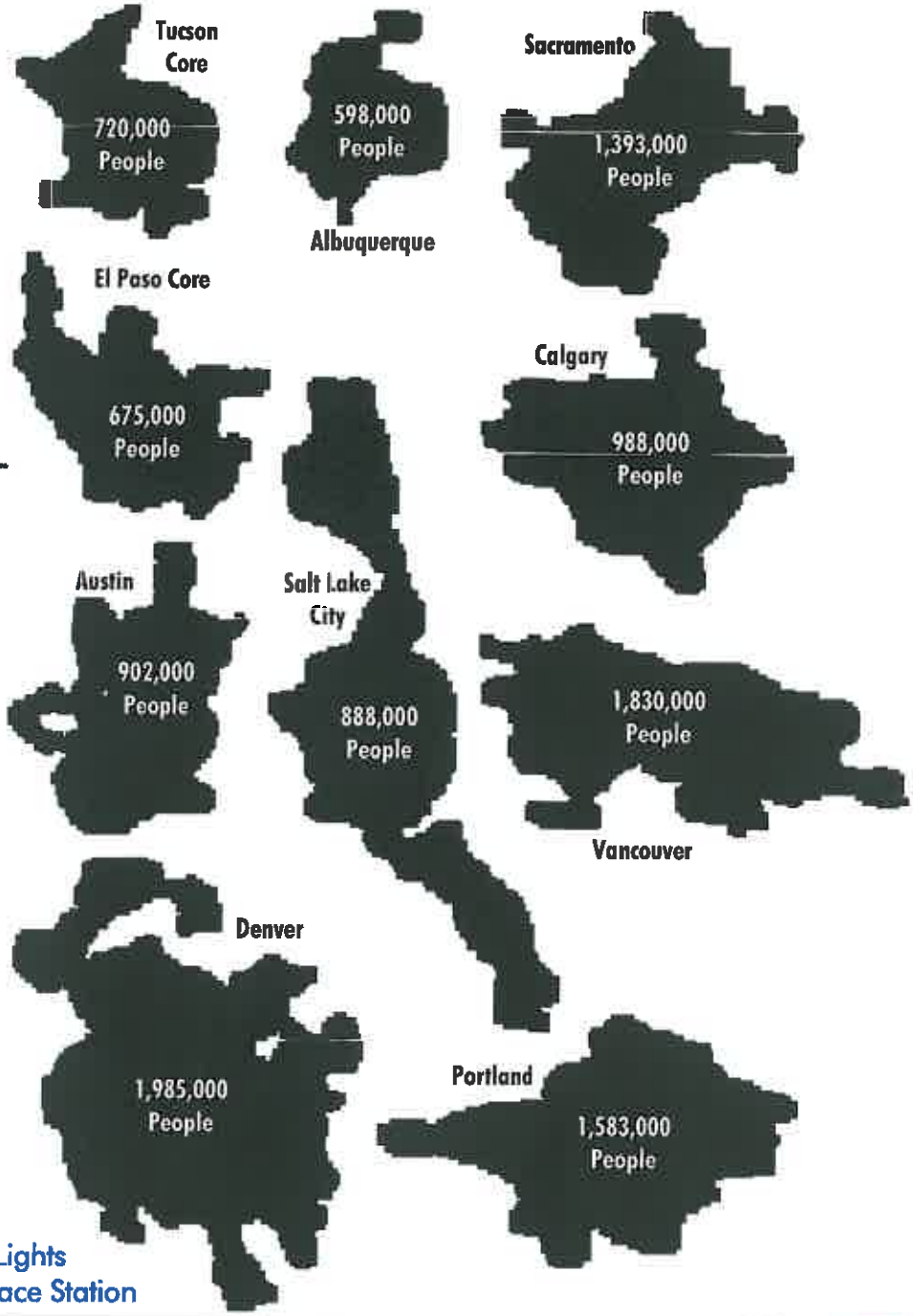


Like the circumference of an island, community populations and densities can be measured at many levels of detail with varying results. For example, the calculated Tucson population density of 2,470 people per square mile shown above drops to a density of 1,873 people per square mile indicated by the white dashed line when the density is calculated using a population of 1,023,320 over a corresponding area of 546 square miles. These larger figures include the four primary local municipalities and larger portions of unincorporated Pima County. Both are valid computations; it is merely noted that the parameters we are examining inhabit a natural range of variation.

The shape and aspect ratio of communities is highly evident at night when viewed from the great altitudes of space. Although not purely equivalent given small variations in viewing altitude and angles, night-time photography from the International Space Station is of qualitative interest in comparing the evidence of the extent of human activity as it relates to urban area population.

Original night views of city lights from the International Space Station © NASA.

"The unaided eye sees incredible detail when gazing upon cities during a 40-minute pass around the dark side of the planet. Efforts to record this beauty on film are only a natural extension of human desire." – Astronaut Don Pettit



Night Views of City Lights From the International Space Station

Table 5 provides another measure of comparing the peer communities; in this case density-calculating statistics were collected strictly for the land area within the named City limits. This method naturally yields the highest stated density for Tucson, while densities for Edmonton and Salt Lake City were skewed lower than their metropolitan area values.

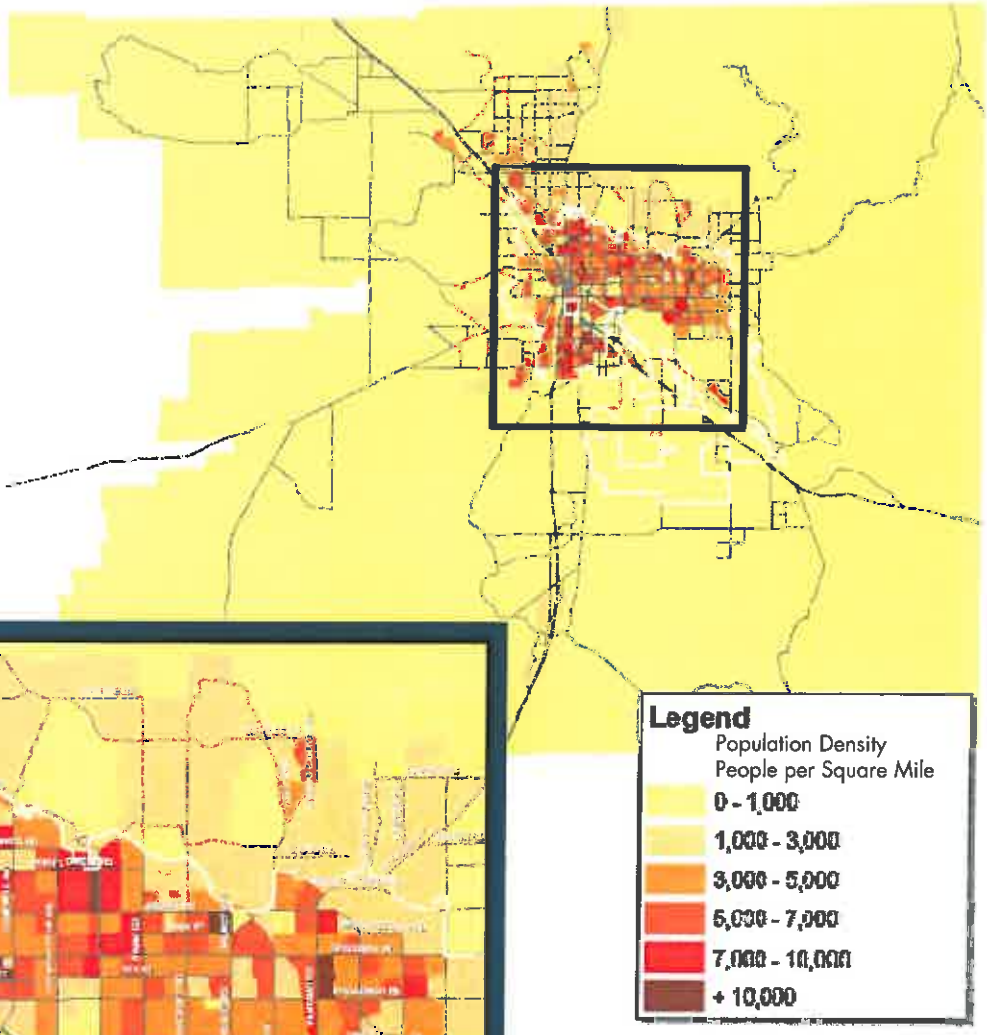
While the city densities vary somewhat from the urban area densities, it is still apparent that the selected communities are both peers and interesting comparisons for the future of the City and County.

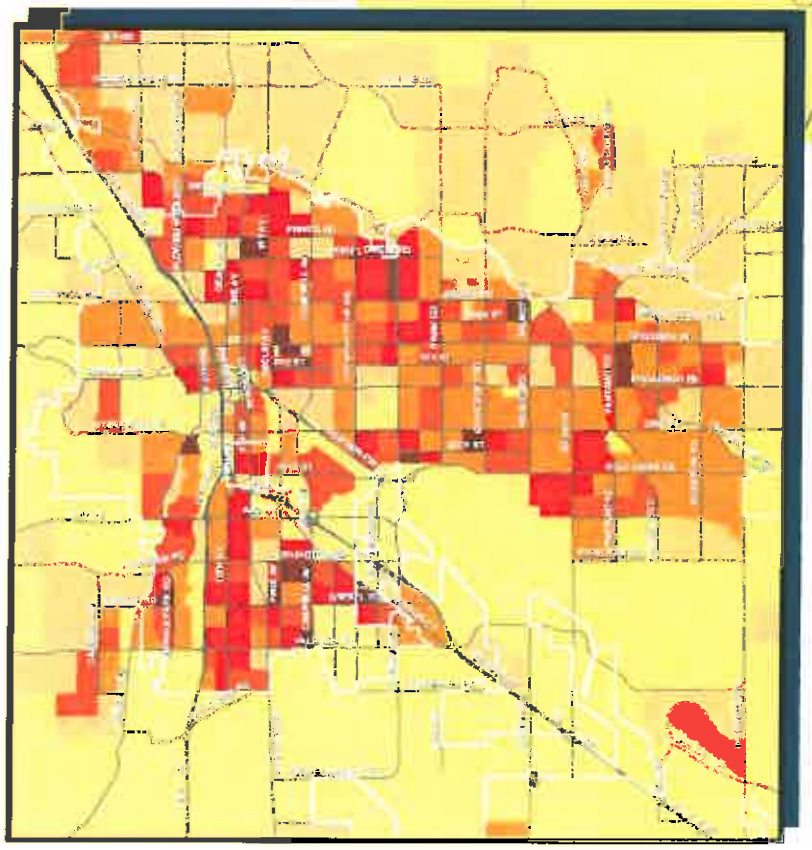
Table 5: City-Based Population Density Statistics

"Today's" Peer Cities	Population Estimate ('06-'07')	Land Area (Square Miles)	Density (People per Square Mile)
Colorado Springs	466,000	197.3	2,362
Edmonton	782,000	328.2	2,383
Tucson	720,000	291.5	2,470
Albuquerque	598,000	223.9	2,670
Austin	902,000	318.1	2,835
El Paso	675,000	219.3	3,078
"Future" Peer Cities	**Population Estimate ('06-'07')**	**Land Area (Square Miles)**	**Density (People per Square Mile)**
Calgary	879,000	271.0	3,243
Portland	1,583,000	474.1	3,339
Sacramento	1,393,000	369.1	3,774
Salt Lake City	888,000	230.9	3,846
Denver	1,985,000	498.8	3,979
Vancouver	1,830,000	432.4	4,232

As Tucson grows, there are many multiple pathways forward. Beyond the status quo scenario, densities could reduce or increase over time. In terms of densification, the peer community data suggests that moving from today's average of 2,000 to 2,500 people per square mile up to an average of 4,000 to 5,000 people per square mile and beyond represents a clear possibility given the choice of peer communities.

The variation of population density across the study area and in Downtown Tucson is illustrated with the maps below. In general, population densities above 3,000 people per square mile are located within the City of Tucson, while suburbs in unincorporated Pima County and other municipalities have lower density.





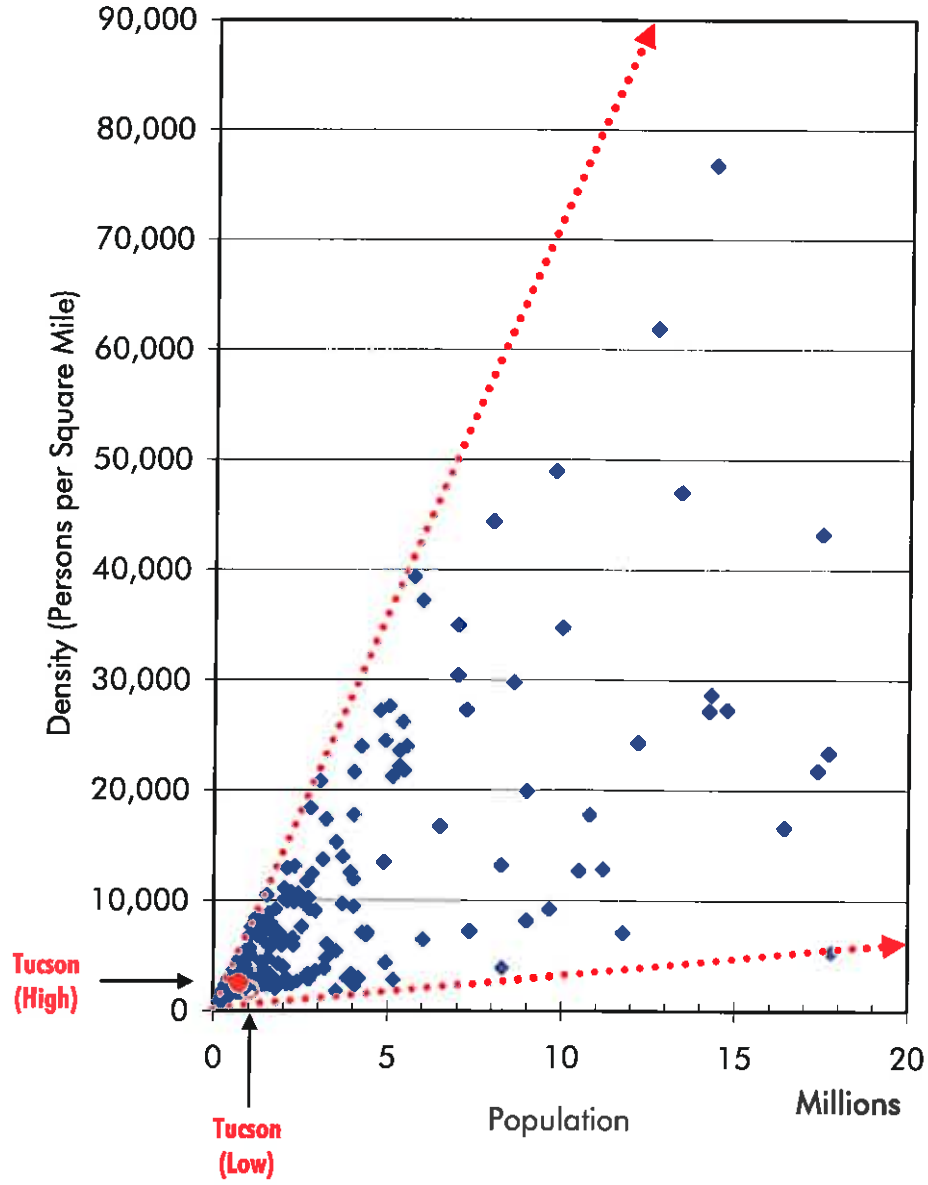
These polygonal areas are not homogeneous in terms of the <u>average</u> densities shown above. Many blocks have apartments on corners or along main roads, with internal areas containing single family residences.

2.2.1 Pathways to Locating a Future Population

Referring again to the Top 250 World Cities and Urban Areas dataset, Figure 12 outlines a very broad view of alternate pathways forward. There is an evident densification trend with increasing population; however the range of densities for similarly populated urban areas is significant.

Given our present position – whether using the high or low estimates of population and density – it is necessary to examine the lower left hand corner of Figure 7. Refer to Figure 8 for a closer view.

Figure 7: Top 250 World Cities Density Trends with Increasing Populations

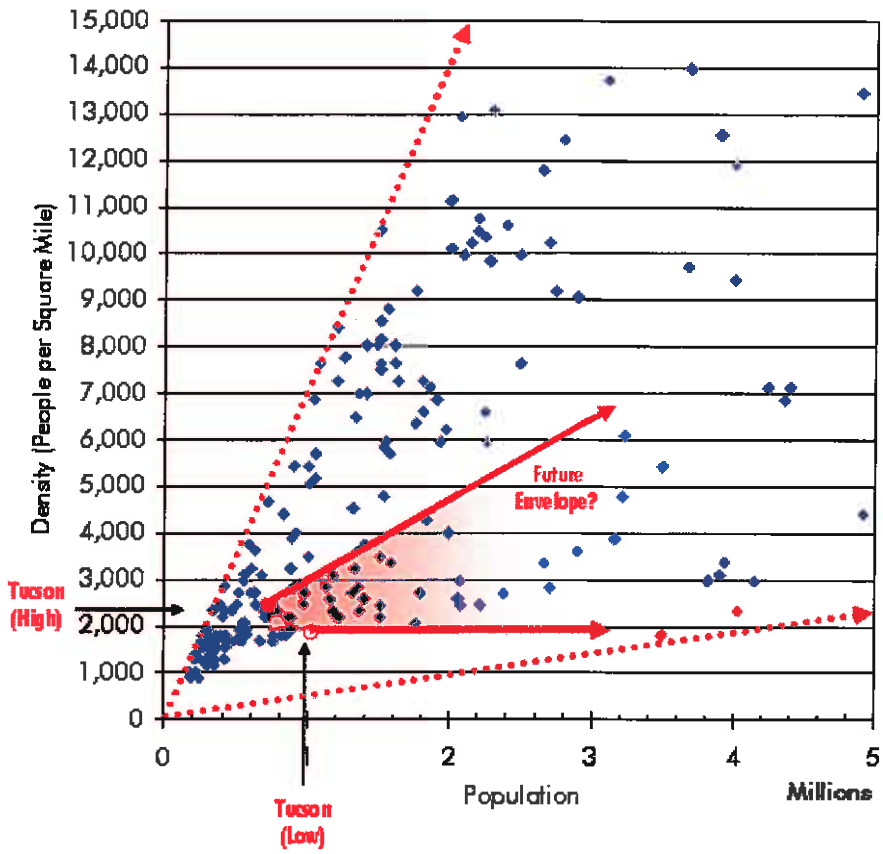


As Tucson grows, it will move to the right from either of the existing population statistics shown on Figure 7. If the status quo holds in terms of population density, it will move precisely to the right – and there are U.S. cities that have done just that. It is also possible that our community could grow to the right and upwards in terms of density and population.

There are also cities in that direction; it is a plausible future.

Figure 8 contains one likely envelope of future scenarios; in theory the entire solution space is reachable – with some locations being much more probable than others given our particular opportunities and constraints. This envelope ranges from the status quo density to a doubling of the overall average density and beyond.

Figure 8: Likely Envelope of Future Population and Density Scenarios

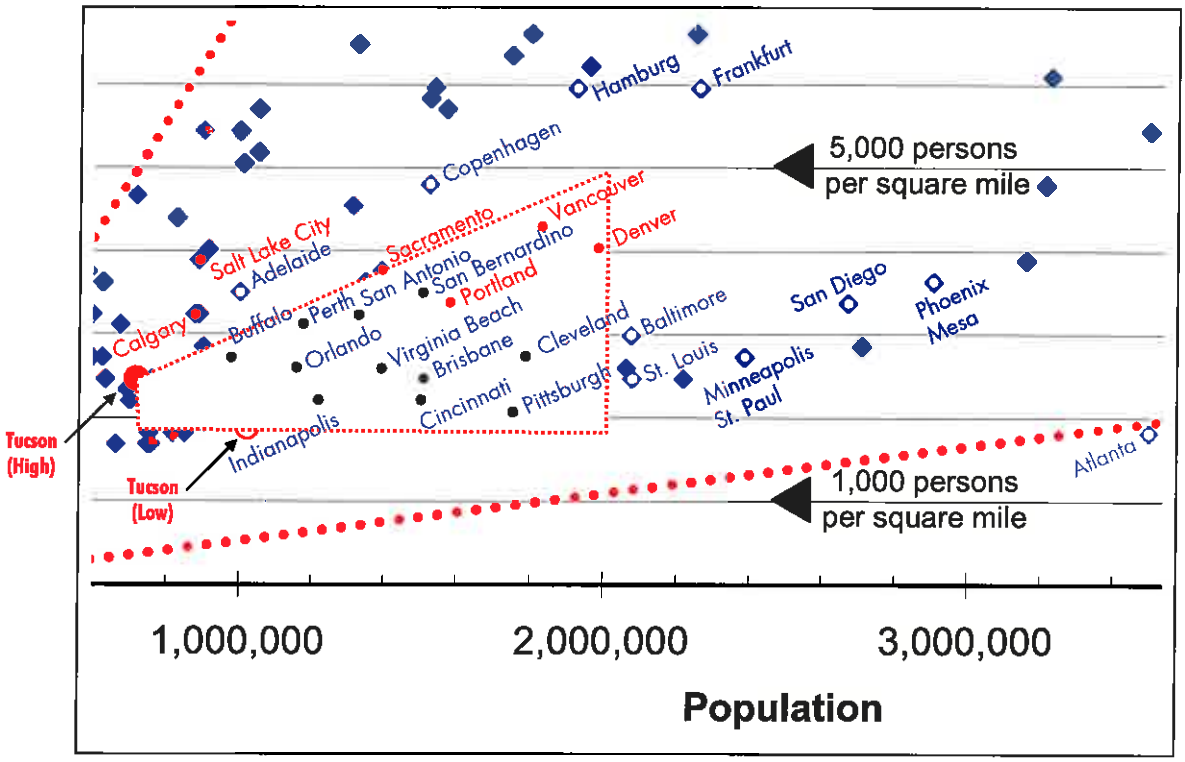


In terms of benchmarking, we are immediately interested in the identities of the cities within the likely future envelope.

Figure 9 examines a small subset of Figures 8 and 7. It identifies several of the urban areas by name. It is revealing to examine where the six "emerging practices" peer communities are located. For clarity, please note that the name labels refer to those diamond symbols with superimposed circles. Red circles are peer communities, while white and black circles were used to increase visual impact.

One of our important questions now becomes one of choosing the best pathway forward, and informing that decision with a strong awareness of the probable causal pathways created by that choice. The trail we end up tracing on this type of graph will have many real consequences for the citizens of Tucson and Pima County. The remaining portions of Section 2 will delve into many of these outcomes in detail.

Figure 9: Peer Communities In and Adjacent to Likely Future Envelope



2.3 Comparing Urban Form and Design: Benchmarking Results

This section documents the best and emerging practices benchmarking. Three levels of comparisons were completed to varying extents depending upon the urban form factor being examined. The City and County were compared to their peer municipalities. For certain factors, data from over 800 Transportation Analysis Zones (TAZ) within the City and County were compared to each other. When available, similar internal breakdown maps of the key urban form factors were collected from planning staff at the peer communities.

2.3.1 Benchmarking Population Density and Your Commute

"When you're making a housing decision, you're also making a decision on transportation." - Barbara Lipman

The cumulative housing type and location choices made by community members create population density trends and patterns. These density patterns have a direct correlation with the average annual car passenger miles these same community members then travel in their automobiles. Figure 10 displays this relationship for more than 50 higher-income world cities, the City of Tucson, and most of the selected peer communities.

Several scales of density are provided, including gross residences per acre at the average occupancy rate of 2.4 people per residence.

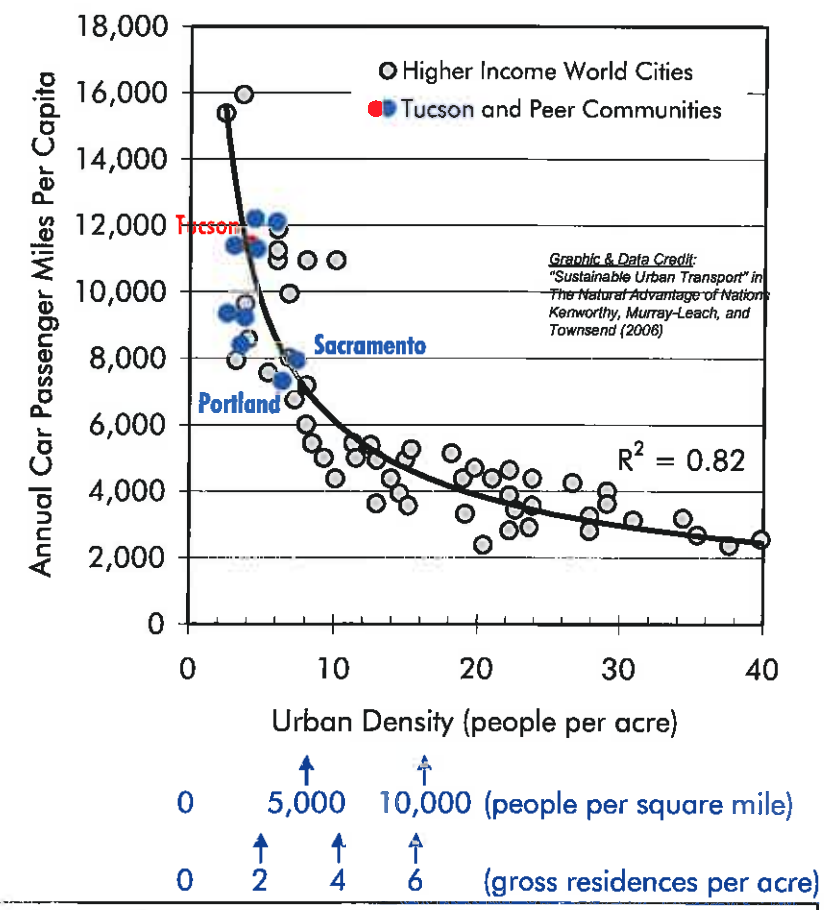


Figure 10: Density and Annual Car Passenger Miles Per Capita

Of interest to this White Paper is the relative position of the City of Tucson community, and the strong relationship between urban form and transportation behavior. The shape of the best-fit curve indicates that significant gains in trip reduction should be expected as densities increase to about 9 people per acre, or 6,000 people per square mile.

If the City of Tucson presently averages about 4 people per acre today, what might such an increase in density look like? The photograph to the left depicts a typical Tucson subdivision with 2.5 residences per acre, or a total of 6 people per acre.

Page 36 Graphic Credit: Excerpt from Visualizing Density by Julie Campoli and Alex S. MacLean. © 2007 by the Lincoln Institute of Land Policy, Julie Campoli, and Alex S. MacLean.

Aerial photographs © 2007 Alex S. MacLean.

Compare this density to the photograph below to see the influence of a different urban form and design; this Longmont, Colorado subdivision yields 7.7 residences per acre, or a total of 18.5 people per acre.

Note the variation of density and the floor space to area ratio (FAR).

Figure 7 indicates that over the range of these two photographed urban forms one might expect the annual car passenger miles traveled per capita to be reduced in half. **This tells us that urban form is important.**

"What really matters is how the streets are laid out, how the land is subdivided, how the buildings are arranged and detailed... These are all functions of design." – Lincoln Institute of Land Policy

This reduction in car passenger miles has obvious and significant impacts on affordability that will now be discussed.

Assuming population densities in large portions of our community can increase to 6,000 people per square mile, the expected annual car passenger miles per capita would drop from 11,400 miles to about 7,000 miles.

In the City of Tucson and Pima County, this effect of urban form causes wide variations in the amount of household income spent on housing and transportation. A recent study entitled "*Housing + Transportation Affordability in Tucson Metropolitan Area, Pima County, and Pinal County*" by the Center for Neighborhood Technology (CNT) and the Drachman Institute is available at http://www.drachmaninstitute.org/.

This study documents how housing and transportations costs in the central city can be less than 30% of the area median income, and greater than 60% of the area median income in outlying areas.

On a daily rather than an annual basis, this is a drop of almost 40% from 31.2 miles per day to 19.2 miles per day. This is highly significant in light of CNT research that suggests transportation costs (as a percentage of income) begin to exceed housing costs when average commute distances lengthen past a distance of 15 miles.

Similar research has been completed for other centers, with many more communities being studied at present. The combination of housing and transportation affordability is a strong emerging benchmark.

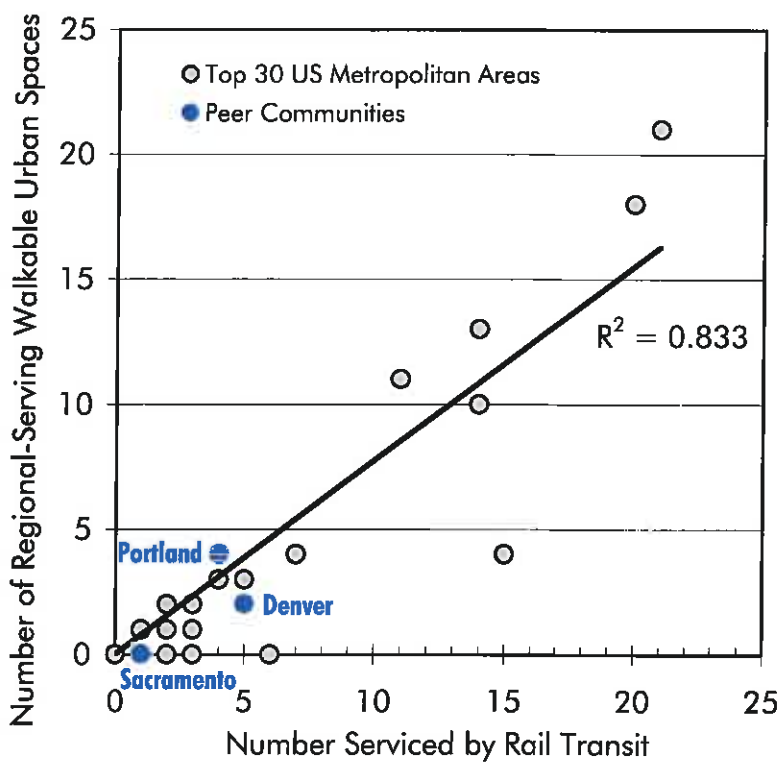
2.3.2 Benchmarking Rail Transit, Density, and Walkable Urban Spaces

A recent survey of regional-serving walkable urban spaces identified 157 such spaces in the largest 30 metro areas in the United States. The survey defined walkable urban spaces to be at least five times as dense as typical suburbia (requiring a FAR of at least 0.8 and upwards to 40.9), include mixed uses, be compact (between 100 and 500 acres in size), be accessible by multiple transportation modes, have regional more than local significance, and to be completely walkable from within. The survey excluded institutions that by their very nature are regional walkable urban spaces, such as medical, corporate, and university campuses, and theme parks.

The survey found most such places are adjacent to downtown, while others were in suburban town centers, formed during suburban redevelopment, or were developed as lifestyle centers.

The survey also noted that rail transit or even being "rail transit ready" apparently plays a large role as a catalyst, as shown on Figure 11.

Figure 11: Role of Rail Transit in Serving Walkable Urban Spaces



Two potential regional-serving walkable urban spaces within our community were quantified. This included Downtown Tucson and the University of Arizona campus, although campuses were specifically excluded from the original survey.

The University of Arizona campus meets most of the technical criteria; however it has a current gross land area of 590 acres and a stated net future land area of 355 acres. According to the 2003 Comprehensive Campus Plan Space Needs Forecast, it has a gross floor space square footage of 7.7M square feet. Using these areas yields a FAR between 0.3 and 0.5, both of which fall short of the minimum FAR of 0.8.

Downtown Tucson is closer to qualifying as regional-serving walkable urban space. It has a combined residential and commercial FAR of 0.6 over 338 acres. A smaller boundary and area of 231 acres had the maximum FAR, with a slightly higher ratio of 0.7.

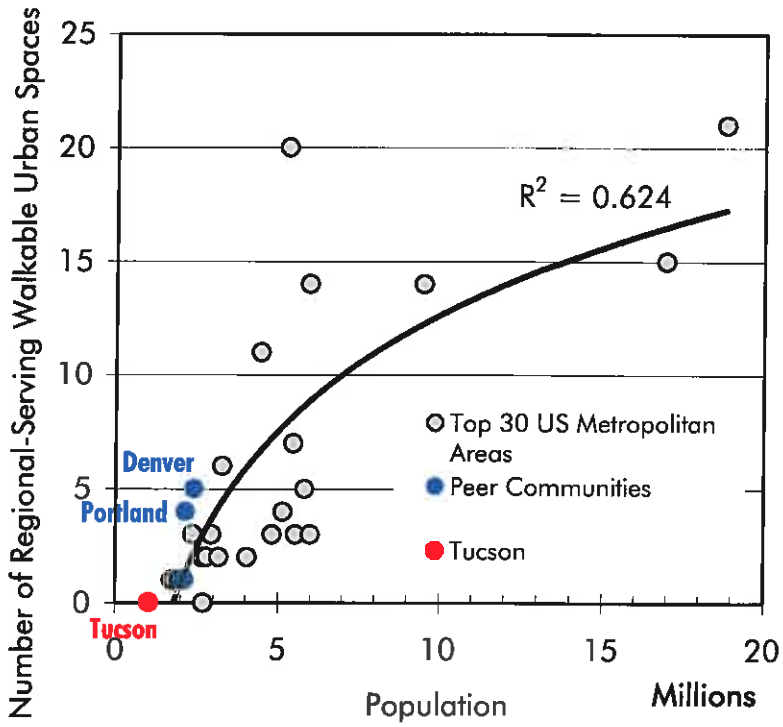
With the arrival of the Tucson Modern Streetcar, it is likely that the additional energy and final ingredients imparted to Downtown Tucson will create a vibrant regional-serving walkable urban space.

Extension of high capacity transit can be encouraged by higher densities. Densities of six to eight residences per acre (about 11,000 people per square mile) are needed to encourage even bus rapid transit, let alone light rail or commuter rail transit.

Figure 9 below highlights the forward-looking nature of conducting benchmarking in terms of emerging practices. The smallest of the Top 30 US Metropolitan Areas surveyed had 1.7 million residents, so it is suggested that including Tucson is premature, yet revealing.

Although the population of Pima County has just surpassed one million, it is possible to look ahead and identify points of difference with other peer communities. Seen far enough in advance, it is possible to adjust course and reach a new destination if desired.

Figure 12: Urban Population and Walkable Urban Spaces



Photograph © 2008 Audrey Bonnet. Used With Permission.

For a population of two million residents, the survey suggests that following these emerging practices would see Tucson develop anywhere between one and five qualifying regional-serving walkable urban spaces. The photo at left depicts the dense Streetcar-catalyzed Pearl District in Portland, Oregon.

This is an opportunity that our community can readily seize within a few decades.

2.3.3 Benchmarking Transportation Congestion

Tucsonans are aware that their time spent in traffic congestion is increasing. The Texas Transportation Institute (TTI) has been assessing urban congestion and use of various modes for two decades. Its annual report on congestion trends usually makes the headlines and the national television news. The TTI "*2007 Urban Mobility Report*" indicates that:

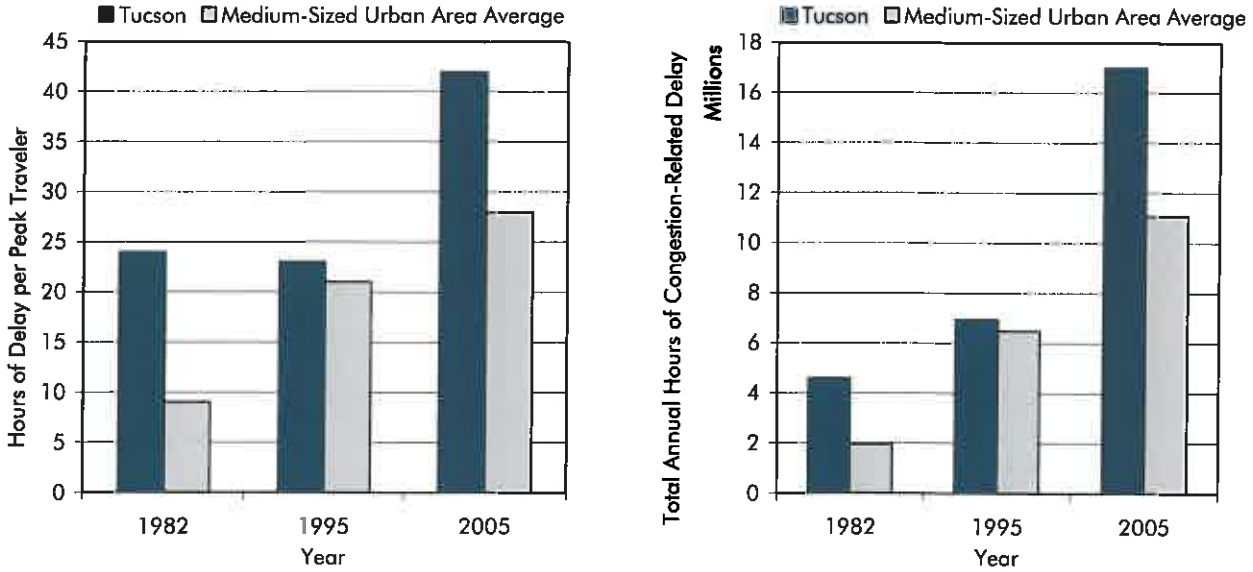
> "Congestion has increased even though there are more roads and more transit service. Travel by public transportation riders has increased 30 percent in the 85 urban areas studied in this report. The contribution of the road growth effect to the congestion problem is difficult to estimate..."

The report estimates that travel has increased 105% in large metropolitan regions while road capacity on freeways and major streets has grown by only 45 percent. We clearly are not able to, and in fact probably cannot, build our way out of congestion through increased road construction.

The 2007 Urban Mobility Report has been updated yearly and contains transportation data for most major cities. Congestion data is provided for each city based on several metrics, including delays, wasted fuel, and travel time. Figure 13 shows the growth in delay per traveler and total delay in Tucson from 1982 to 2005 and provides comparison with other "medium size" cities including many of our peer communities.

Page 41 Data Source: Texas Transportation Institute, 2007.

Figure 13: Growth in Tucson Delay from 1982 to 2005



The following Tables 6, 7, and 8 show 2005 key mobility measure data for the peer cities within the United States identified earlier in this White Paper. Data is shown in ascending order of the rank of each peer city. Information for the Tucson area is shown in red. Ranking is shown only for the peer cities, based on 85 urban areas listed in the TTI 2007 Urban Mobility Report.

Table 6: Annual Delay per Traveler per Year

Peer City	Annual Delay per Traveler	
	Hours	Rank
Denver, CO	50	11
Austin, TX	49	13
Tucson, AZ	42	25
Sacramento, CA	41	27
Portland, OR	38	33
Albuquerque, NM	33	36
Colorado Springs, CO	27	45
Salt Lake City, UT	27	45
El Paso, TX	24	51

The Travel Time Index shown in Table 7 is the ratio of travel time in the peak period to travel time at free-flow conditions. A Travel Time Index of 1.35 indicates a 20-minute free-flow trip takes 27 minutes in the peak, and a Travel Time Index of 1.00 indicates no congestion.

Table 7: Travel Time Index Benchmarking Results

Peer City	Travel Time Index	
	Index Value	Rank
Denver, CO	1.33	13
Sacramento, CA	1.32	14
Austin, TX	1.31	15
Portland, OR	1.29	21
Tucson, AZ	1.23	28
Salt Lake City, UT	1.19	36
Albuquerque, NM	1.17	42
El Paso, TX	1.17	42
Colorado Springs, CO	1.14	51

Page 42 and 43 Data Source: Texas Transportation Institute, 2007.

Congestion also wastes extra fuel consumed during peak period travel, as shown in Table 8.

Table 8: Wasted Fuel per Traveler per Year

Peer City	Annual Wasted Fuel per Traveler	
	Gallons	Rank
Austin, TX	33	15
Denver, CO	33	15
Sacramento, CA	30	21
Portland, OR	27	27
Tucson, AZ	26	31
Albuquerque, NM	21	39
Salt Lake City, UT	18	44
Colorado Springs, CO	16	46
El Paso, TX	16	46

Puget Sound Regional Council's *"Vision 2020 + 20 Update: Information Paper on the Cost of Sprawl"* documents that unchecked urban sprawl is more costly than smart growth. The document cites prominent research papers dealing with comparing the costs of alternative development patterns and summarizes the findings to draw general conclusions about the costs of sprawl. One of the important studies cited in the report was "Measuring Sprawl and Its Impacts" written by Reid Ewing, Rolf Pendall, and Don Chen in 2002. This effort surveyed 83 metro areas and ranked them by their "Sprawl Index". He then compared the top ten most sprawling metro areas with the ten least sprawling in the following travel and transportation related outcomes:

- *Daily vehicle miles traveled per capita.*
- *Average vehicle ownership.*
- *Percent of commuters taking transit to work.*
- *Percent of commuters walking to work.*
- *Average commute times.*
- *Average annual traffic delay.*
- *Traffic fatalities per 100,000 people.*
- *Ozone pollution levels.*

The least sprawling metro areas were found to perform better than their sprawling counterparts in nearly every parameter: fewer miles driven per day, fewer cars owned, greater percentage of commuters walking or taking transit to work, fewer traffic fatalities and lower ozone levels. Interestingly, sprawling and compact regions were not found to have a significant difference in commute time or traffic delay per capita, dispelling the belief that we can sprawl our way out of traffic congestion.

2.3.4 Benchmarking Centrality

Figures 14 and 15 provide benchmark data for growth and development locations. Our community is running in the middle of the pack both when compared to the peer communities and nationally. This represents an opportunity to encourage greater levels of infill and redevelopment.

"In half of the fifty largest US metro regions, urban core communities increased their share of new building permits from 1990 to 2007. People want homes close to high-paying jobs." – USEPA

Figure 14: Building Permit Locations (2000–2008)

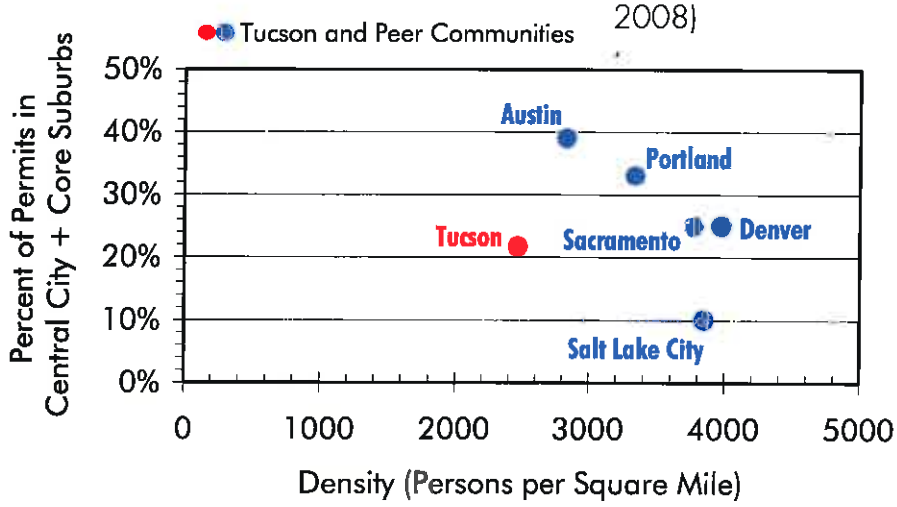
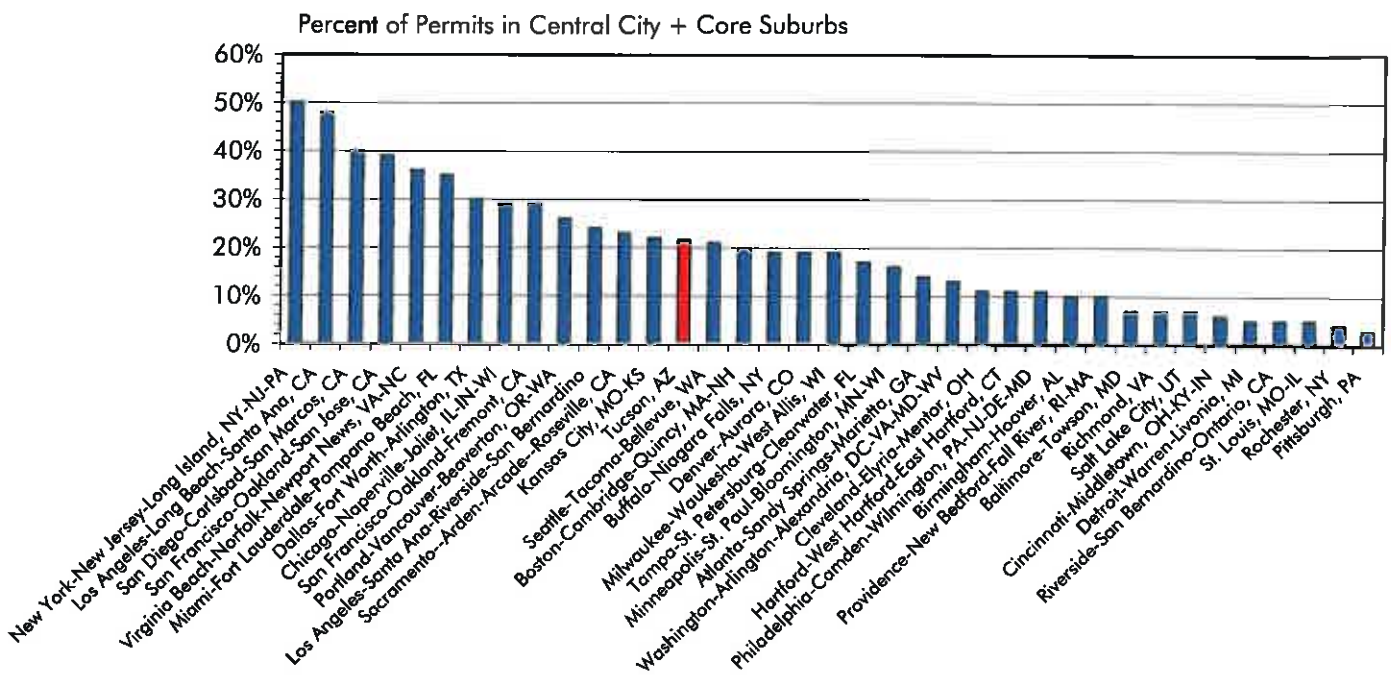


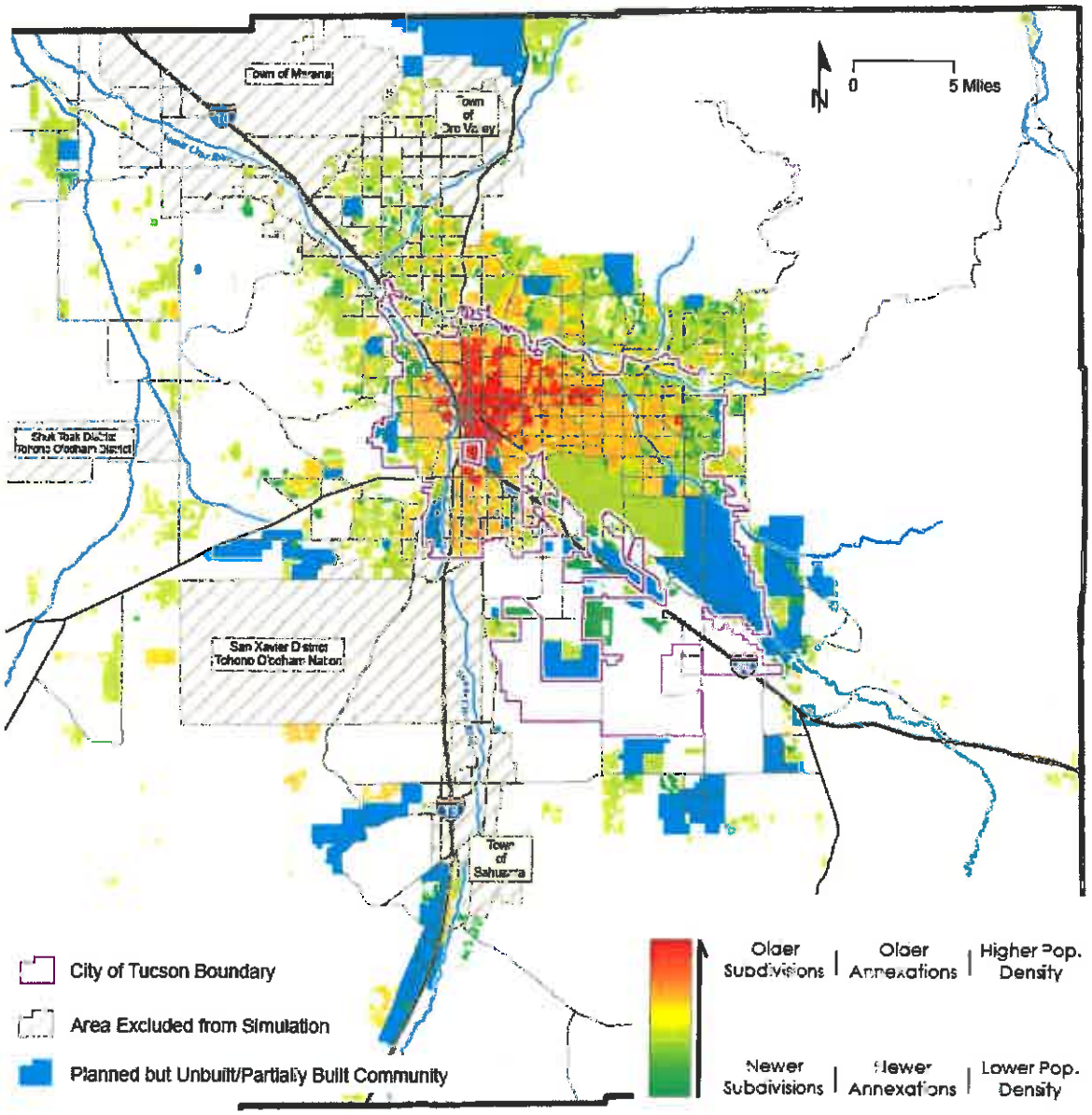
Figure 15: Residential Construction Centrality (2002–2007)



The map below depicts a blend of our community's density, location, and history. It simultaneously outlines the spectrum of older versus newer annexations and legal subdivisions, and the spectrum of higher versus lower population densities. This data formed the basis of the areas defined in Figure 4.

The location of the blue newer planned communities and green subdivisions and annexations is shown in clear contrast to the orange and red denser older areas. Our recent growth direction is not inwards, and is not aligned with centrality.

Centrality and a vital central business district can drive transit use.

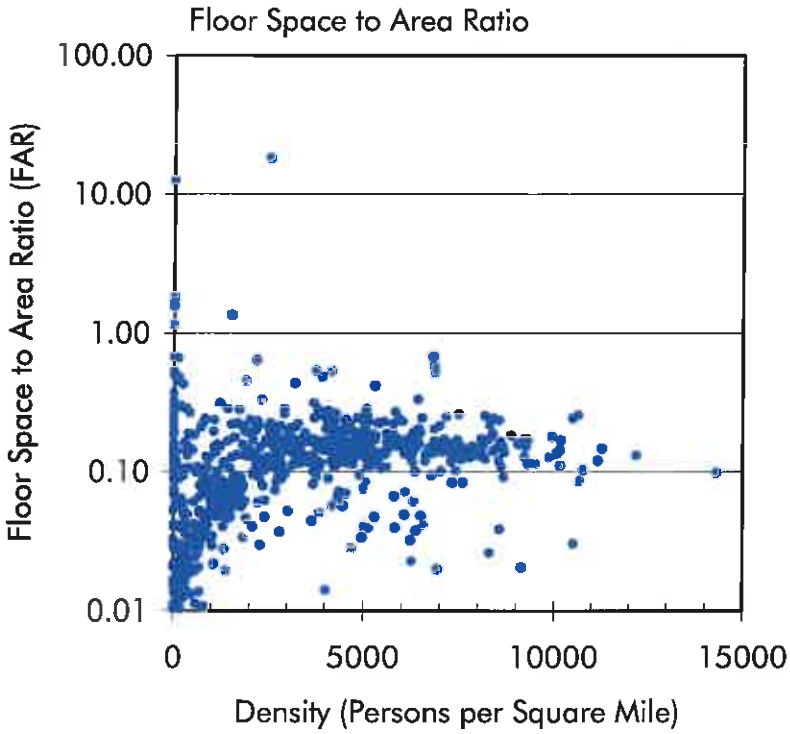


2.3.5 Benchmarking Floor Space to Area Ratio (FAR)

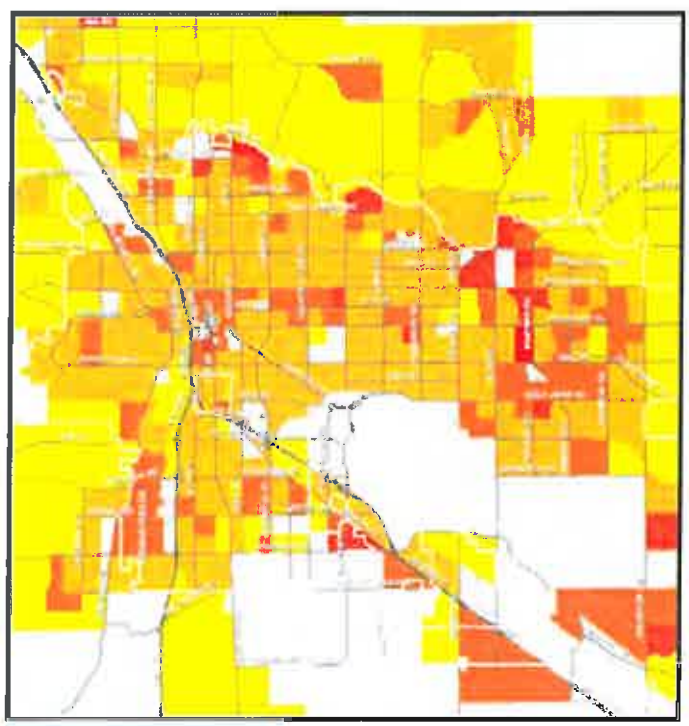
Section 2.3.2 introduced the importance of FAR in defining walkable urban spaces; it has other consequences as a metric. Tradtional economic models of monocentric cities predict that FAR, density, and land costs all become smaller with increasing distance from a central business district. Many municipalities use maximum FAR regulations to control density at its highest levels. Our community does not necessarily follow that trend, as our central FAR statistics are relatively low.

Figure 16 displays the distribution of FAR across the eastern Pima County TAZ dataset. Only four percent of the 809 TAZ areas have an aggregate residential and commercial FAR in excess of 0.4.

Figure 16: FAR Distribution across Pima County TAZ Database



Should our community use minimum FAR regulations to manage density efficiencies?



Mapped to the left is the variation of residential FAR in the central core. Portions of more distant activity centers and suburbs in Oro Valley and Rancho Sahuarita also have TAZ FAR of between 0.3 and 0.5. The FAR pattern is discontinuous and non-uniform in its gradient away from downtown.

Residential FAR

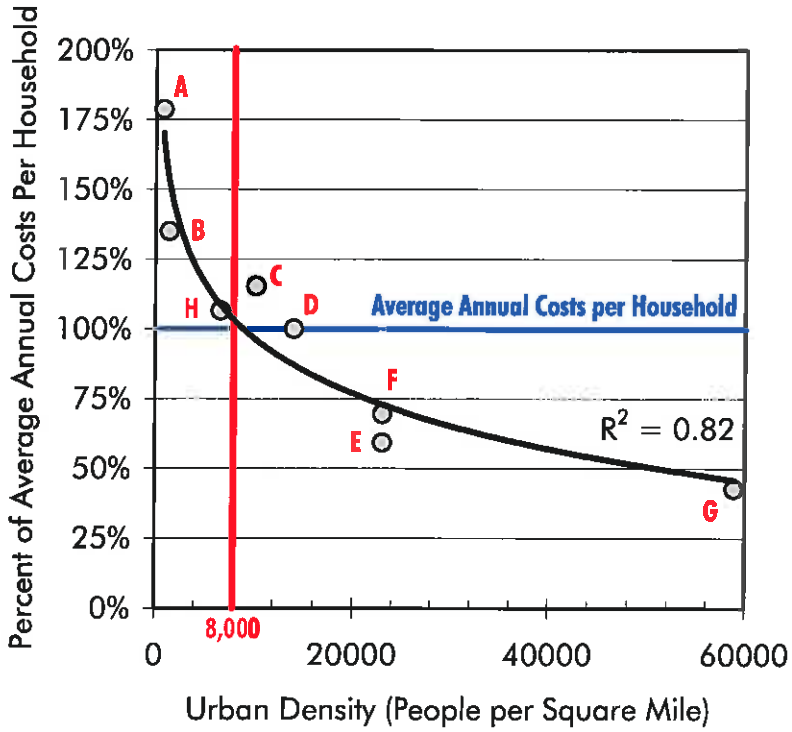
- 0.01 - 0.09
- 0.10 - 0.18
- 0.19 - 0.27
- 0.28 - 0.49
- 0.50 - 0.95

2.3.6 Benchmarking Infrastructure and Service Costs

Many studies have linked urban form factors and their direct impacts on costs and affordability. Several of these are listed in the bibliography. One of the most comprehensive studies completed recently by the Halifax Regional Municipality (population 370,000) examined the costs per household for the eight settlement patterns shown to the left with their corresponding net residences per acre statistics. The costs examined were comprehensive: roads, transit, solid waste, stormwater, libraries, parks and recreation, police, fire, culture, governance, costs paid to higher levels of government, school bussing, and either private or public water and wastewater servicing depending on the settlement pattern. The study considers both the operational and capital replacement costs required for each service.

Figure 17 displays the reduced costs per household for the settlement patterns with higher population densities. The largest cost savings are realized as densities increase to 8,000 people per square mile. Beyond this point it requires larger density increases to achieve similar savings.

Figure 17: Costs per Household for Eight Settlement Patterns with Increasing Density



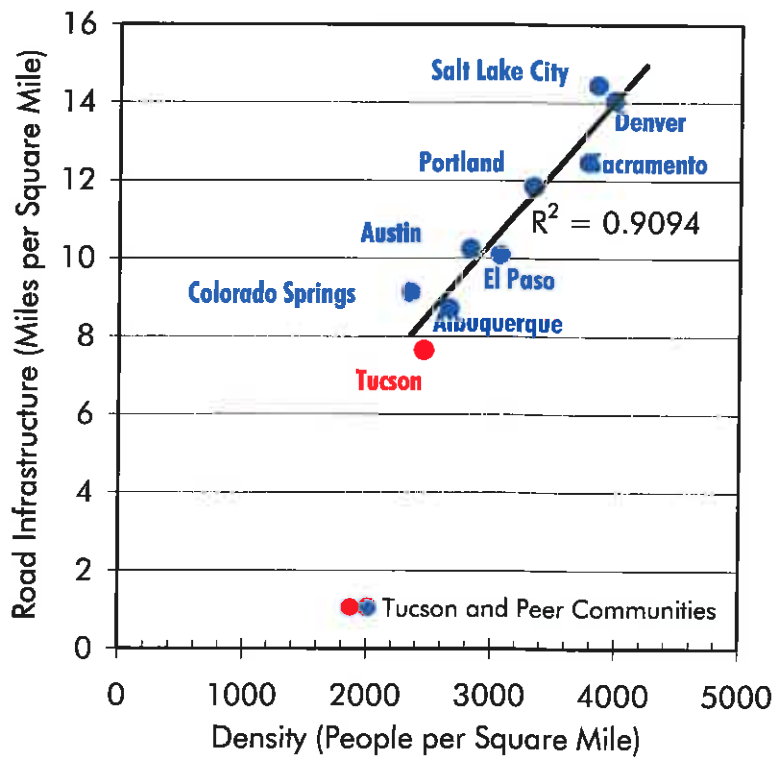
The other studies examined confirm these general results. They also highlight the cost and affordability impacts of increasing development dispersion and a lack of centrality. **Our density is low on this scale.**

Page 47 Data Source and Graphic Credit: Halifax Regional Municipality

North American municipalities invest heavily in transportation and other infrastructure networks, although not as much in the recent past. From 1950 to 1970, the United States devoted 3 percent of its gross domestic product (GDP) to infrastructure spending. Since 1980, spending on infrastructure has been cut by a third, to just 2 percent of GDP. This drop in funding has served to greatly increase the importance of efficient urban form, design, and land use planning decisions.

Figure 18 highlights how our community currently has the lowest density of road infrastructure among the peer communities. It also depicts a trend of higher road densities with increasing population density.

Figure 18: Road Network Density of Peer Communities



These statistics are valid at a city or county scale, and are made up of varying mixes of interstate highways and freeways and expressways, principal and minor arterials, collector roads, and local roads.

Figure 19 highlights the benefit of peer community benchmarking. A relatively unique characteristic of our community has been identified. Going forward, our planning decisions will strengthen or weaken this uniqueness on the basis of our answers to a simple question:

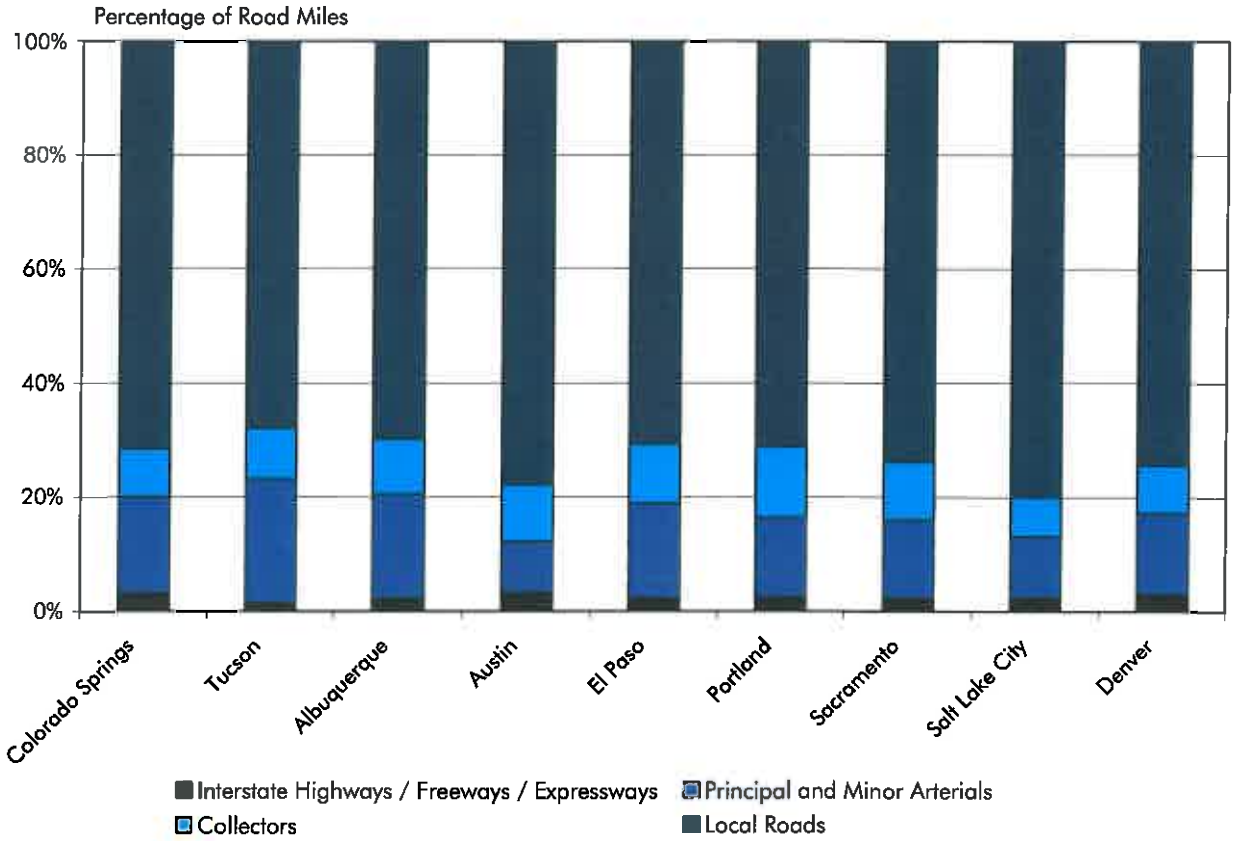
Over time, will Tucson build more roads – or include other modes?

Later investigations provided additional context for Figure 18; see Figure 20 on page 50.

Figure 19 outlines the breakdown of the peer community road network data. Our community has the smallest percentage of interstate highways and freeways and expressways, roughly less than half of the equivalent percentage share in Colorado Springs, Austin, and Denver. Conversely, our community has the greatest percentage of principal and minor arterials – more than twice the share found in Austin and Salt Lake City.

Figure 19: Peer Community Road Network Structure

Page 48 and 49 Data Source: U.S. Department of Transportation, Federal Highway Administration, Highway Statistics, 2000

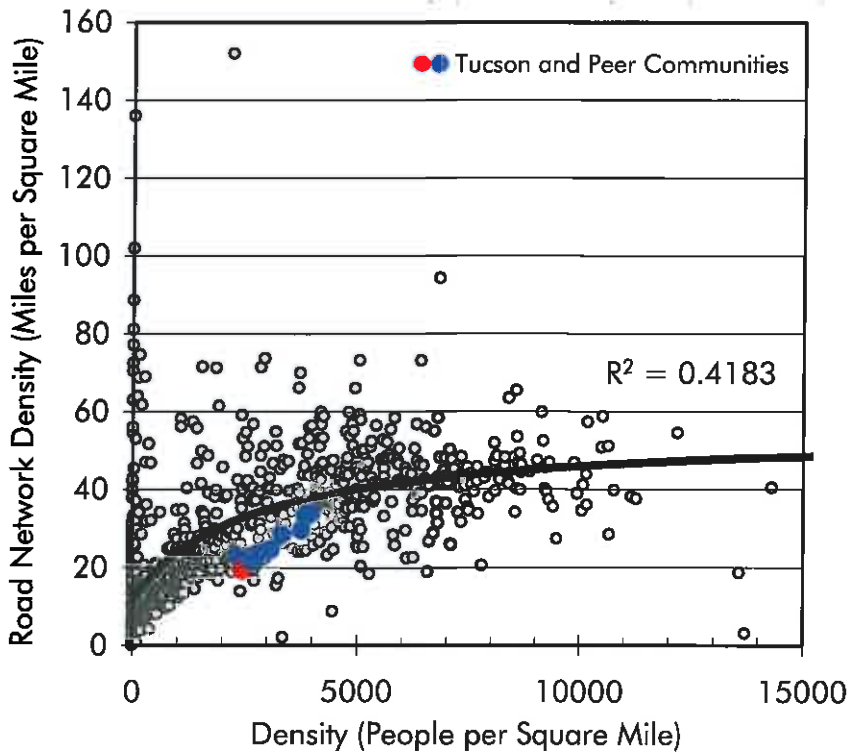


Although local roads are the great majority of the overall network, Tucson and Pima County have the smallest percentage of local roads – a full ten percent less than Austin and Salt Lake City. When its roadway infrastructure compared to the peer communities, Tucson is similar to Albuquerque in its makeup – and distinct from Austin and Salt Lake City.

The above road hierarchy is traditionally concerned with a range of mobility and access functions. However, each class of roadway can also be closely tied to place functions: regions, cities and districts, neighborhoods, and housing. As a result, road infrastructure should be judged as much for its ability to serve unique types of places as much as for capacity and traffic flows.

At the TAZ level, more perspective is gained. Figure 20 displays this data, while switching from units of miles of roadway per square mile to the more complete currency of lane-miles of roadway per square mile.

Figure 20: Road Network Density at the Community and TAZ Levels



The community-level average data from Figure 19 was roughly converted to lane-miles (by assuming typical lane counts for each class of roadway) and is displayed with blue and red circle symbols on Figure 21. The trend from Figure 19 now is given relevance in terms of the more granular TAZ trend between road network density and population density. Increasing population density does require more road infrastructure, however once population density has increased past at least 3,000 (and even more so 5,000) people per square mile, less additional roadway is required for greater density. It is interesting to note that some of the TAZ's with the most lane-miles of roadway support the lowest population densities.

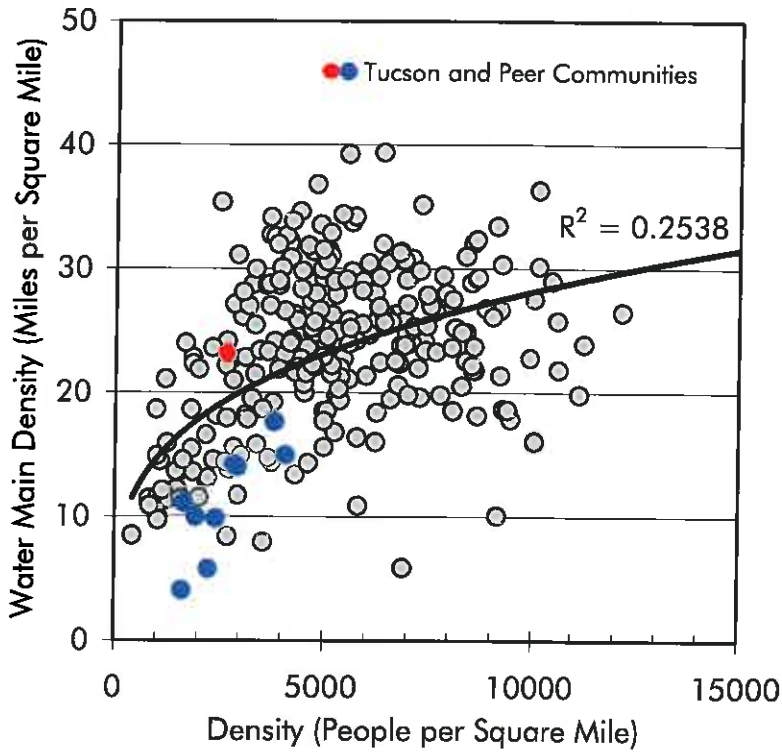
For purposes of comparison recall that 5,000 people per square mile is equivalent to 3.3 residences per acre – nearly twice our average today.

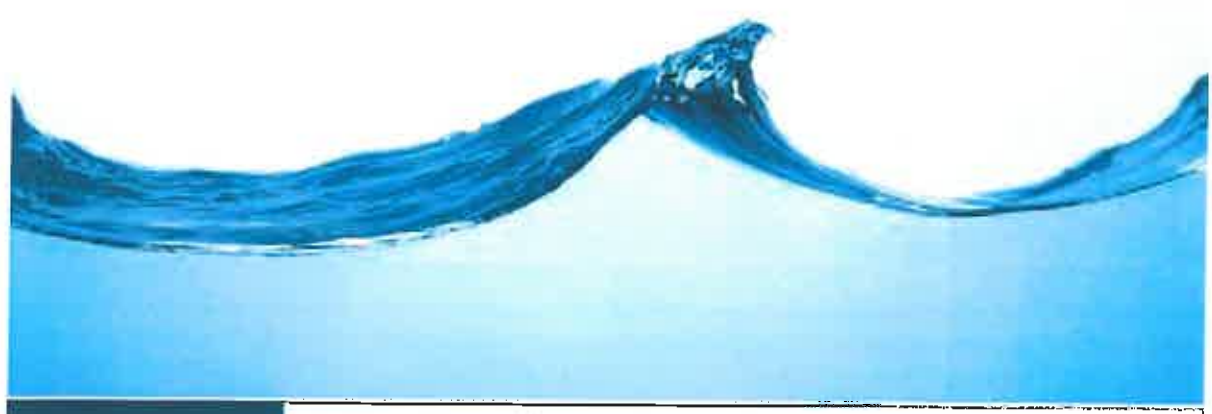
In conjunction with the earlier example of Figure 7, where population density was seen to have a dramatic impact on the use of automobiles, this result emphasizes the impact of urban form factors on infrastructure.

The Tucson Water network has a significantly higher water main network density compared to the peer communities, as shown by blue and red circular symbols on Figure 21. When the potable water transmission and distribution network TAZ data (in gray) is examined for trends with respect to population density, there is less of a correlation and an apparent relative benefit with increasing numbers of people per square mile. Only those TAZ located completely within the Tucson Water service area are graphed.

Community infrastructure assets must be right-sized and operated and maintained effectively

Figure 21: Water Main Network Density at the Community and TAZ Levels



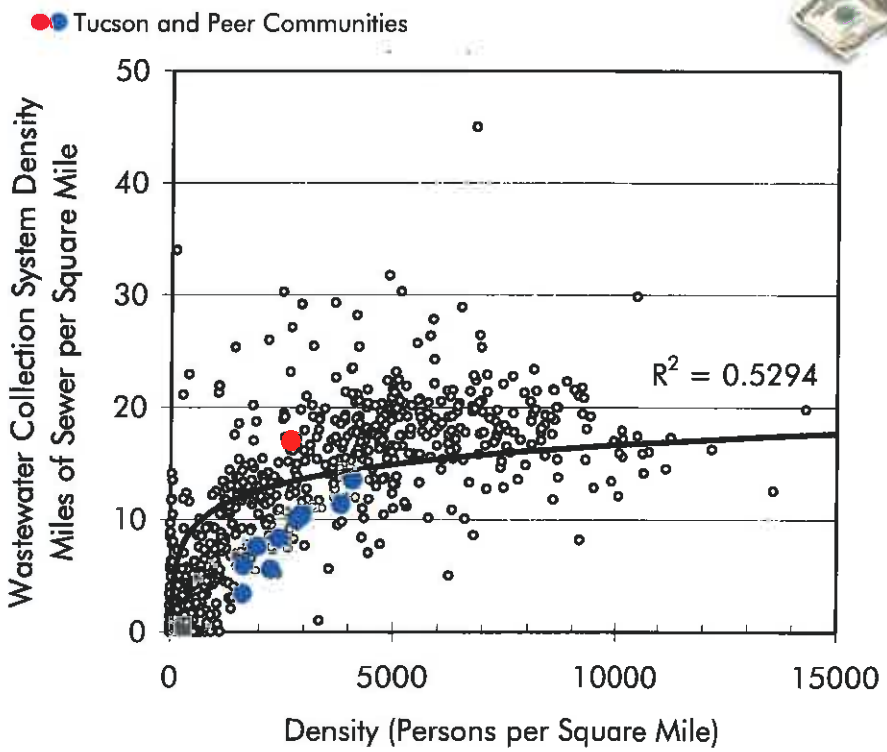


The Pima County Regional Wastewater Reclamation Department sanitary sewer network has a higher collection system density compared to the peer communities, as shown by blue and red circular symbols on Figure 22. The wastewater collection and conveyance network TAZ data (in gray) was examined for trends with respect to population density. There is an apparent benefit with increasing numbers of people per square mile, particularly when densities increase over 5,000 people per square mile.

Higher densities implies higher infrastructure efficiencies; and result in lower costs for the customers

Similar to its water system, Tucson has the highest wastewater collection system density of the identified peer communities. Many factors likely contribute to this status, and further examination of network efficiencies may be warranted.

Figure 22: Wastewater Collection System Network Density at the Peer Community and TAZ Levels



2.3.7 Benchmarking Resource Consumption

In addition to the raw resources consumed by the construction of the infrastructure systems discussed above, other resources are notably consumed by growth and influenced by urban form.

Water consumption is clearly influenced by population density as shown in Figure 23. The denser the community, the less water it uses.

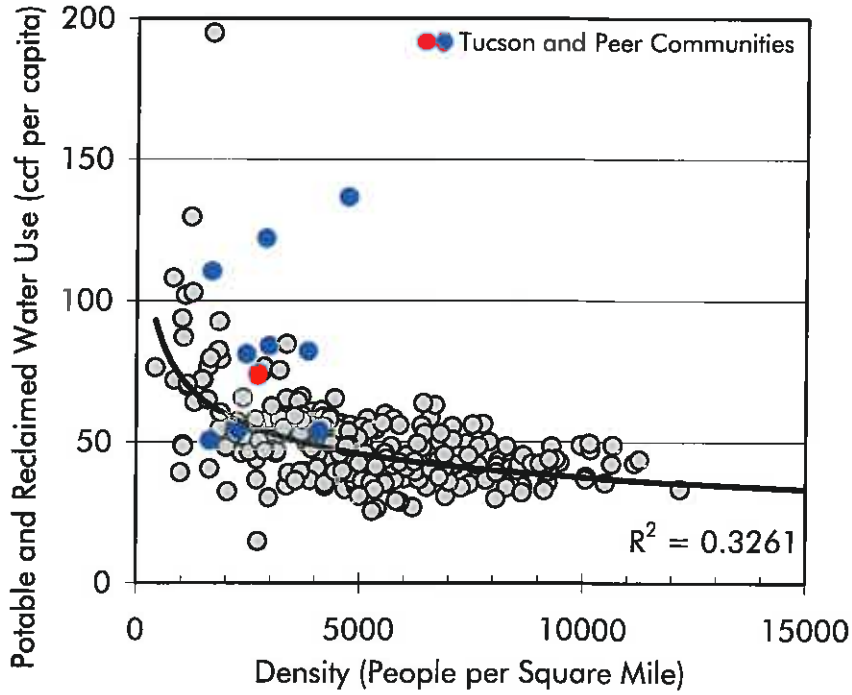


Figure 23: Water Consumption Data at the Community and TAZ Levels (Tucson Water 2005 Data)

This per capita demand reduction with size phenomenon is also evident on Figure 24, which shows the peer community utility sizes and per capita water consumptions statistics.

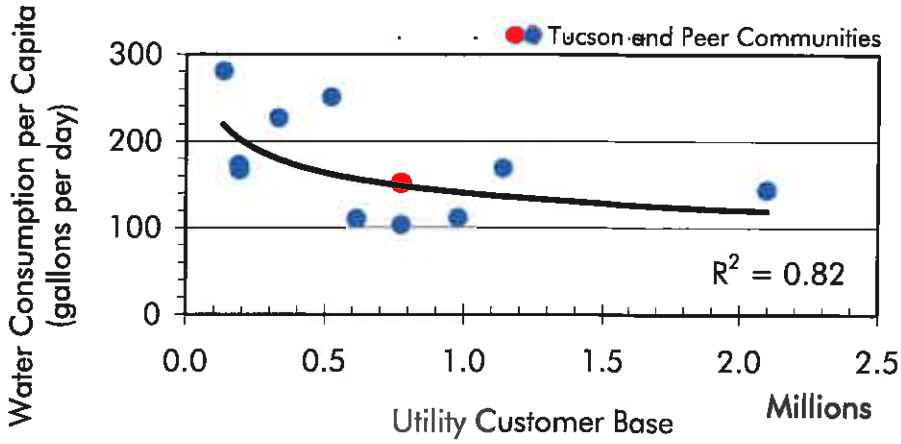
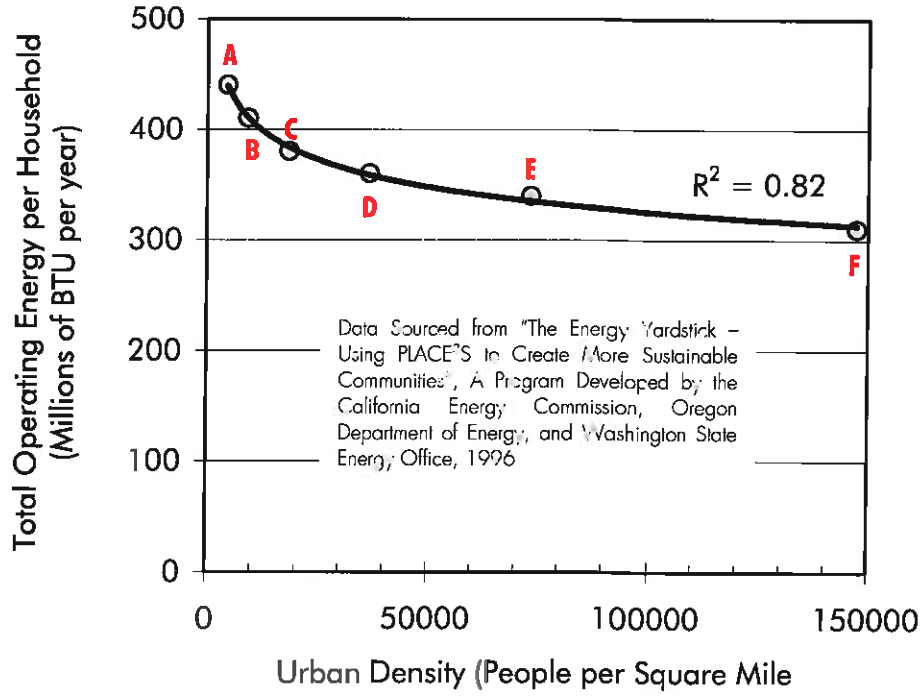


Figure 24: Per Capita Water Consumption and Utility Customer Size Relationship

Residential density has a direct impact on energy consumption. Figure 25 displays the total operating energy for six forms of development with increasing population densities. Table 9 defines the six urban forms.

Figure 25: Urban Form Factors and Total Operating Energy per Household



The energy shown in Figure 26 includes building, travel, and community fractions. Strong energy savings accrue from increasing densities up through 20,000 people per square mile, where diminishing returns start.

Table 9: Urban Form Definitions for Figure 25 and 26 Households; See Page 56 for Photographic Depictions of Similar Densities

Urban Form	Residences Per Acre	Defining Characteristics
A	3	Auto dependent, single family subdivision on 10,000 square foot lot
B	6	Detached housing on 5,000 square foot lot, commuter transit service
C	12	Townhouse on 2,500 square foot lot, high level of transit to employment
D	24	Low-rise apartments, walking and transit trips equal to auto use
E	48	Energy-saving mid-rise apartments, transit/pedestrian trips exceed auto use
F	96	Efficient high-rise apartments with very high transit and pedestrian activity

It is not just the urban form factor of population density that impacts residential energy use. Other influencing factors were documented in a recent study *"The Impact of Urban Form on U.S. Residential Energy Use"* authored in 2008 by Reid Ewing and Fang Rong of the University of Maryland and Milken Institute. Key findings from the regression modeling in this paper and its accompanying literature review include:

- Compared with households living in multi-family units, otherwise comparable households living in single family detached units consume 54% more energy for space heating and 26% more energy for space cooling.
- Compared with a household living in a 1,000 square foot house, an otherwise comparable household living in a 2,000 square foot house consumes 16% more energy for space heating and 13% more energy for space cooling.
- The average household would consume 18 million few BTU's of primary energy annually (about twenty percent less) by living in a compact county than in a sprawling county.

For the last of the above findings, levels of compactness and urban sprawl were defined using an index computed from factors such as gross population density, percentage of population living at low and moderate or high suburban densities (less than 1,500 or more than 12,500 people per square mile), average block size, and percentage of blocks with areas less than 1/100 of a square mile – the size of a typical traditional urban block.

3.1 RAC
4,800 P/mi²
Phoenix, AZ

6.0 RAC
9,200 P/mi²
Tucson, AZ

12.7 RAC
19,500 P/mi²
Sun City, AZ

23.3 RAC
35,800 P/mi²
Salt Lake City, UT

44.0 RAC
67,600 P/mi²
Oakland, CA

96.1 RAC
147,600 P/mi²
Seattle, WA

2.3.8 Benchmarking Greenhouse Gases

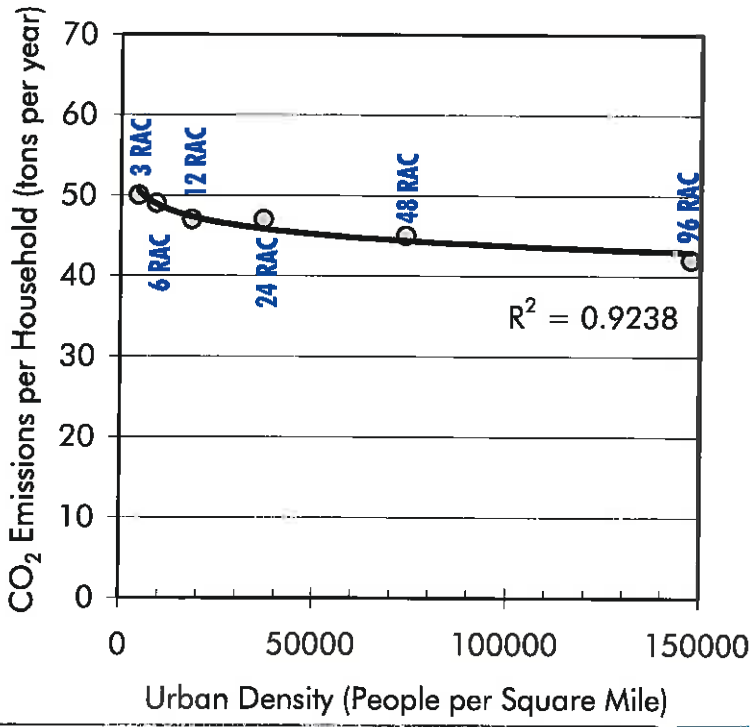
The urban forms described earlier and pictured to the left also have a correlation with greenhouse gas production. Figure 26 builds upon the same assumptions from Table 9 on page 54 and input data that created Figure 25. It displays the equivalent CO_2 emissions for each urban form. The gains in reducing CO_2 emissions are less than the energy savings gains shown on the preceding page but still significant.

The Center for Neighborhood Technology (CNT) has examined the CO_2 emissions per household from **household auto use** for the White Paper study area. Their results indicate that the lowest density portions of our community generate more than 9.5 tons of CO_2 per year. Conversely, the highest density portions of our community generate 3.6 to 5.6 tons of CO_2 per year.

Page 56 Graphic Credits: Excerpt from Visualizing Density by Julie Campoli and Alex S. MacLean. © 2007 by the Lincoln Institute of Land Policy, Julie Campoli, and Alex S. MacLean.

Aerial photographs © 2007 Alex S. MacLean.

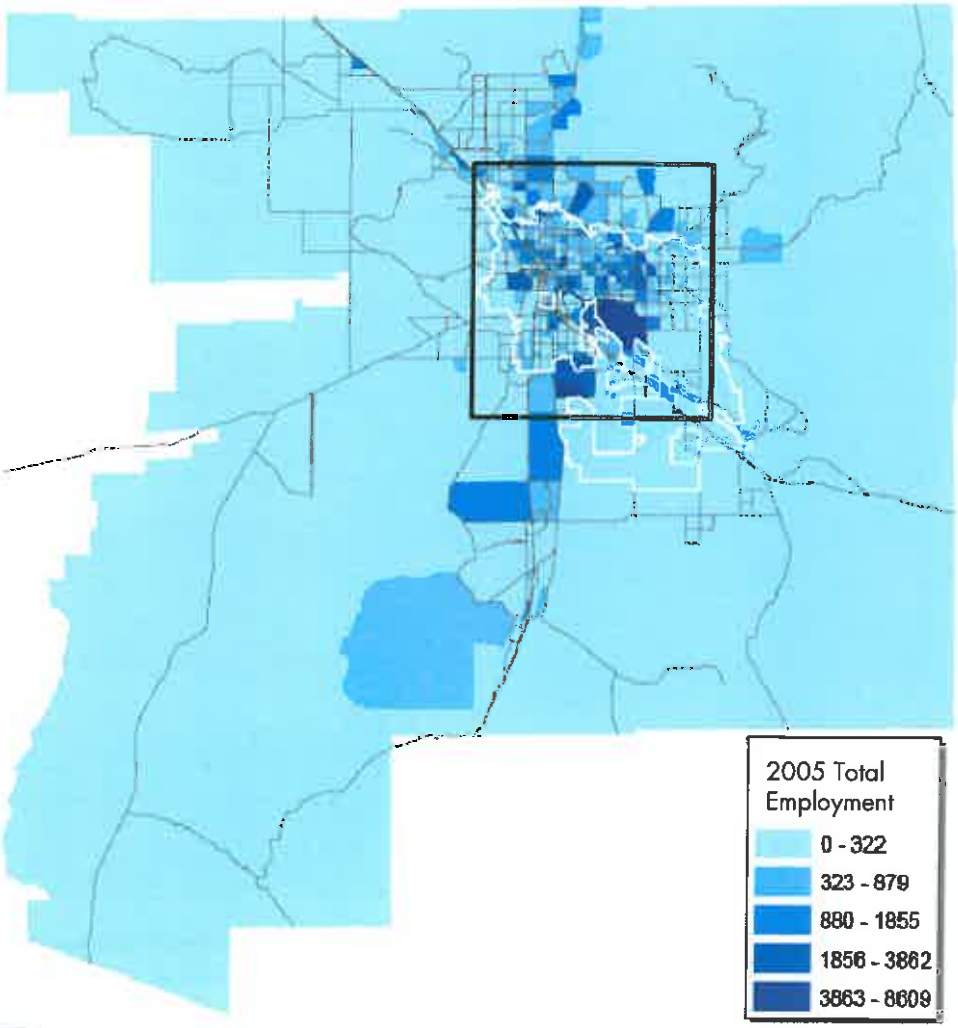
Figure 26: Urban Density and CO_2 Emissions per Household



Employment Density Plays a Large Role in Deciding Urban Form, With Transportation and Parking Issues

2.3.9 Benchmarking Employment Density and Innovation

In terms of innovation, it is employment density that drives opportunity. In their 2006 paper "*Urban Density and the Rate of Invention*", Gerald Carlino, Satyajit Chatterjee, and Robert Hunt of the Federal Reserve Bank of Philadelphia document this effect. They found that a city with twice the employment density (jobs per square mile) of another city will exhibit a 20 percent higher patent intensity (patents per capita). They suggest that patent intensity is maximized at an employment density of about 2,200 jobs per square mile. This effect is strongest at a population of about 750,000 people, with diminishing returns at higher employment densities and populations. Currently our metropolitan community has an approximate average employment density between 1,400 and 1,600 jobs per square mile. This is very similar to the average employment densities of the 280 metropolitan areas studied, and illustrates a future opportunity to rise above the average. Additional compact mixed use land use designations will help accomplish this.



2.3.10 Benchmarking Land Consumption

A recent study of rural land loss in fifteen US cities contains very useful data that helps inform the choices our community faces. The 2004 paper *"The Portland Exception: A Comparison of Sprawl, Smart Growth, and Rural Land Loss in 15 US Cities"* authored by Northwest Environment Watch provided data for Figure 27. Five of the cities are from the group of peer communities chosen for this White Paper.

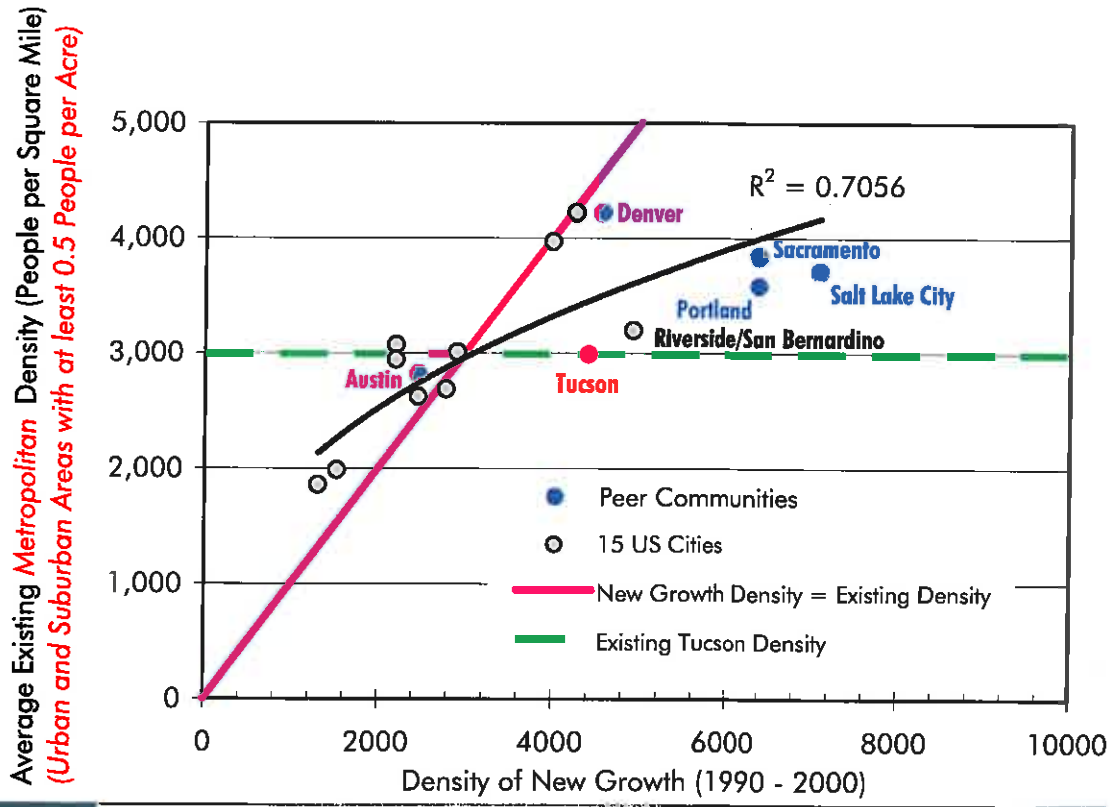
While many communities are creating new growth at their historical or even lower densities (i.e. along or to the left of the red line), Tucson and others are limiting rural land losses and adding to their communities at much higher densities than their existing average densities.

New growth densities in Salt Lake City, Portland, and Sacramento are about 80% higher than their existing average metropolitan densities. With an average existing metropolitan density of 2,991 people per square mile, we have many choices for our density of new growth.

Where will we land on this graph ten and twenty years from now? It will be somewhere along the green horizontal line given our existing density, and there are clear benefits to being further to the right of the red Status Quo line and red existing situation.

Clearly, our trends do not have to be equal to our destiny.

Figure 27: Density of New Growth Compared to Average Existing Metropolitan Densities in Fifteen US Cities



2.4 Summary of Best and Emerging Practice Benchmarking

This section of the White Paper has demonstrated many examples of apparent causal pathways and relationships that depart from urban form factors. Urban form is important, as we have learned in general that:

- A variety of growth factors has led our community growth to the suburbs; from 2000 to 2008 almost 80% of building activity occurred outside the urban core and core suburbs.
- We have grown out, not up – as more than 95% of the Pima County TAZ areas have an aggregate residential and commercial FAR less than 0.4.
- Our combination of population size and density is not unique, and there are many cities that have grown larger at both similar and higher densities.
- Building at higher densities and with efficient designs boosts the economy by saving time and money in many areas, and lowers taxation requirements.

- Density, land use mix, and design create choices.
  - Tucson now has a low density road network.

Specifically, the benchmarking curves have identified potential thresholds to grow towards with respect to population density, including:

- Increasing density to at least 6,000 people or more per square mile should greatly reduce annual car passenger miles per capita.
  - Densities greater than 3,000 people per square mile require fewer incremental lane-miles of roadway.
  - Densities greater than 5,000 people per square mile require fewer incremental miles of sanitary sewer per square mile.
  - Dense communities consume less water, particularly those over a density of 3,000 people per square mile.
  - Higher urban densities reduce energy and material consumption and lower greenhouse gas emissions.

Just as numerous are the alternate pathways forward in terms of growth, urban form, and the cost of infrastructure.

SECTION 3 – FUTURE GROWTH LOCATIONS AND SCENARIOS

Throughout the investigative and development process for this White Paper, the most widely discussed topic was which growth scenarios should be investigated during the modeling portion of the project. The project team, made up of several members of the City and County staff, was keen to see the various possibilities for Tucson's future if a few urban form factors were adjusted.

For each scenario, most of the factors and constraints remained the same as the baseline Status Quo scenario. This highlighted the impact of changing a small set of key individual variables.

The model building and GIS data collection and analysis tasks were completed by the County and City GIS departments, lead by Mike List and Josh Pope respectively. The inputs, direction, and vision for the status quo and alternative scenarios were provided by the entire team.

"Remember that all models are wrong... but some are useful." – George E. P. Box

It is noted that the modeling process is built upon many inherent assumptions and yields its best accuracy at higher levels of consideration. Its results should not be dissected and used independently at the detailed parcel, block, or even neighborhood levels of analysis.

It is also noted that other unanticipated changes will certainly occur over time within the various regional jurisdictions, such as annexations. This does not invalidate the model process or results, but calls attention to the fact that ongoing regional visioning and cooperation is paramount.

3.1 Modeling Growth Area Scenarios

Table 10 on page 61 lists the included factors used to develop the status quo scenario, while Table 1 in Section 1.1.4 (see page 14) provides a list of the assumed absolute development constraints for growth area suitability modeling.

These factors were weighted using a matched pair comparison; each factor was scored as being minimally, moderately, or significantly preferred to the other factors in terms of impact on urban form.

These weights were recalculated as shown in Table 10 after one of the original twelve factors could not be factored into the growth area suitability model due to incompatible project timelines. This combined housing and transportation affordability index could easily be introduced as a factor in future scenarios.

Table 10: Growth Area Suitability Factors and Weights – Status Quo Scenario

Status Quo Scenario Growth Area Suitability Model Factors	Relative Weighting
Proximity to Existing and Committed Road Infrastructure	14.9 %
Proximity to Existing and Committed Transit Services	0.0 %
Proximity to Existing and Committed Wastewater Infrastructure	9.0 %
Proximity to Existing and Committed Water Infrastructure	13.4 %
Proximity to "Top 100" Employment Centers	2.2 %
Proximity to Locations of 2002-2007 Building Permits and Sales	19.5 %
Proximity to Current Built Environment	6.0 %
Proximity to Trailheads and Municipal Parks	0.7 %
Proximity to Obligated Service Area of Designated Water Providers	16.4 %
Quality of School District	8.2 %
Stress Index	9.7 %

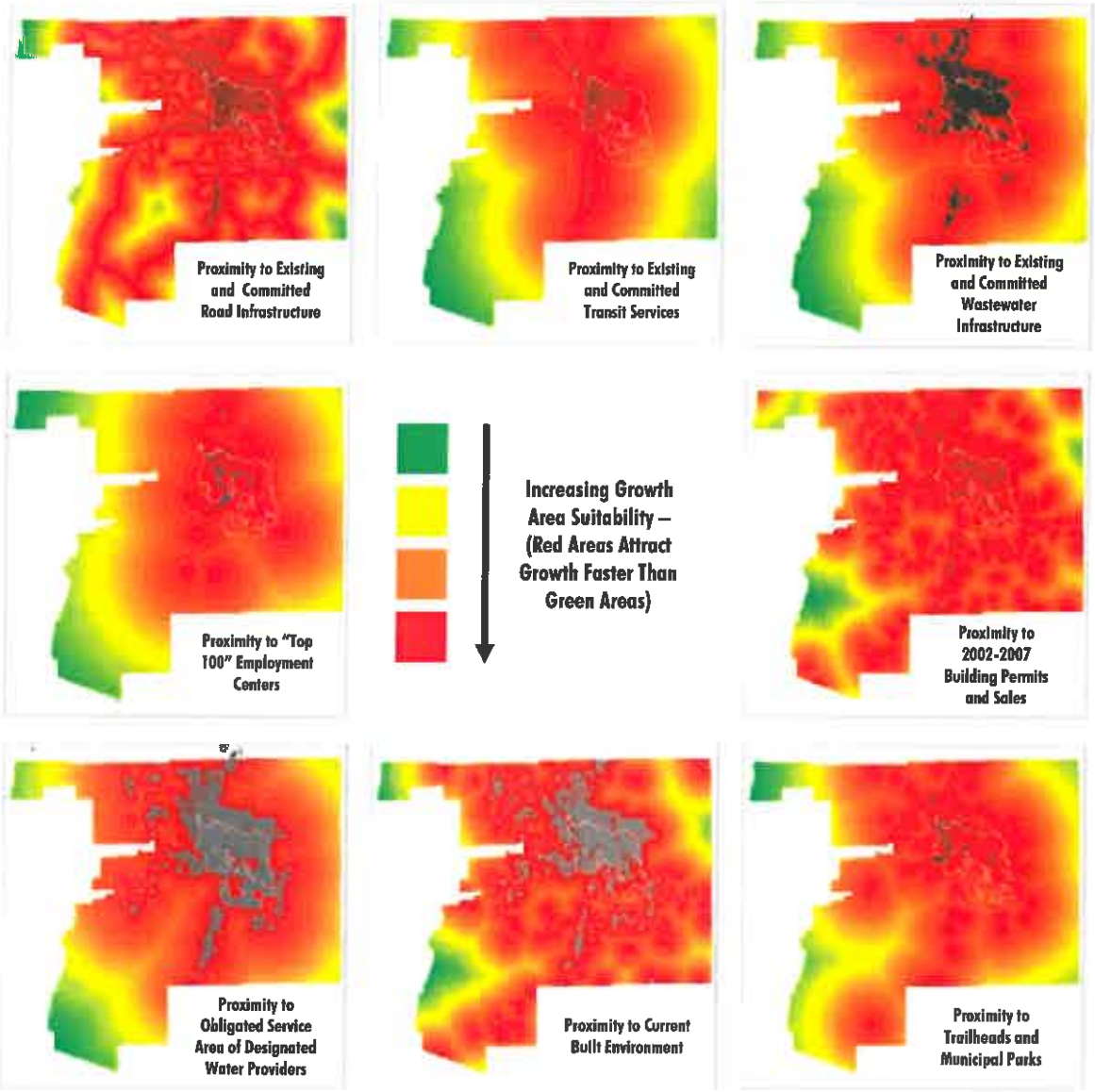
The "Stress Index" is a composite indicator previously developed by Pima County. It reflects local levels of family and housing conditions indicating dependency and need related to economic status, shelter costs and conditions, and social dependencies such as old age and disability. See http://www.dot.pima.gov/gis/data/layers/stress00/

The "Proximity to 2002-2007 Building Permits and Sales" factor was used as a viable surrogate for consumer and land developer preference.

The graphics in Figure 28 below depict eight of the eleven component factor maps that were mathematically summed to create the growth area suitability surface as defined across the grid cell landscape. For a given factor, red colored areas have the highest suitability for growth. Conversely, green colors have the lowest suitability for growth. Yellow and orange colors are moderately unsuited and suited for growth, respectively.

The inputs in Figure 28 were used for the status quo scenario.

Figure 28: Growth Area Suitability Factor Maps for the Initial Status Quo Scenario



Using the summation of the eleven factors listed in Table 10 on page 61, the land absorption mapping was completed for the scenarios. First, population projections were assigned on a status quo percentage basis to four defined planning sub-regions that make up our community. These populations were then translated into the amount of land to be absorbed into the built environment using the density assumed by the scenario. The four planning sub-regions are depicted in Figure 29. Their delineation was influenced by elements of the City of Tucson's General Plan and advice from Pima County planning staff regarding the dynamics of exurban settlement. Their recent trends in terms of land absorption share are contained in Table 11 on page 64. These trends were used to establish an approximate share of the modeled Status Quo growth.

Note that the suburbs definition includes lands defined as "planned but un-built or partially built communities". These planned but un-built or partially built areas have received some type of development approval. They range from the totally un-built (such as the lands addressed by the Houghton Area Master Plan) to those that are planned but partially built.

Figure 29: Map of Defined Planning Sub-Regions

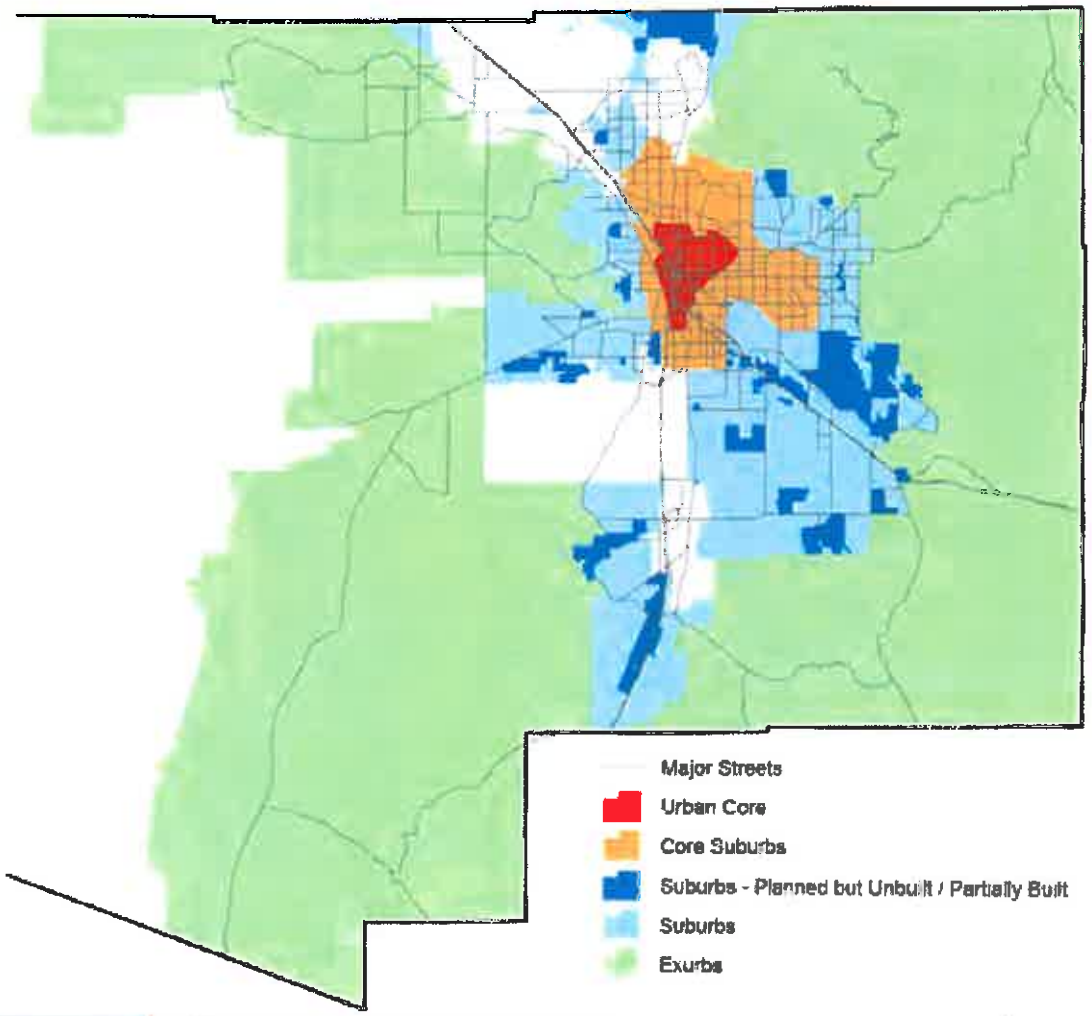


Table 11: Planning Sub-Region Trends and Modeling Rules for "Status Quo" Scenario

Planning Sub-Region	Residential Building Permits ('00-'08)	Percent of Total	Modeled Growth Share Rule
Urban Core	2,797	3.9%	5.0%
Core Suburbs	12,713	17.7%	15.0%
Suburbs	52,382	73.0%	75.0%
Exurbs	3,840	5.4%	5.0%
Totals	**71,732**	**100.0%**	**100.0%**

This acreage was then translated into an equivalent number of grid cells. The grid cells (not already eliminated from consideration by the absolute development constraints listed in Table 1 on page 14) with the highest suitability scores were iteratively chosen until the population projection was satisfied. Up to 90% of the projected growth in the suburbs was allocated to the planned but un-built or partially built communities, an absorption process that continued until that sub-region was fully developed. Vacant land was always absorbed first; if insufficient vacant land was available, the Table 11 allocations were still made but not specifically geo-referenced in the GIS model. These unmapped allocations were tracked with a separate database for later analysis.

Tucson's Urban Core at Night

This model served as the foundation for the four growth scenarios that were constructed and analyzed in relation to the extensive benchmarking that was completed.

3.1.1 Scenario #1: Status Quo

What if our community did not change the way it is growing now? For a speculative view from this one potential future, you are encouraged to read Appendix B – "A Tale of Four Cities".

"The status quo is the only solution that cannot be vetoed." – Clark Kerr

Just because we can change does not necessarily mean we must. As a starting point for our future analyses, we developed a base scenario that reflected the status quo condition to answer the questions: What would the land form look like if we held current average densities, and how much land area would be consumed by the projected population growth? The fact is that not choosing is still a choice to be investigated.

As mentioned in previous sections, weighted factors were used to direct land absorption as population growth was applied to the model. These factors, combined with several general rules of how the land was to be made available controlled where the population was actually placed on the ground.

One of the defining rules involved how the Pima County Conservation Lands System (CLS) was to be modeled in the scenario. For the status quo model, exurban growth outside of subdivided areas (or areas of lot split activity) could not absorb more than one third of the Multiple Use Management areas as defined by the CLS. While it follows the precepts of the CLS ordinance, this rule actually did not come into play, as the land limit that this constraint imposed was well beyond the actual amount of land absorbed by the new population.

The County (and City for annexations) is currently implementing the Conservation Lands System guidelines during land use changes. The County adopted the CLS map and guidelines in 2001 to:

(1) Identify where the most important lands in Pima County are for conservation, versus the most suitable lands for development.

(2) Establish conservation set-aside guidelines that apply development within the important conservation areas.

(3) Guide County investments in public infrastructure (such as roads, sewers, and libraries) to areas most suitable for development.

The CLS was not included as a major factor or constraint in Status Quo model. CLS conservation set-aside guidelines only apply to development that requires a discretionary action of the Board of Supervisors, such as a rezoning approval.

A significant amount of development was planned prior to the adoption of the CLS. The CLS can impact the location and configuration of future planned development. However, it is difficult to estimate how much

development will occur via land use change and as planned versus unplanned development, and therefore how much future development would be impacted by the CLS. The City of Tucson has also adopted the CLS to apply during annexations and to incorporate during the upcoming General Plan update. However, similarly to the County's implementation, it is difficult to determine which future development areas will be annexed or subject to the CLS. As a result, the CLS was not included as a major factor or constraint in the Status Quo model even though it is understood it will likely have an impact on both location and intensity of growth.

The status quo model also allocated population to the four major areas being studied using a specific set of land absorption rules, based on the permit and sales activity in the region for the past several years:

- The Urban Core was assigned 5% of the incoming population, at a density of 4,500 people/square mile.
- Core Suburbs were assigned 15% of the incoming population, at a density of 4,000 people/square mile.
- Suburbs were assigned 75% of the incoming population, at a density of 2,500 people/square mile.
- Exurbs were assigned 5% of the incoming population, at a density of 500 to 2,500 people/square mile, dependent upon current zoning classifications.

Table 12 contains a breakdown of the existing urban form by population, area, and population density. The growth suitability modeling built forward from this situation.

Table 12: Existing Urban Form Statistics (2009)

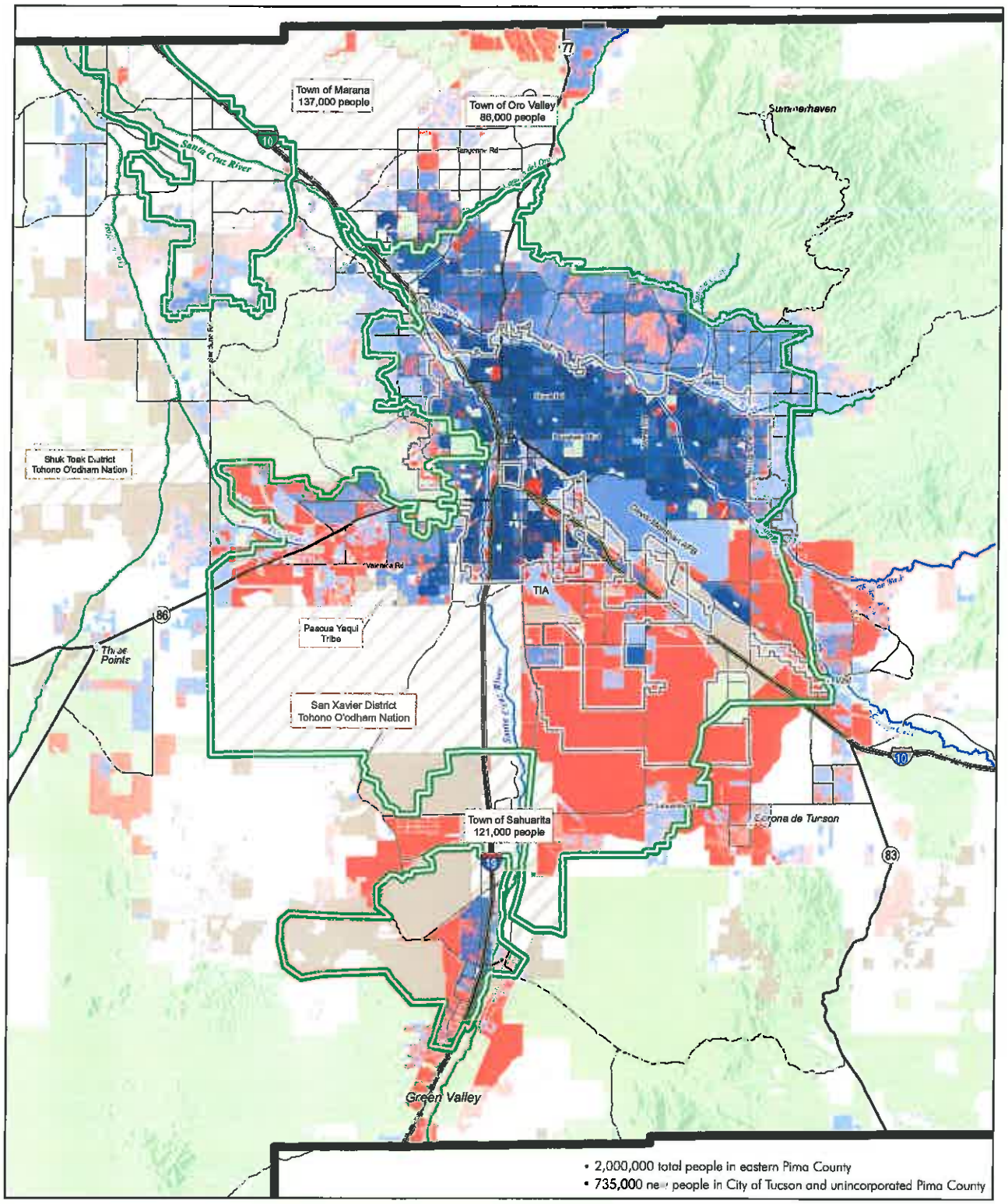
Defined Growth Area	Existing Population	Existing Area (Square Miles)	Density (People per Square Mile)
Urban Core	128,724	23.09	5,575
Core Suburbs	340,456	73.36	4,641
Suburbs	422,751	189.78	2,228
Exurbs	28,067	49.89	563
Totals	**919,998**	**336.12**	**n/a**

Figure 30 on page 68 illustrates the results of the status quo analysis. The project land mass absorption indicates that a large amount of available vacant land space will be consumed in and around the built environment, which nearly doubles in size. A majority of the simulated growth occurs in the south, southwest and southeast sectors.

This growth is not just within the City of Tucson and unincorporated Pima County, but also in the Town of Oro Valley, the Town of Sahuarita, and the Town of Marana (recall that they are being "grown" per their respective Arizona Department of Economic Security population forecasts). Table 13 displays these growth assumptions that were held constant for all scenarios.

Table 13: Estimated Current & Forecast Populations for the Towns of Marana, Oro Valley, and Sahuarita

Municipality	Estimated Current Population	Forecast Future Population
Town of Marana	36,000	137,000
Town of Oro Valley	42,000	86,000
Town of Sahuarita	28,000	121,000



PEOPLE / SQUARE MILE

Current		Projected
	0 - 500	
	501 - 1500	
	1501 - 3000	
	3001 - 5000	
	5001 - 8000	
	> 8000	

City of Tucson Boundary

Area Excluded from Simulation
(with total population projected by AZ Dept. of Economic Security)

Park or Natural Preserve

Development Constraint

Conservation Lands System Boundary
(area inside green and white line is outside CLS)

N

0 5 Miles

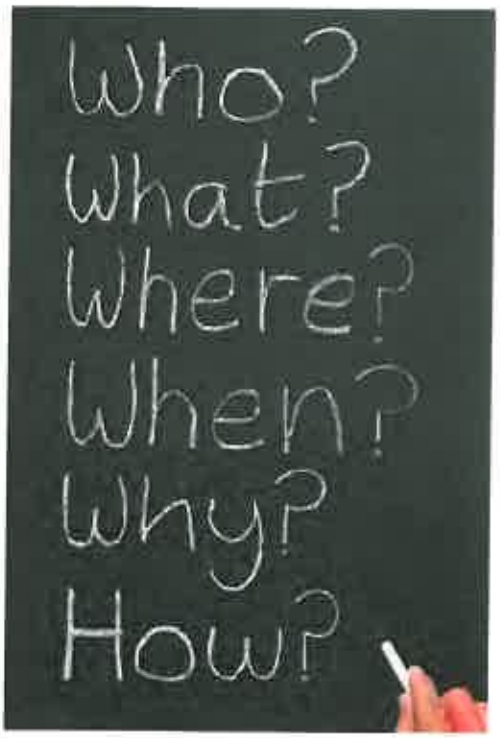
Figure 30. Scenario #1: Status Quo

3.2 Alternate Futures

Based upon their deliberations, the White Paper team held the items in Table 14 to be Top Ten considerations in developing alternate futures:

Table 14: Top Ten Considerations for Alternate Future Scenarios

Top Ten Considerations in Developing Other Choices for the Future
Benefits to existing residents
Location of growth
Density of growth
Advantages of growth
Costs of growth
Natural Environment
Quality of Life
Choice and diversity
Opportunity and equity
Community efficiency



The alternate future scenarios were built from the status quo model assumptions and weighted factors. Additional rules and alternate weightings were also applied to direct the focus of the model towards a specific goal as defined by the team. In reality, we will all have a say.

3.2.1 Scenario #2: Enhanced Habitat Protection

What if our growth patterns emphasized enhanced habitat protection? For a speculative view from this alternate future, you are encouraged to read Appendix B – "A Tale of Four Cities".

Tucson and Pima County contain lands that are rich in biological diversity, species diversification, and habitat significance. The creation of the Conservation Lands System highlights the region's commitment to preservation of these valuable resources. Given that habitat preservation is sometimes in conflict with the need to absorb incoming populations, this scenario was constructed to examine the issue.

In addition to the base assumptions that were instilled with the status quo model, this growth scenario applied some additional or modified rules to emphasize habitat protection goals. They included the following:

- The CLS categories of Biological Core, Important Riparian, and Multiple Use Areas were treated as absolute constraints to development, with the exception of planned but un-built or partially built communities, which forced suburban growth to occur at a higher density.
- Expanding suburbs were absorbed at 3,600 people per square mile, as opposed to the 2,500 used in the status quo model.

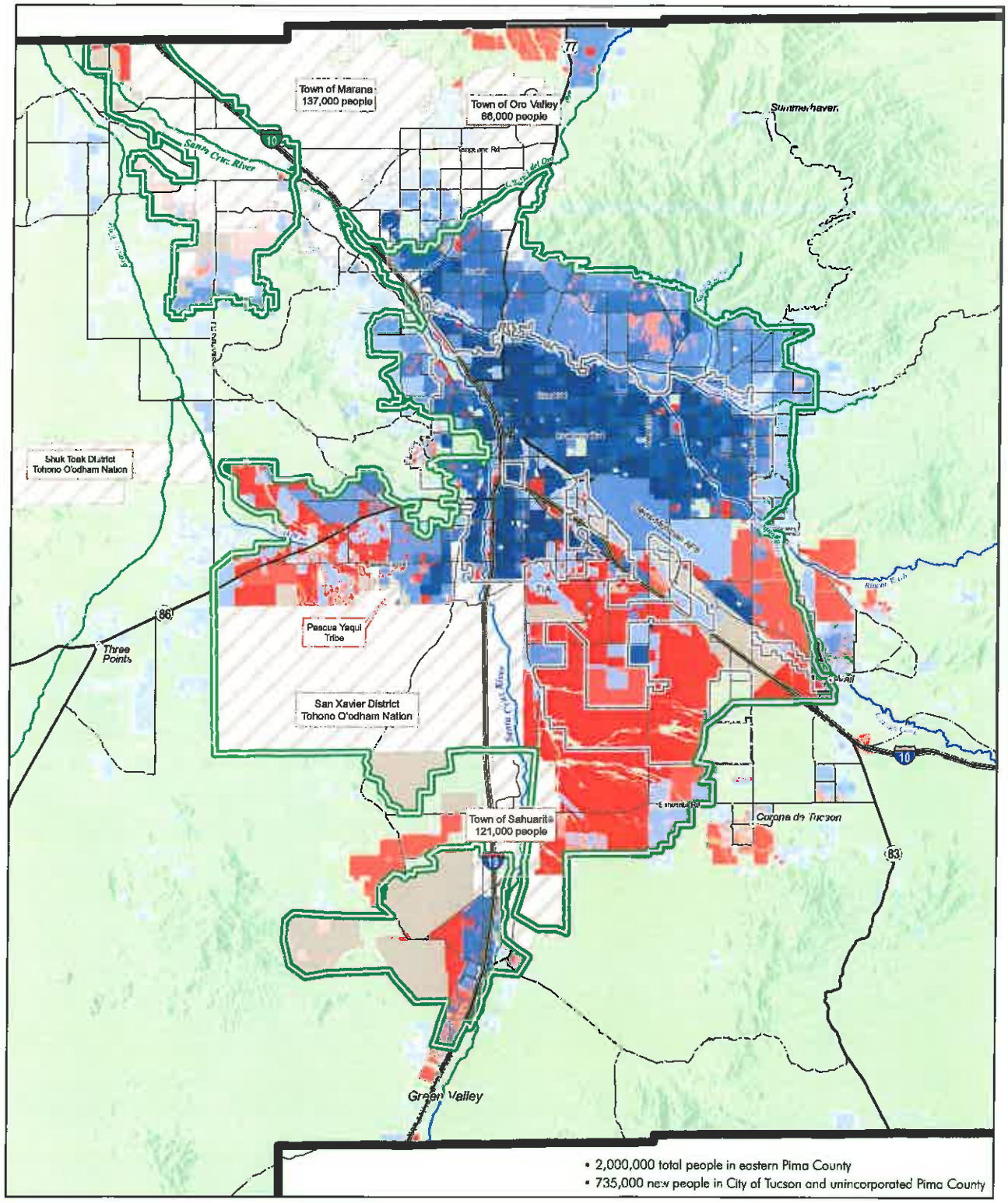
This assumes that either:

(1) All future development (excluding planned but un-built or partially built communities) voluntarily occurs outside of the CLS. One tool the County has to encourage this is the voluntary Transfer of Development Rights program.

(2) All of the CLS that is not yet conserved is purchased by the City, County, other conservation organizations, or developers seeking mitigation lands (excluding planned but un-built or partially built communities).

(3) City and County are able to develop some additional implementation enforcement, without a change in State or Federal law, which prevents development in these areas.

Figure 31 on page 71 illustrates the results of the enhanced habitat protection scenario analysis. These additional constraints resulted in the land base being exhausted. To accommodate the intended population, the expanding suburbs were settled at a density of 3,600 people per square mile. This shows that enhanced habitat protection and urban growth are not incompatible; one does not have to occur at the expense of the other. This is a key point in the County's Sonoran Desert Conservation Plan.



PEOPLE / SQUARE MILE

Current	Projected
0 - 500	
501 - 1500	
1501 - 3000	
3001 - 5000	
5001 - 8000	
> 8000	

City of Tucson Boundary

Area Excluded from Simulation
(with total population projected by AZ Dept. of Economic Security)

Park or Natural Preserve

Development Constraint

Conservation Lands System Boundary
(area inside green and white line is outside CLS)

N

0 5 Miles

Figure 31. Scenario #2: Enhanced Habitat Protection

3.2.2 Scenario #3: Infrastructure Efficient/Taxpayer Savings

What if our urban growth patterns emphasized increased density in order to yield infrastructure efficiencies and taxpayer savings? For a speculative view from this alternate future, you are encouraged to read Appendix B – "A Tale of Four Cities".

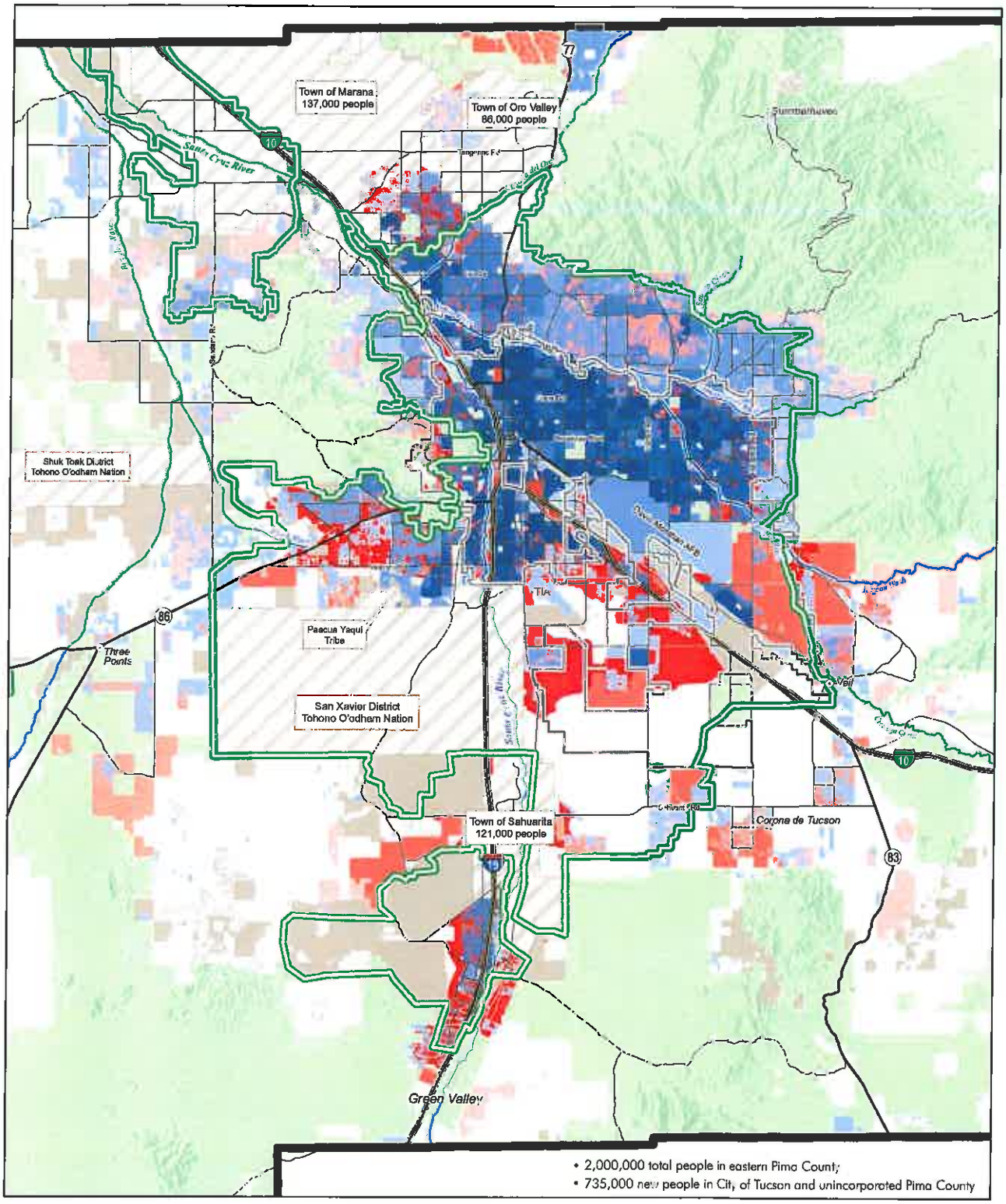
A number of the benchmarking activities outlined earlier in Section 2 indicate that there can be meaningful efficiencies in the establishment of water, wastewater, transportation, and other infrastructure for higher population densities. With infrastructure costs continuing to rise, and capital and maintenance funds potentially limited, the effect of maximizing infrastructure efficiency was investigated. One significant end result of this scenario would be taxpayer savings.

Once again, the base assumptions and constraints that were established in the status quo model were held. In additional, the following rules were applied:

- Suburbs, outside of the planned but un-built or partially built communities and the low-density suburb developments in the Catalina and Tucson Mountain foothills, were settled at a density of 8,000 people/square mile, as opposed to the 2,500 used in status quo.
- Encroachment into the Biological Core and Important Riparian Areas of the CLS was assumed to incur off-site mitigation, but the location of that mitigation was not precisely determined. Note that the remaining (unabsorbed) land base within these two categories was sufficient to accommodate this mitigation.
- Growth locations were restricted to those contiguous pieces of land greater than 5 acres in size.

Figure 32 on page 73 illustrates the results of the infrastructure efficient/taxpayer savings scenario analysis. With these changes, we start to see less land consumed in suburban growth, with a defined attraction towards the core of the city.

In hindsight, the message from this scenario's model would have been more powerful if an additional rule had been created to increase the density of suburban development within the planned but un-built or partially built communities. Relatively speaking, more square miles of land should have been developed at 8,000 people per square mile. This would have achieved the **average area densities** related to the desired infrastructure efficiencies and taxpayer savings, and provided a better picture of the impact of this scenario.



PEOPLE / SQUARE MILE

Current	Projected
0 - 500	
501 - 1500	
1501 - 3000	
3001 - 5000	
5001 - 8000	
> 8000	

City of Tucson Boundary

Area Excluded from Simulation
(with total population projected by AZ Dept. of Economic Security)

Park or Natural Preserve

Development Constraint

Conservation Lands System Boundary
(area inside green and white line is outside CLS)

N

0 5 Miles

Figure 32. Scenario #3: Infrastructure Efficient/Taxpayer Savings

3.2.3 Scenario #4: Transit Oriented Development

What if our urban growth patterns were oriented to enhance mass transit? For a speculative view from this alternate future, you are encouraged to read Appendix B – "A Tale of Four Cities".

The Tucson Modern Streetcar initiative and potential light rail transit, bus rapid transit, and eventual commuter rail options highlight another option for growth: transit oriented development (TOD). In transit-oriented communities, substantial growth occurs along the transit lines and in the vicinity of the passenger stations. For the transit oriented development growth scenario, the following rules were applied:

- Re-development was assumed to occur along significant transit corridors. This included light rail lines, bus routes, and future commuter rail lines. With multiple transit options possible for the future, priority was placed on those deemed more likely in the nearer term than longer term endeavors. Locations of high capacity transit were derived from PAG study documentation and related City of Tucson Modern Streetcar documentation.
- Encroachment on the Biological Core and Important Riparian Areas of the CLS was assumed to incur off-site mitigation, but the location of that mitigation was not precisely determined. The remaining (unabsorbed) land base within these two categories was sufficient to accommodate this mitigation.
- The density rules held in the status quo model were eliminated for the most part. The only rule that remained governed how the exurb areas were populated.

The rankings of transit alternatives were as follows:

- 1st – Population was placed along the Modern Streetcar alignment in a swath one city block wide on each side of the line, with a density of 11,000 people per square mile; Streetcar stations were given emphasis, with a ¼ mile-radius sphere of influence. Density placed within this radius was applied at a rate of 23,000 people per square mile.
- 2nd – Bus Rapid Transit and Light Rail Transit lines were added, again using a swath width of one city block on each side of the alignment, and 11,000 people per square mile density; stations were handled in a similar manner, with a ¼ mile radius, and a density of 23,000 people per square mile within that radius.
- 3rd – Existing and future bus lines were added, and population was placed along the lines at a density of 11,000 people per square mile.

- 4th – Planned commuter rail lines, with a density of 23,000 people per square mile along those lines, were added.

Figure 33 on page 77 illustrates the results of the transit oriented development scenario analysis. The results show heavy infill and redevelopment in the urban core and core suburbs of the city, and reflect the lowest levels of land absorption across the various scenarios. This scenario would be highly effective at increasing the density aspects of Tucson's urban form.

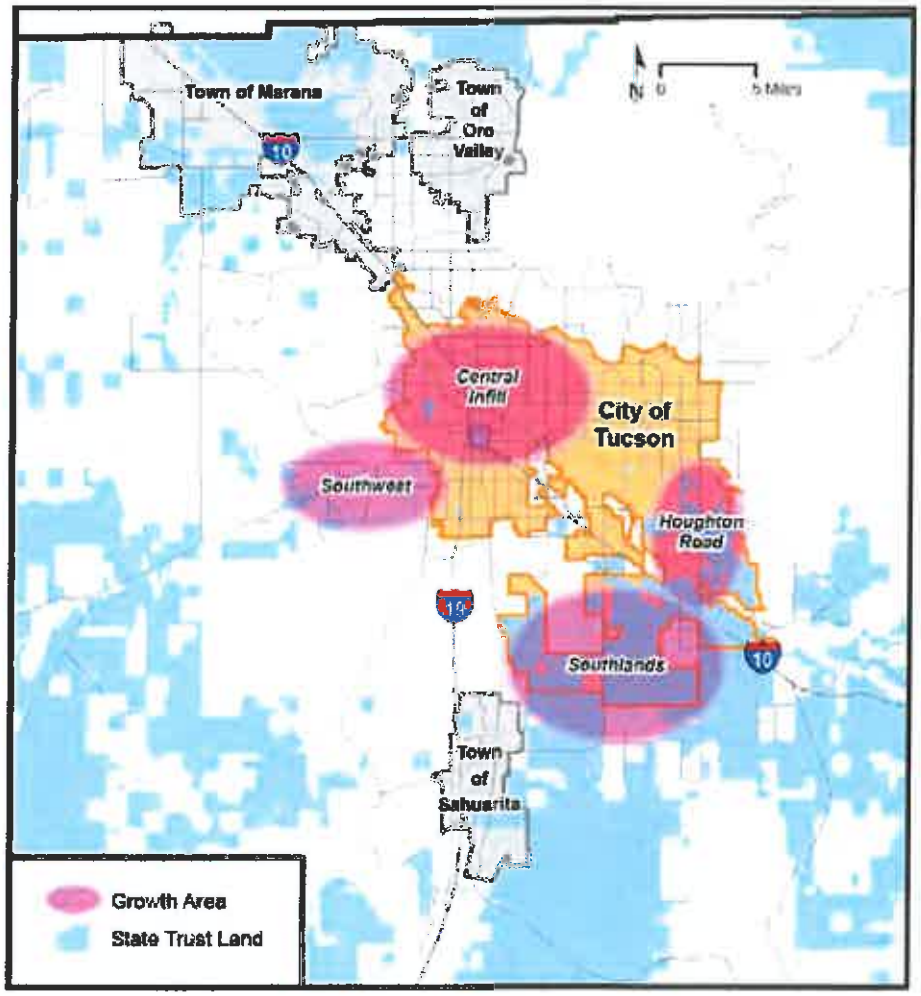
3.2.4 Identification of Growth Areas

The graphical scenario results documented in Figures 30 through 33 indicate that growth within the City of Tucson metropolitan boundary will likely occur in some combination of four significant growth areas:

- Infill development throughout the current built environment.
- Houghton Road corridor.
- Southlands area.
- Southwest area.

Figure 34 indicates the general location of these growth areas.

Figure 34: Future Recommended Growth Areas



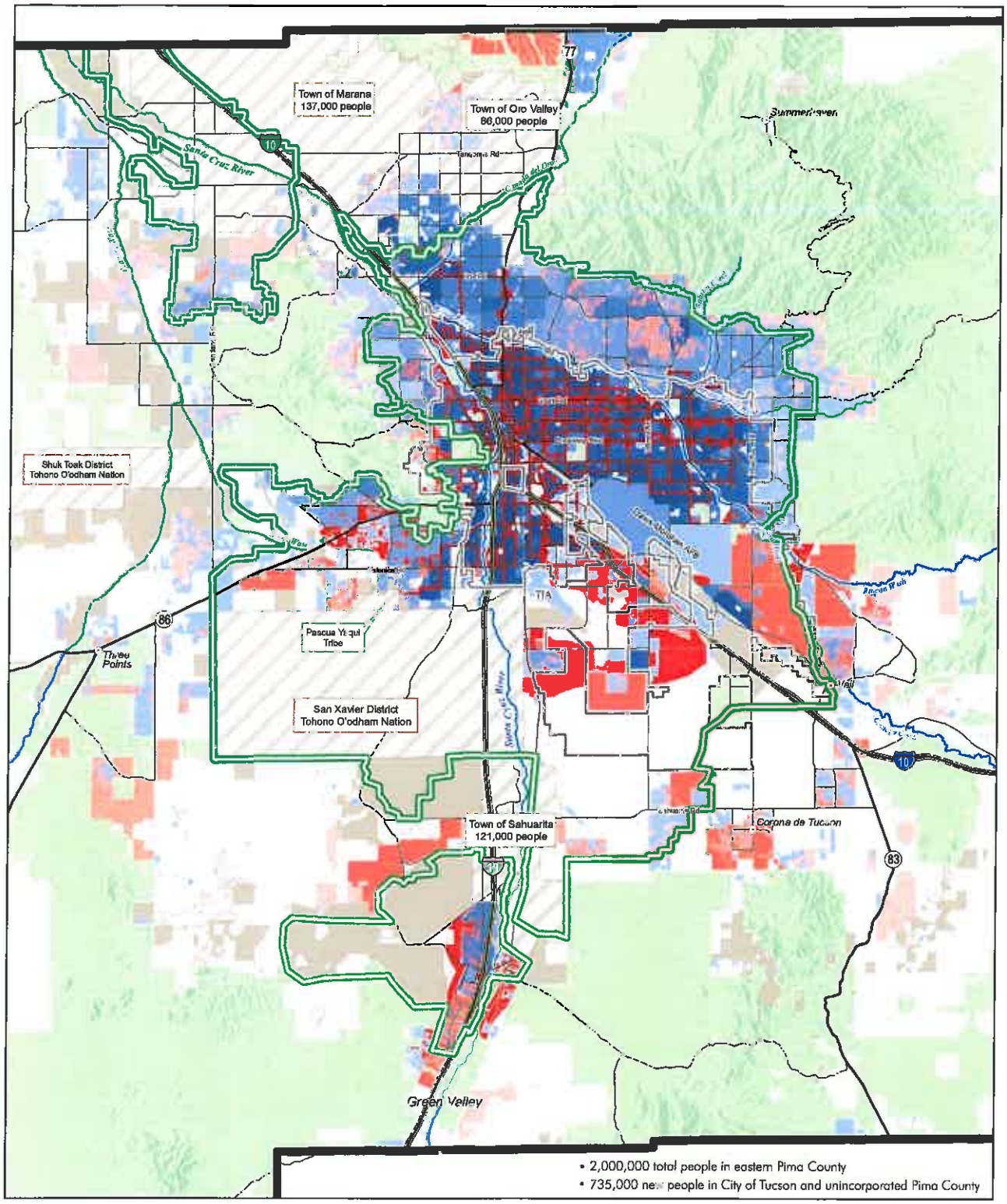


Figure 33. Scenario #4: Transit Oriented Development

3.3 Quantitative Comparisons of Alternate Futures

Visual comparison of the resultant scenario maps reveals many differences between the alternate futures. Figure 35 below captures the quantitative nature of two key output variables. The colored columns indicate the total populated land area by planning sub-region in each scenario. The status quo model has nearly double the urbanized land of the current built environment. **Every other subsequent scenario creates less suburban land**. The urban core and core suburbs are fairly static.

The status quo modeling rules result in a slightly lower density than the current built environment – a drop of six percent. Densities then increased in the final three models. The transit oriented development model created an average density 17% greater than the status quo, with average densities for the enhanced habitat protection and infrastructure efficient/taxpayer savings scenario being in between the two.

Increasing the average density of our community will require a strong will and clear intentions; these four scenarios have increased overall average population densities, but not to the optimal extents envisioned.

Combined rules from the four scenarios should now be modeled.

Figure 35: Total Land Area and Population Densities Compared to Current Built Environment

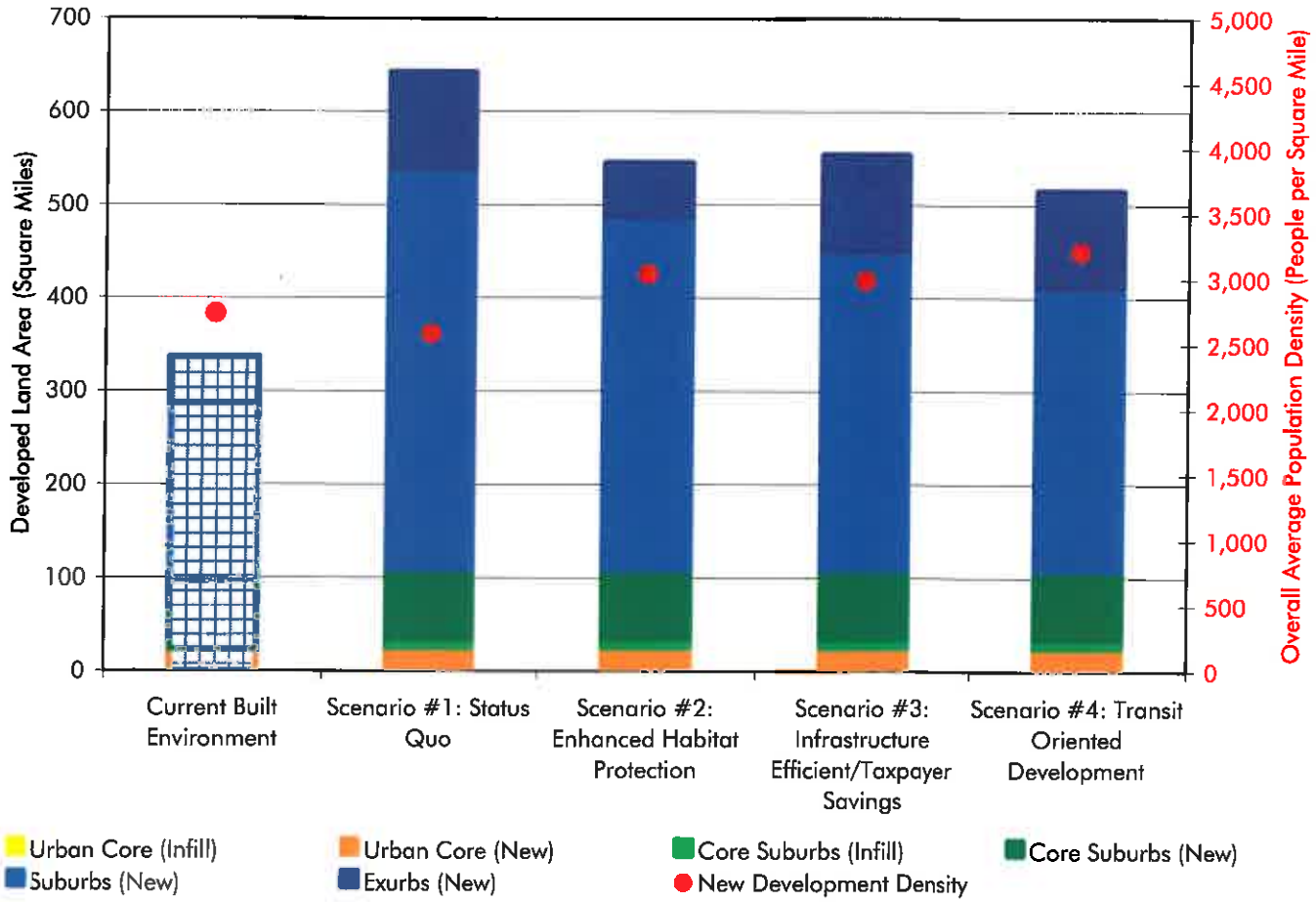
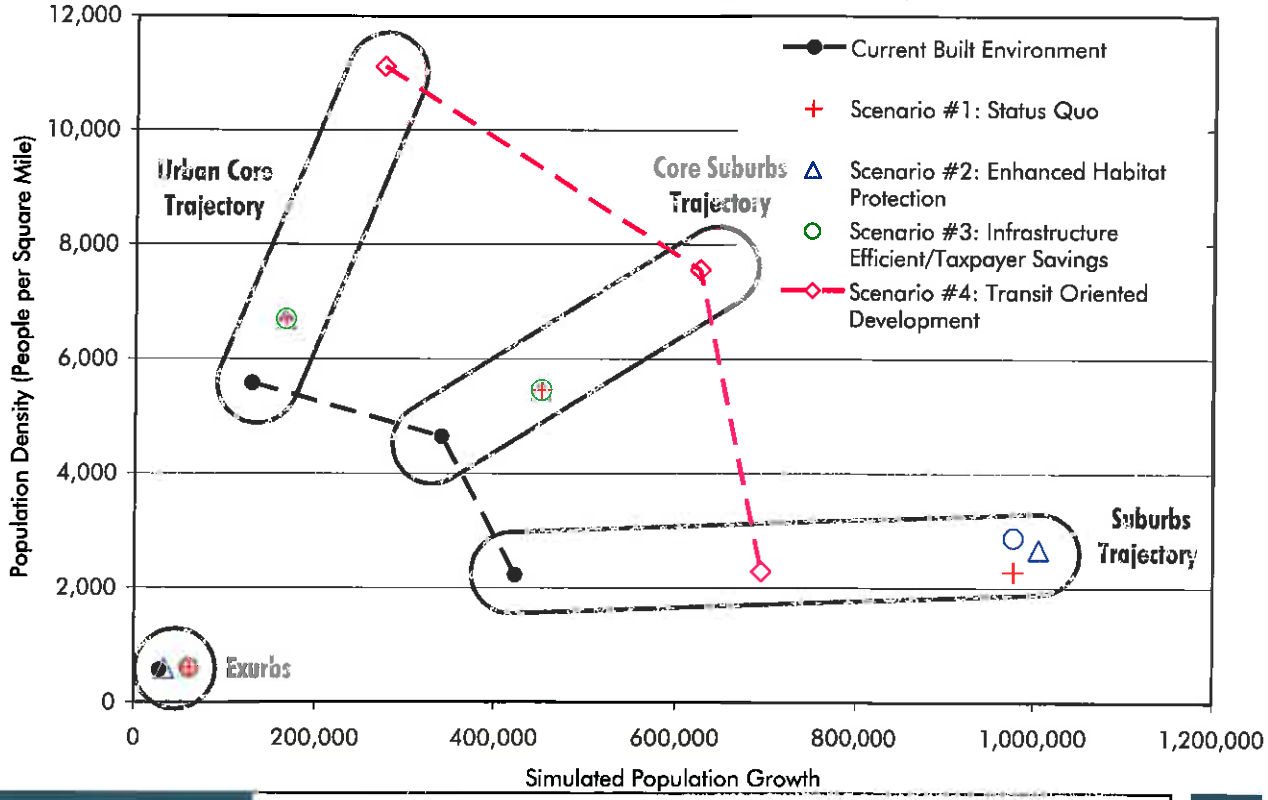


Figure 36 displays the incremental population additions simulated and their overall applied densities, visualized in a manner consistent with Figures 12, 13, and 14. The growth in each scenario is broken down into the component exurb, suburb, core suburb, and urban core areas. The apparent trajectories of each of the above four areas away from their current built environment positions are highly revealing:

- The pattern of the exurban growth and development is essentially constant from scenario to scenario. The enhanced habitat protection scenario does not lead to the doubling in exurban population seen with the other two growth scenarios. In all cases exurban density stays similarly low. Exurbs are in relative terms is the least consequential component of population growth.
- The urban core trajectory see densities increase by some 20% for most scenarios – and double for transit oriented development. Population growth for this area amounts to 29% for most scenarios, and 113% for the transit oriented development.
- The core suburbs trajectory is less vertical than for the urban core. Density gains for most scenarios drops to 17%, while related population gains increase to 32%. The TOD scenario represents density and population gains of 163% and 84%, respectively.
- For all scenarios, the suburbs trajectory indicates large increases in population with very small gains in density.

Figure 36: Modeled Trajectories for Added Land Area and Population Densities



Figures 30, 31, 32, and 33 have depicted varying growth locations across the City of Tucson and Pima County.

These modeled populations cross across several key boundaries to varying extents in the current built environment and each of the four scenarios. Figure 37 on page 81 displays the following future population splits:

- Across the City of Tucson corporate limits.
- Across the Conservation Lands System boundary.
- Across the designated service area boundary of Tucson Water.
- Across the designated and undesignated service area boundaries within the Tucson Active Management Area as mapped by the Arizona Department of Water Resources.

Note that in each future scenario, the population displayed is less than two million people, given the assumptions for future growth inside other area municipalities.

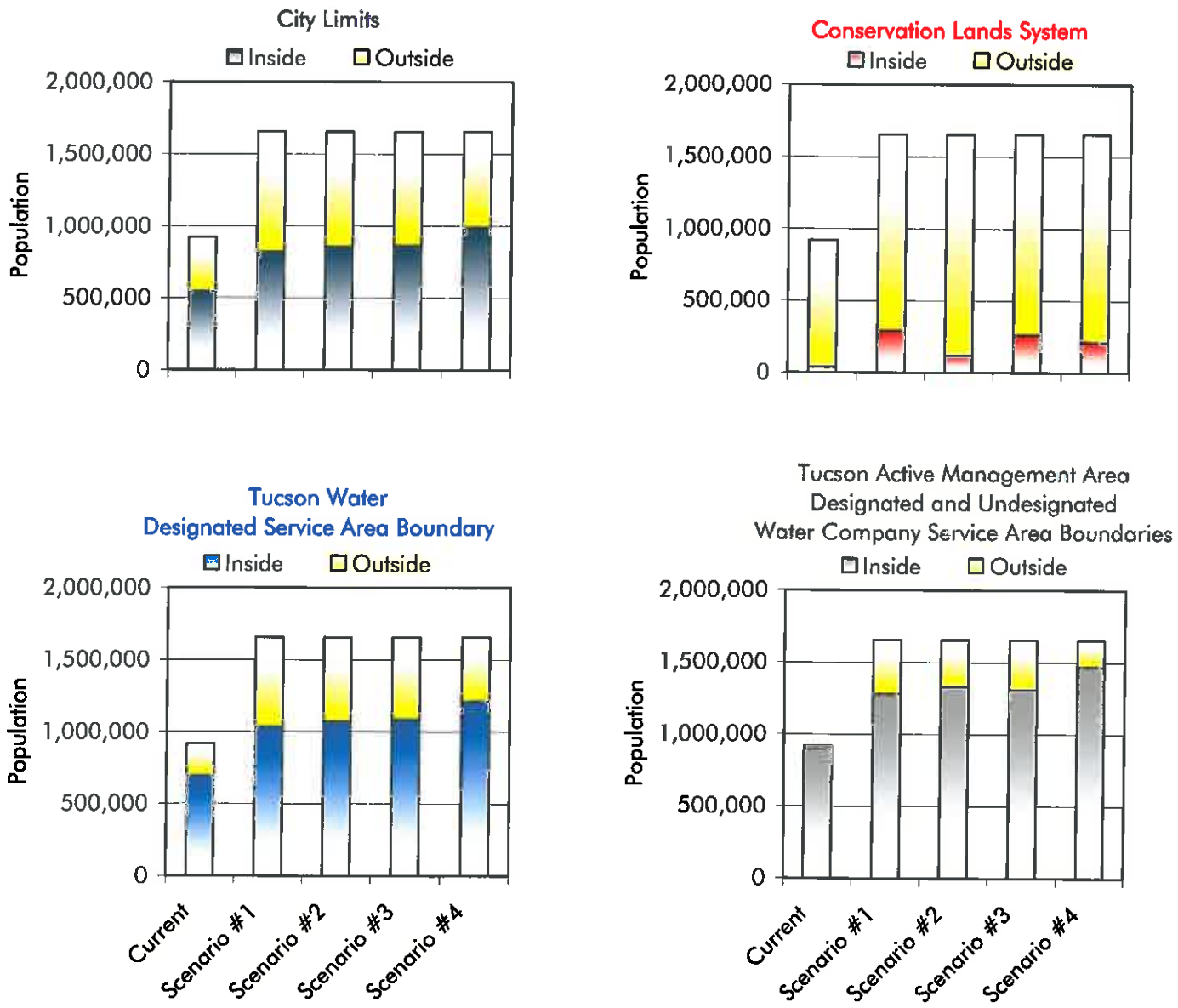
On average, 53% of the future growth is located within the City of Tucson corporate limits – compared to 59% at present.

On average, 13% of the future growth is located within the Conservation Lands System boundary – compared to 5% at present.

On average, 66% of the future growth is located within the Tucson Water designated service area boundary – compared to 76% at present.

On average, 81% of the future growth is located within the designated and undesignated service area boundaries – compared to 98% at present

Figure 37:
Modeled Splits of Population across Geographic and Utility Boundaries of Interest



3.4 Qualitative Comparisons of Alternate Futures

In addition to the simulation results that permitted the quantitative comparisons documented in the preceding section, the White Paper team qualitatively compared the scenario results.

Table 15 displays the subjective results; your personal opinions and value judgments may very well be different. This qualitative assessment used a simple scale ranging from "no checkmarks" to one, two, and finally three checkmarks for those deemed most beneficial.

The Infrastructure Efficient / Taxpayer Savings scenario would likely receive one additional "checkmark" for the Infrastructure Efficiencies, Cost of Services and Tax Levels, and Water, Resource, Energy, and Land Consumption comparators if a revised model simulation was completed as mentioned on page 72.

Table 15: Qualitative Comparison of Modeled Scenarios

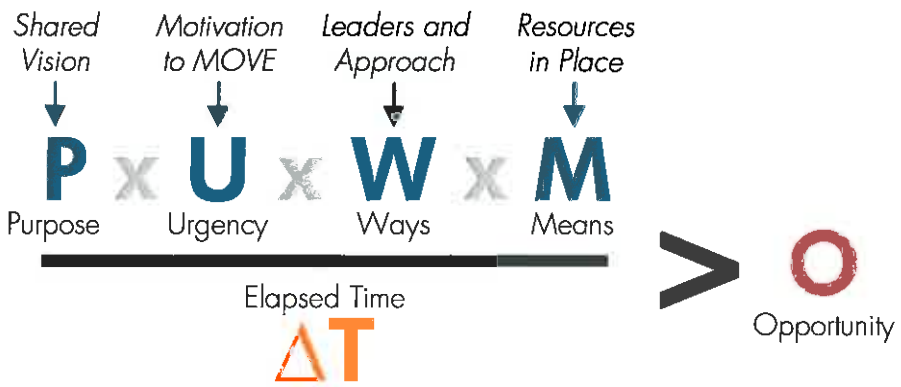
Comparator	Status Quo	Enhanced Habitat Protection	Infrastructure Efficient/ Taxpayer Savings	Transit Oriented Development
More Walkable Communities	—	✓	✓	✓✓
Higher Infrastructure Efficiencies	—	✓	✓✓	✓✓✓
Lower Cost of Services and Tax Levels	—	✓	✓✓	✓✓
More Transportation Mode Choices	✓	✓	✓✓	✓✓✓
More Housing Type Choices	—	✓	✓✓	✓✓✓
More Housing and Transportation Affordability	—	✓	✓✓	✓✓✓
Lower Water, Resource, Energy and Land Consumption	—	✓	✓✓	✓✓✓
More Access to Jobs and Services	✓	✓	✓✓	✓✓✓
More Easily Implemented	✓✓✓	✓	✓	✓

SECTION 4 – ENCOURAGING CHANGE

How can the City and County encourage positive change?

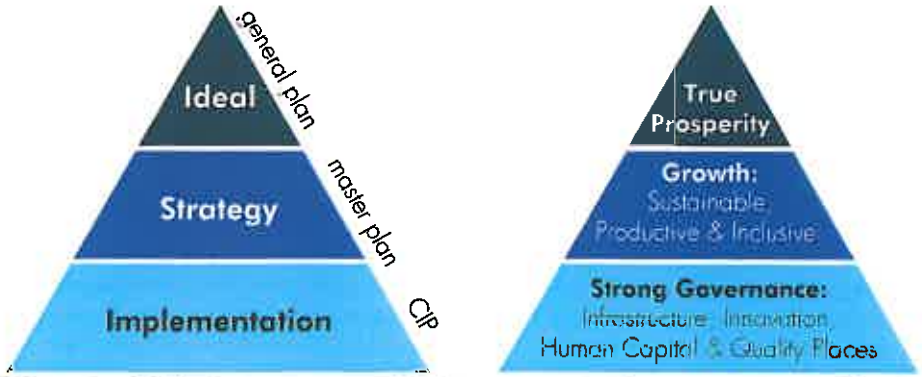
The most important success factors in ensuring successful change management involve people. These people must share a vision, have the motivation to succeed, be armed with the appropriate technical and operational skills, and propagate ownership in the proposed solutions.

The equation below contains all the key factors that will guide a successful change process for our community. If any of the blue factors in the numerator are zero at any time, the result on the left side of the equation will be zero and the opportunity will not be seized. If the time span lengthens, more effort and resources will be required to realize the opportunity; if it's too short, opportunities may be lost because of haste.



The opportunity is clear – there are new pathways to an improved Tucson and Pima County. We believe that the City and County administrations and leadership have laid the appropriate and necessary groundwork of purpose and urgency.

The mechanism of change is obvious; updated comprehensive and general plans and a contextual hierarchy of supporting plans and decisions implemented at all levels represent a strong supply of ways and means. Given time, we can mobilize our community and work together to combine these factors and realize the future of our dreams.



Process Suggestions

Based upon the research conducted during the preparation of this White Paper, the following process suggestions are provided:

- Assume that continued low density development in a relative monoculture is a major issue.
- Create joint (or separate but harmonized) City / County urban form implementation plans, timelines, and requirements. Work together to identify or create the necessary funding sources.
- Continue and intensify regional discussions of visioning, open space, water resources, and development efficiencies.
- Harmonize county and municipal land use regulations based on regional goals.
- Create evaluation measures and processes including identified benchmarking metrics and targets.

4.1 Looking Deeper Into Our Design Toolbox

Recall that this White Paper has identified six primary urban form factors: Development Location, Land Area, Block, Lot, and House Size, Land Use Mix and Diversity, Population, and Street Layout. These were related to six dependent factors: Centeredness / Centrality, Housing Unit Density, Floor Area Ratio, Open Space Index, Population Density, and Street Connectivity / Walkability.

Encouraging good design is the beginning of good urban form, and so suggested options that should be considered during future growth and development discussions are organized by the following design issues.

Development Location Suggestions

- Designate target growth areas.
- Encourage residential uses within the urban core.
- Encourage rezoning for more multi-family and attached housing.
- Concentrate development in regional and town centers plus transit corridors and station areas.
- Be prepared to manage the fact that infill development and increased densities in existing, settled residential neighborhoods often upsets established expectations and creates conflict.

Block, Lot, and House Suggestions

- Rezone for more multifamily and attached housing.
- Encourage diversity and mixed-income housing developments.

- Reinvest in neglected communities and provide more housing opportunities; rehabilitate abandoned property and buildings.

Land Use Mix and Diversity Suggestions

- Create new zoning districts for intense mixed use developments.
- Allow for compatible, small-scale neighborhood commercial uses (e.g., corner stores) adjacent to or within residential neighborhoods.
- Provide for an approximate mixture of housing and jobs, as opposed to predominantly single-family residential development with no jobs nearby.

Street Layout / Connectivity / Walkability Suggestions

- Reduce reliance on major thoroughfares.
- Enhance walking environments.
- Combine the best attributes of grid and loop/cul-de-sac designs: return to orthogonal geometry for clarity of organization and directness of pedestrian access, and provide loops and cul-de-sacs for local streets to achieve safety, tranquility, and sociability.
- Revise street standards to lower any excessive requirements for local subdivision streets.
- Include maximum parking ratios that can be built in a particular development in addition to minimum parking requirements.
- Create opportunities for sustainable modes of transport such as walking and cycling to increase their modal share.
- Link urban form to activity space-time measures to facilitate the understanding of how urban design strategies may shape individual space-time interactions.

Centeredness / Centrality Suggestions

- Encourage centralization of major amenities.

Infrastructure Density Suggestions

- Leverage infrastructure benchmarking with detailed analysis examining links between land use decisions and efficiencies; this may occur as part of White Paper examining integrated land use and water resources planning.

Housing Unit Density Suggestions

- Develop under-utilized land.
- Soften perceptions of density through exceptional design. Density does not have to equate to a feeling of crowdedness.

Floor Area Ratio Suggestions

- Raise maximum building heights in urban land use zones.
- Pay attention to the lowest vertical building elements that frame the pedestrian environment.
- Emphasize visual permeability allowing access to light (sky and sun) and fresh air.

Open Space Index Suggestions

- Continue to implement the Conservations Lands System policies.
- Encourage connection of open spaces and greenways to existing destinations and open space preservations.

Population Density Suggestions

- Establishing minimum density requirements in centers of activity, and where needed to achieve the benefits of population density.
- Pursue the evolution of Downtown Tucson and the University of Arizona campus as regional-serving walkable urban spaces.

Access to Transit Choice, Employment and Opportunities Suggestions

- Invest in rail transit.
- Consider housing, employment and transportation policies and investments together.
- Encourage development in locations that can be served by transit, and at transit-appropriate densities.
- Maintain a supply of large-lot industrial sites for major new employers.
- Provide areas suitable for expansion and retention of existing employers, and prevent excessive conversion of employment lands to retail and residential uses.

4.2 Go-Forward Planning Recommendations

This White Paper and its findings are intended to inform the outputs of the City/County Water and Wastewater Infrastructure, Supply, and Planning Study.

It should also initiate several direct actions. To that end, the following important go-forward planning recommendations are made:

- The City and County should agree on future growth locations and continue to actively facilitate consensus on regional growth locations amongst the area municipalities.
- The City and County should identify efficient and sustainable urban form concepts to be implemented in these future growth locations. These concepts should be developed at the general and comprehensive plan levels, quantified through infrastructure and urbanization master plans, and supported by coordinated capital improvement programs and infrastructure investments.
- The City and County should work with all eastern Pima County jurisdictions; a regional approach should culminate in local implementations.

SECTION 5 – SUMMARY

This White Paper does not require an overly elaborate or lengthy summary. Based upon the best and emerging practices benchmarking and growth area suitability modeling, the team has developed and presented clear evidence to support three key conclusions.

Urban Form Is Important to our Lives

Every resident of the City of Tucson and Pima County is surrounded and impacted daily by our existing urban form. These personal impacts range from the physical to the financial and from the emotional to the social.

"Destiny is not a matter of chance, but a matter of choice. It is not a thing to be waited for, it is a thing to be achieved." – William Jennings Bryan

Our future urban form will have pronounced economic, social, and environmental impacts upon our community, and will define the quality of life for our children and many generations to come.

Growth Can Be Directed Differently To Our Benefit

The four alternate choices presented are just the beginning of our considerations; they can be combined in many ways, and augmented with other choices. Each scenario will have a mix of costs, benefits, and detriments. It is important to do our best to direct growth and development so that form and function are unified to benefit our lives.

Let's Choose our Future Wisely

The call to action is being sounded. Now is the time for us to unite in commitment to a new and wonderful urban form, and move with intention from ideas to action.

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APPENDIX A – ON THE TRUE DENSITY OF TUCSON

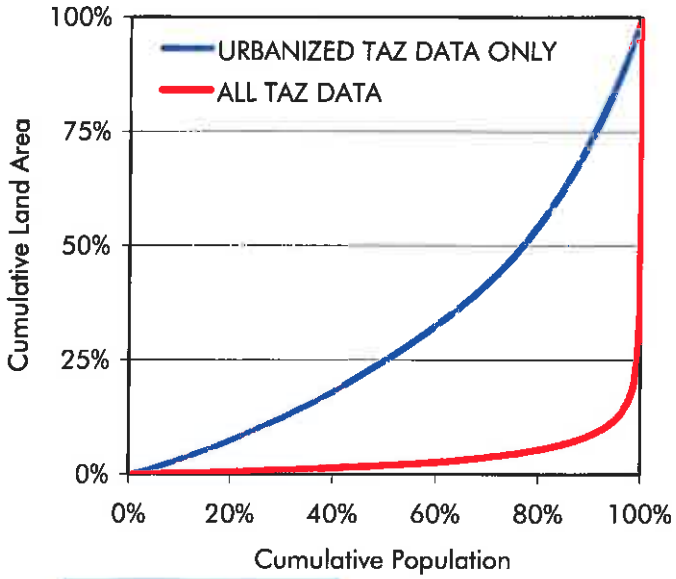
Throughout this White Paper, population densities are calculated at varying scales. This begs the question as to what precise urban area limit should be used to define population densities.

If the urban area only includes built-up areas within the municipality, then higher densities will be calculated. If a wider urban area is used that includes fringes and less developed parts of the municipality, then lower densities will be calculated.

For example, it is possible to calculate the density of our community by simply summing the TAZ areas and 2005 population statistics for the 853 zones to arrive at totals of 3,884 square miles and 943,044 people. This yields a very low density of 242.8 people per square mile.

Reference 1. in the Bibliography addresses this effect explicitly:

> "If one conducted a survey of residents to find out the density they experience, one would obtain a higher value of residential density than by simply dividing the total residents by the total land area of the "urban area". There are more people who live in high density situations (per unit of land) than there are people living in low density areas. A "population-weighted" average of residential density will therefore give a higher residential density than an "area-weighted" density.
>
> More importantly, a "population-weighted" average of residential density will give a value of residential density which is not affected by the addition of spurious empty regions to the outskirts of the urban area, because their lack of population means that they won't be counted in a "population-weighted" calculation, thereby removing a major source of potential bias in the calculation of residential density."



The graph to the left reinforces this fact; in reality when the full TAZ dataset is used, 90% of the total population can be seen to live in only 8.5% of the total land. This is a highly non-uniform relationship between land and people.

Restricting the dataset to "urbanized" TAZ (here assumed to be any TAZ over a threshold density of 1,000 people per square mile) results in the blue curve at left, which indicates a more uniform relationship between the land and the people occupying each TAZ.

Moving our City of Tucson and Pima County density calculation down to the TAZ level and calculating a "population-weighted" average of residential density yields a density of 4,440 people per square mile.

If the TAZ data set is restricted to only those TAZ with "urbanized" levels of density (again assumed to be 1,000 people per square mile) then the simple traditional "area-weighted" density of 3,392 people per square mile. Calculating a "population-weighted" average of residential density from this reduced data set yields a density of 5,308 people per square mile.

For purposes of comparison with other cities, however, it is relatively rare to find densities calculated using "population-weighted" methods or even standardized to a common value for the size of a populated area.

As a result, population densities quoted throughout this White Paper are not "population-weighted" so as to maintain accurate benchmarking.

APPENDIX B – "A TALE OF FOUR CITIES"

This Appendix provides the reader with four tales from possible futures, as we imagine what life might be like in the White Paper's different scenarios. We acknowledge that these suppositions are only partial snapshots of the future, and could be further elaborated upon from both economical and social standpoints with the dedication of more time and effort. The future is always a ripe target for speculation, however, and it is in the spirit of deductive imagination that these four tales are presented for your consideration.

A VIEW FROM THE FUTURE: SCENARIO #1 – THE STATUS QUO

It is the year 2060 and our community has stayed on a consistent course over the last 50 years. While our region is now home to roughly two million people, the City of Tucson's historic annual growth rate has slowed to less than one percent. In addition to the other incorporated areas, most growth is now occurring in the outlying master planned communities that have flourished in the southwest corridor (known as the SWIP), in the Southlands and along the Houghton Corridor southeast of the City. The low cost of housing in these areas has made them far more attractive than the relatively expensive housing available in the City, and they have been growing for decades at 2.3 percent per year.

"There's one thing worse than change and that's the status quo." – John Le Carré

The stock of vacant land in the valley has dwindled as the majority of new housing is single family tract housing that occupies a relatively large amount of land. To attract home buyers, master developers have worked tirelessly to introduce necessary service amenities such as retail centers, restaurants, schools and medical centers. Large national retailers continue to take an interest in the areas as market-driven demand has increased. Far from downtown, large outdoor malls service the residents of these outlying communities.

To reduce the social and economic costs of driving long distances to get to work, many people living in the suburban communities are looking for jobs in the diffused employment centers that are springing up. Traffic is heavy along the I-10 corridor, which was widened years ago to 6 lanes in each direction in an attempt to relieve the heavy traffic congestion during rush hour. Toll roads, built at significant costs due to land purchases and right-of-way acquisitions, are being planned to traverse the City and connect the suburban communities. Most suburban residents now bundle their in-City travels into weekend trips to save on automobile and fuel costs.

To attract new residents and infill development, the City has embarked upon a dramatic effort to re-brand itself as a center of knowledge, focusing on its largest employers including the University of Arizona. As traffic congestion issues continue to hurt the University's ability to attract students, they are now focusing marketing efforts in offering virtual e-classes despite the associated reduction in personal contact with professors and other students.

City tax increases, enacted in an attempt to pay for the costs of new infrastructure and infrastructure repair, have further discouraged both commercial and residential development in the City. The hike in taxes has also created an increased vulcanization of the area leading communities to compete over scarce resources. Outlying areas, such as the Southlands, are opposed to paying for improvements and other services within the City's core (since they generally don't visit the City anymore) and are now actively engaged in reverse annexation movements.

Downtown Tucson continues to serve primarily as the center of government for both the City and County. Planning has become de-centralized and urban planners continue to react and respond to emergent development needs and propositions. They struggle with alleviating the negative aspects of continued low density suburbanization.

A VIEW FROM THE FUTURE: SCENARIO #2 – ENHANCED HABITAT PROTECTION

It is the year 2060 and our community is well known for placing a high priority on habitat protection in order to preserve our natural resources. Years ago, the City and County purchased large expanses of native desert lands and ranches in a regional program to support native plants and wildlife, expand recreation areas, and protect natural floodplain functions and water sources.

"Study nature, love nature, stay close to nature. It will never fail you." – Frank Lloyd Wright

The City and County are now known as havens for nature lovers. The regional trail systems built throughout the area are attracting hikers and bicyclists from all over the United States. Much of the population is enjoying the opportunities for exercise and relaxation that are available at the plentiful outdoor recreation sites in and around the City. Tourism is enhanced by opportunities to view the robust wildlife populations that have successfully returned to the area.

Private lands adjacent to purchased open space have increased in land value, spurring increased pressure to develop them.

Long ago, City and County leaders designated with foresight several specific target growth areas. These included the southwest area of the City (known as the SWIP), the Southlands, and the area along the Houghton Corridor southeast of the City – as well as infill development within the built environment of the day.

Voters continue to support dedicating tax dollars to pay for the conserved open spaces. The City and County have also created initiatives that provide incentives to developers to build in the most suitable areas, particularly inside the existing urban footprint. Developers have found ways to be creative and innovative in their planning efforts. Flexible multi-use zoning has encouraged re-development and two to four storey buildings are more common than ever. Denser residential developments are proceeding without public investment given the higher returns they now generate.

Rainwater harvesting, renewable energy initiatives, and water and energy-conservation technologies enacted over the last 50 years have resulted in remarkable per capita drops in resource consumption. Regional leaders and planners have been able to focus on supporting and encouraging development efforts that focus on sustainability (such as green housing, distributed energy, and infrastructure systems) making efficient usage of available land and ensuring that our region continues to live up to its reputation as a sustainable area.

A VIEW FROM THE FUTURE: SCENARIO #3 – INFRASTRUCTURE EFFICIENT/TAXPAYER SAVINGS

"Efficiency is doing better what is already being done." – Peter Drucker

It is the year 2060 and our community is now enjoying the benefits of the emphasis they placed years ago on increasing densities and clustering development in designated growth areas. This was done to establish infrastructure efficiency in the areas of water delivery, wastewater service and the transportation systems that remain largely auto-dependent. Our relatively lower tax structure and cost of living is continuously attracting new residential and commercial development.

Mixed use neighborhoods are thriving in metropolitan Tucson, the SWIP area, Houghton Road Corridor and the Southlands area. New developments are occurring at average densities several times greater than historic rates. Concentrating growth around planned and existing infrastructure, as well as infill development incentives offered by the City

and County, has resulted in minimal encroachment into major biological corridors and important riparian areas. Opportunities for appropriate off-site habitat mitigation are readily available and evaluated on a case-by-case basis.

The sense of community encouraged by the high density, mixed use development is resulting in strong neighborhood centers. The communities are enjoying high qualities of life and a strong sense of place. Well designed public areas and open spaces have been developed to offer opportunities for informal and formal interaction, recreation, gardening, and the enjoyment of scenic vistas.

Many residents still live in large houses and drive automobiles to their jobs, services and entertainment. As the region expands, planners continue to advocate the expansion of roadway infrastructure as opposed to alternate transportation systems. Some residents are able to live in smaller houses, closer to their work and amenities, saving money by reducing or eliminating their need for cars.

The increased densities have attracted retail businesses and employment centers to neighborhoods in proximity by providing a readily available local workforce. Infrastructure efficiency has resulted in per capita drops in water use and resource consumption. The region enjoys the reputation of providing highly walkable, close-knit neighborhoods.

A VIEW FROM THE FUTURE: SCENARIO #4 – TRANSIT ORIENTED DEVELOPMENT

"Transit-oriented development is not a one-size-fits-all phenomenon; it is a flexible form of development adapted to local circumstances." – Bay Area Metropolitation Transportation Commission

It is the year 2060 and our community is enjoying the benefits of the emphasis placed years ago on transit oriented development combined with alternative forms of transit systems. The result has been increased housing options and diversity of choices in the community, as well as vibrant mixed-use retail, housing and service hubs along the major transit corridors established by regional planners.

Lively pedestrian neighborhoods comprised of new and existing housing and mixed use redevelopment now flourish along transit corridors. Drawn by convenience and amenities, heavy infill and re-development has occurred within the urban core and core suburbs of the City and County. The combination of the modern street car, light rail and efficient rapid transit bus routes have served to densify those city blocks along major transit corridors. Some of the most desired neighborhoods are within a quarter mile of the streetcar stations where residents can enjoy a great

variety of services, employment and entertainment options. Older neighborhoods that were struggling years ago have now been preserved and strengthened as people have reinvested in these areas.

Concentrating growth around planned and existing transit corridors has resulted in minimal encroachment into major biological corridors and important riparian areas as designated by the Conservation Land System (CLS). The successful infill development incentives offered by the City have helped this occur.

The transit choices the population now enjoys are being supported through taxes and user fees that are being generated primarily by the benefitting high density neighborhoods.

The expansion of the community is significantly based on the expansion of the transit system. In order to achieve the targeted densities, regional planners offered flexible multi-use zoning. Parking structures have been removed or re-purposed as demand decreased. Vertical development of two to four storeys (including residential and commercial components) have carefully considered the retention of critical view sheds.

The City enjoys the reputation for providing highly connected and close knit neighborhoods with local employment opportunities. Planning is focused on mixed use development with interspersed pockets of open space such as parks and pavilions. The high densities have also resulted in per capita drops in water use and other resource consumption.

Many residents still choose to live in large house and drive cars multiple times each day. Others enjoy the saving of time and money they realize from taking shorter trips and not owning a car.