Alternative Future Scenarios Technical Report

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Introduction

This task developed three CommunityViz scenarios that describe alternatives to the Trend Scenario. When combined with the indicator models developed, these scenarios will help planners and decision-makers understand the long-term implications of planning actions and development patterns.

About Scenario Planning

Scenario planning is based on the idea that to develop a plan for the future, we first need to know what we want that future to be, within the bounds of realistic possibility. We expect the population of the County of Hawai'i will grow and with it the need for infrastructure and development, but where the growth will occur and what its ramifications will be are less certain and more possible to influence with a plan. Scenario planning allows us— the County together with residents—to explore a range of planning choices and their potential outcomes, in effect "trying out" where different future paths might lead. Equipped with that awareness, we are better prepared to make informed decisions about our plan's final direction.

Each future outcome is called a scenario. The number of possible future scenarios is infinite, but a scenario planning process usually explores 3 – 5 alternatives. That number is small enough to be manageable but large enough to allow for the study of significant planning choices. Each scenario includes a "package" of planning choices that are organized around a consistent theme to make them easier to understand and think about. Once the major outcomes of a scenario have been calculated and studied, small changes can be made to test sensitivities or explore secondary topics.

Scenario performance is modeled and measured quantitatively with numbers called indicators. Indicators are also used for quantifying neutral descriptive characteristics.

Many of the lessons learned from scenarios come from comparing them to one another. For example, we might see that one scenario performs better relative to County goals for, say, agricultural preservation, while a different scenario does better on the cost of new infrastructure. To allow for useful, apples-to-apples comparisons, we try to maintain consistency on most dimensions while varying only the topics of interest. In particular, all scenarios here use the same

- Forecasted growth amounts by Forecast Analysis Zone (FAZ) as provided by SMS[1]
- Known near-term changes (e.g., pipeline projects)

[1] SMS is a private research and consulting company. *www.smshawaii.com*

- Transportation, water, and wastewater infrastructure. However, scenarios are evaluated on how much additional infrastructure would be required to serve their needs.

By comparing the outcomes of alternate scenarios, planners and decision-makers learn lessons about the effects of various planning policies and future development patterns. Based on those lessons, they design a single "preferred" scenario and supporting planning policies that best achieve their long-term goals.

CommunityViz software was used to develop alternative scenarios to reflect possible futures for the County of Hawaii. The software provides two different methods creating scenarios:

1. **Model Driven:** Computer algorithms that model where new development will occur over time are used to construct the scenario based on rules and assumptions provided by the planner. For example, the Trend Scenario was constructed by using the CommunityViz Allocator 5 algorithm together with a set of rules about development capacity and assumptions about historic growth drivers continuing into the future, among other variables. Models can be used to create alternative scenarios by adjusting their inputs. For example, an operator can expand or limit capacity for certain zoning or land use types, prioritize particular growth drivers, assume a greater degree of redevelopment activity than previously, etc. Another name for this method is "predictive" scenario planning.
2. **Planner Driven:** Alternative scenarios are constructed by a planner who makes explicit decisions about the location of future growth by, for example, sketching on a map. The planner need not follow any systematic rules, although there are usually good reasons for particular choices. This method is good for capturing qualitative ideas (e.g., public opinion about where growth should go), and it can also be more expedient than model-based construction when implementing particularly complex rules. Another name for this method is "normative" scenario planning.

While both these methods were considered when alternative scenarios were being selected, it turned out that all scenarios we used were primarily model-driven, with some planner-driven adjustments when needed.

Reference Scenarios

We have already created three scenarios that serve as points of reference and comparison for the other scenarios.

Baseline

The baseline scenario looks at what is currently existing in terms of housing units, jobs and population. Using property appraiser data (TMKs), US Census data, and data provided by SMS, this scenario provides a picture of what the island looks likes today.

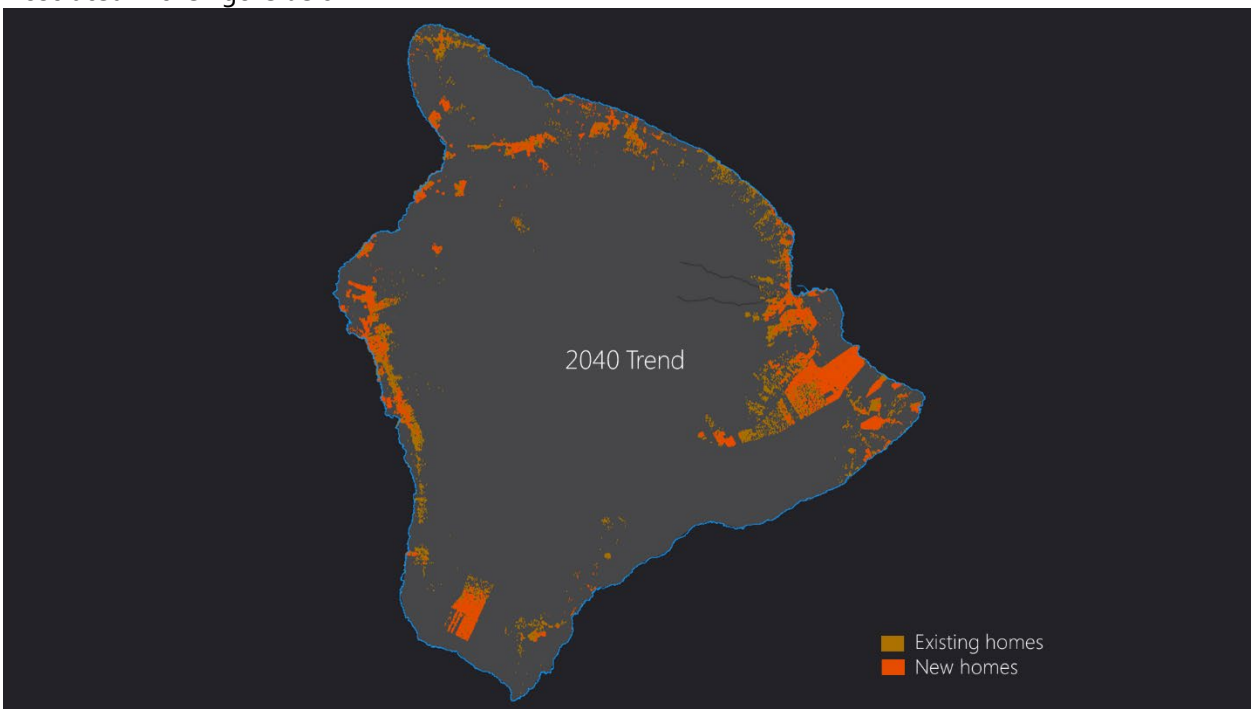
Build-Out

The Build-out scenario, also known as the Capacity analysis, takes a series of rules from regulatory and other land use mechanisms to determine a theoretical maximum capacity for growth on any given property on the island. In the most basic sense, this capacity is based on the size of the property and the allowable density of development per zoning regulations. A number of additional steps were incorporated to account for natural and regulatory constraints (property slopes, overlays, special

districts, etc.), planned developments, and realistic thresholds from past development. This scenario provides a framework for island-wide capacity and was used to inform the Trend scenario.

Trend

The trend scenario provides a picture of what is likely to occur by 2040 if current trends continue. It is sometimes called the "do nothing differently" scenario. It uses a combination of the *Capacity* scenario, projected *growth* by FAZ, and a score for likely locations where development might occur (*desirability*). The projected growth amounts come from SMS forecasts. The desirability score is based on a desirability surface representing historic development trends. More than 30 potential influences of growth (geographic, property characteristics, terrain/climate conditions, development status of property and nearby neighbors, land use, island location) were analyzed using a statistical regression analysis. Based on these factors, growth was allocated to specific parcels within FAZs as a potential future which follows recent growth trends. The development pattern for the trend scenario is illustrated in the figure below.



The original Trend scenario used capacity numbers from the Capacity scenario, which is driven by zoning. Now, as an additional scenario, we have constructed a **LUPAG Trend** scenario based on the current General Plan's General Land Use Pattern Allocation Guide (LUPAG) map. The LUPAG Trend scenario is the same as the Trend Scenario except that its capacity rules follow the LUPAG in some areas instead. Details are provided in a separate section at the end of the document.

Alternative Scenarios Overview

There are no particular rules for designing alternative scenarios, but there are some goals and guidelines for making them most useful to the decision-making process. These include the following:

- Meaningful. Scenarios should help decision-makers explore questions, policies, and priorities that are important and meaningful to the residents of the area.
- Plausible. The scenario should represent an outcome that could realistically occur.

- Imaginative. At least some scenarios should represent ideas and directions that represent a departure from current thinking and practice.
- Distinct. Alternate scenarios should be distinct and independent from one another so that it is easier to see the effects of particular planning choices.
- Fair. Construction should be done fairly and without a pre-formed bias regarding which scenario is "best" or "worst." No scenario is likely to achieve all goals.

Following the precepts described above, this project has developed 3 more alternative scenarios in addition to the reference scenarios and the LUPAG Trend scenario. The characteristics of the alternative scenarios were developed primarily by the County, while Placeways developed the corresponding CommunityViz models. Following is a summary of the three alternative scenarios:

- **CDP** (for Community Development Plans) is an island-wide model of the spatial and policy ideas expressed in currently existing CDPs for North Kohala, South Kohala, Kona and Puna and the draft CDPs for Kaʻū and Hāmākua. In other areas (notably Hilo), the current LUPAG (Land Use Pattern Allocation Guide) map is used. This scenario seeks to illuminate possible conflicts and synergies among the CDPs and to test local plans against island-wide projections for growth in housing and jobs.

- **Agriculture** aims to preserve known, productive agricultural land and protect it from "rural" or other residential development.

- **PDZ** (for Priority Development Zone) focuses future growth in village and town centers that are equipped with supporting infrastructure and services.

The following sections provide more detail on each of the three scenarios above and also on the LUPAG Trend scenario.

CDP Scenario

The Community Development Plans (CDP) Scenario pulls together the extensive work done to prepare future vision and planning guidance for various districts within the County. There are four adopted CDPs – Kona, North Kohala, Puna and South Kohala – and two draft CDPs – Kaʻū and Hāmākua. Each CDP takes a slightly different and localized approach to define the guiding goals, objectives and policies of the community. All plans provide guidance on land use via policy and some explicitly define geographic areas, using GP LUPAG designations, Conceptual land use, Zoning, State Land Use and other regulatory definitions to help guide areas for growth and areas for protection. Where these definitions were clear, spatial locations, GIS data was obtained or prepared as part of this process. Where guidance was less spatially definitive (e.g. protect views), efforts were made to interpret appropriate locations where growth was appropriate or should be restricted.

Each CDP provided some guidance on recommended locations for growth at a level deemed appropriate for the community. These growth "hot spots" were used both to determine potential increases in capacity (from Zoning and LUPAG) as well as locations to increase development desirability (from Trend). Additionally, CDPs specified areas for conservation or hazard avoidance. Capacity was restricted where CDP guidance defined specific locations to limit growth. Growth allocation follows this

modified capacity and modified trend desirability – trend plus CDP-preferred areas, minus CDP-limited areas. Following is some more detail on changes by CDP.

1. **Puna** – The Puna CDP was adopted in September 2008. The overarching plan goals center around reversing the potential consequences to environmental and agricultural uses of continued rural and suburban development. Much of Puna has been subdivided into lots varying in size from 1 acre to 5 acres. These subdivisions rely mainly on services and infrastructure through private means (homeowner's association, initial developer provision, site maintained cesspools, septic and water, etc.). Additionally, there are safety concerns given the myriad of hazards these communities are vulnerable to with limited public infrastructure.

   The Puna CDP establishes the concept of Regional, Neighborhood, and Village Centers to help serve local communities with commercial and civic uses. Additionally, these centers provide a focal point for proposed re-allocation of growth. The concept is that where development has not yet filled in, new homes should be concentrated in and around the Centers, reducing the need for new roads and expanded water infrastructure. Per plan, the LUPAG designations guide development potential within the centers, so no capacity adjustments were made to LUPAG capacity under this CDP. This could be a refinement for a future CDP scenario to increase center capacities.

2. **Kona** – The Kona CDP was adopted in September 2008. While the Kona CDP uses GP LUPAG as a guide to appropriate land use and growth within defined locations, Kona takes a slightly different approach than other CDPs in setting up a framework for proposed future development. The CDP defines an Urban Area boundary to steer future development within and near existing developed areas. It also provides for Rural Town areas where continued growth is anticipated and where growth outside of the Urban Area is preferred.

   Within the Urban Area, the Kona CDP also establishes guidelines and some recommended locations for Transit Oriented Development (TOD) and Traditional Neighborhood Development (TND). TODs are represented as circles, or nodes, along a potential future transit corridor. TNDs are intended to be located based on developer or property owner initiative and will not necessarily follow the proposed transit corridor.

   Kona TOD Existing Development and Capacity
   To analyze the scenario impacts of the TOD locations, the existing development and capacity of TODs was reviewed. Below is a summary of TOD locations' existing and future capacity based on Zoning and LUPAG.

TOD Name	Type	Size	Developed Residential (dwelling units)	Residential Capacity (LUPAG Trend – Net Dwelling Units)	Total Residential Possible (Today plus Future Capacity)	
					By Size	TOD Overall
Honokōhau Village	Regional Center	¼ mile	0	202	202	1,192
		¼ to ½ mile	30	961	990	
Kailua Village Redevelopment	Regional Center	¼ mile	551	1174	1726	5,754
		¼ to ½ mile	470	3559	4028	
Makaeo Village	Regional Center	¼ mile	0	0	1	729
		¼ to ½ mile	57	671	728	
University Village	Regional Center	¼ mile	0	6	6	144
		¼ to ½ mile	0	137	137	
Kahaluʻu Makai Village	Neighborhood Center	¼ mile	0	753	753	2,603
		¼ to ½ mile	153	1696	1849	
Kahului - Puapuaʻa Village	Neighborhood Center	¼ mile	50	465	515	2,858
		¼ to ½ mile	556	1787	2343	
Kalaoa Village	Neighborhood Center	¼ mile	142	500	642	1,328
		¼ to ½ mile	294	392	686	
Kaloko Makai Village	Neighborhood Center	¼ mile	0	664	664	2,223
		¼ to ½ mile	0	1559	1559	
Keahuolū Village	Neighborhood Center	¼ mile	0	231	231	1,257
		¼ to ½ mile	0	1026	1026	
Puaʻa - Waiʻaha Village	Neighborhood Center	¼ mile	75	564	639	3,749
		¼ to ½ mile	619	2490	3109	
TOTAL			2,998	18839	21,837	

Each TOD is intended to be a mixed use node with other services, but the table above is only looking at the residential potential. The idea of a TOD is to promote activity through concentrated services, civic uses and residential development centering on a high frequency transit access point. There is no one definition of exactly "how much" activity is required in a single TOD location, in the Kona CDP or in planning definitions more broadly. Based on County planner guidance, a threshold of 2,000 dwelling units was determined to be a potential minimum amount of residential. This is set up as an adjustable assumption within the model. Any TOD which does not have capacity for 2,000 units (under LUPAG Trend) was adjusted in the capacity to this threshold.

The TOD areas serve as a pull for future growth and are used as the "centers" in augmenting the desirability analysis with proximity to centers. Growth can still occur within other parts of Kona as desirability and regulations allow, but TODs provide an additional magnetism to steer more growth in this direction.

3. **North Kohala** – The North Kohala CDP was finalized in November 2008. North Kohala more than other plans focuses on limited growth and change for the community. The strong policies in the North Kohala CDP center on agriculture, cultural and view protections. The plan identifies "Centers" in the small urban communities along the northern highway. LUPAG Trend provides for capacity in these centers and addresses much of the desired protection. It was determined at this stage to use LUPAG capacity for North Kohala.

4. **South Kohala** – The South Kohala CDP was adopted in November 2008. The plan took yet another approach to community goals and policies around land use and growth. In addition to district-wide policy, each urban center (Waimea, Waikaloa Village, Kawaihae and Puakō) was assigned a chapter in the CDP and analyzed individually. The future land use guidance provided for each urban place was depicted in concept plans. In most cases, concept plans showed where future intent differed from existing LUPAG plan areas. In some instances, policies provided language to make adjustments to LUPAG plan areas, but guidance was not always explicit to property locations.

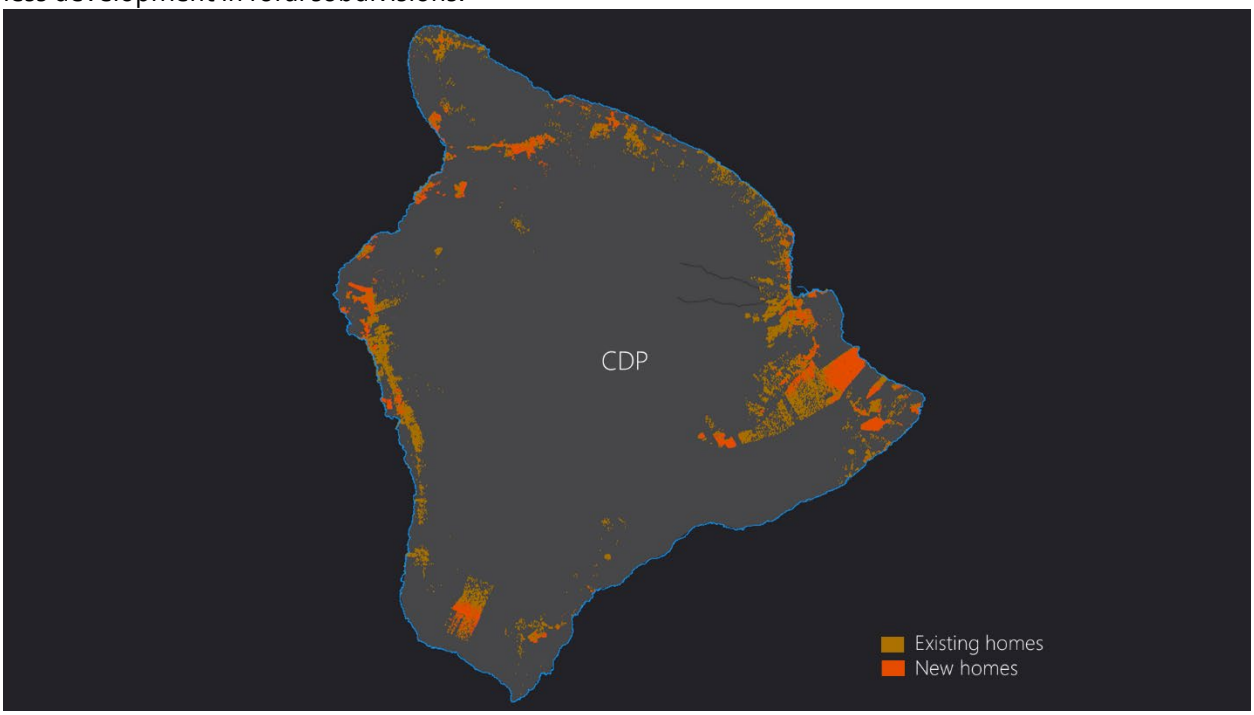
   An attempt was made to create GIS files which represented concept plan land use areas of change from LUPAG. This mapping effort was mostly to facilitate revisions to capacity. The main adjustments to capacity for South Kohala were:
   - Waikaloa Village – Set residential capacities to the plan amounts shown on the Waikaloa Village Plan (Figure 5.2 on page 95).
   - Districtwide – Use Zoning capacity instead of LUPAG capacity. This seemed like the cleanest way to capture all of the policy-driven land use ideas. It also covered areas of concept plans where the desire to "maintain zoning" for agriculture and open areas was specified.

5. **Hāmākua** – The Hāmākua CDP was available as a working draft from September 2015. This draft includes proposed changes to the GP LUPAG, primarily shrinking urban classes and expanding agricultural areas. Using these proposed mapping changes, Hāmākua capacity follows rules from LUPAG trend.

6. **Kaʻū** – The Kaʻū CDP was recommended for adoption by the County in October 2015. Similarly to Hāmākua, Kaʻū uses GP LUPAG classes to define areas where the community is interested in changing the direction of land use. As with Hāmākua, the LUPAG trend was applied in Kaʻū with amended LUPAG classes from the CDP.

All of the CDPs' capacity adjustments were then merged into a single capacity for the island. Where growth was placed in this scenario relied on the trend desirability score settings with one key modification – the addition of a "Near Centers" factor set to a weighting of 10. The concept here was to explore the shift toward more focused, urban development that CDP plans expressed as a common theme. In locations where urban areas were explicitly defined by new boundaries (Kona, Puna), these boundaries were used as the definition of "Centers". In communities that relied on other planning boundary definitions, such as the LUPAG urban classes, these were used as centers. In South Kohala, LUPAG urban classes were adjusted per the concept plans to remove areas where the desire of the plan was to preserve zoning or plan concepts rather than allow for LUPAG-based upzoning. In Kaʻū, Punaluʻu was removed as a potential center since the planning process calls for a community-led master planning process.

The development pattern for the CDP scenario is shown in the figure below. At this scale, the pattern may look superficially similar to the Trend, but closer inspection shows tighter clustering in centers and less development in rural subdivisions.



Agriculture Scenario

The agriculture scenario explores stronger agricultural land protection – strategically preserve known, productive agricultural land; protect that land from non-productive, "rural" or other residential development.

There are a number of ways to define agricultural land for the County of Hawai'i, so in preparation of this scenario, the following datasets were explored as potentially relevant for the definition of what we are ultimately calling "productive agricultural lands".

- State Land Use (SLU) Districts: The SLU districts provide a framework of land use management and regulation in which all lands in the State of Hawai'i are classified into one of four land use districts – Urban, Rural, Conservation and Agriculture. The Agriculture classification for the County of Hawai'i makes up about 48% of the County land area.
- Land Study Bureau (LSB) Soils: The Land Study Bureau of the University of Hawaii prepared an inventory and evaluation of the State's land resources during the 1960s and 1970s.This was further refined to remove the SLU Urban district in 1995. The data classifies areas of the County by soil type, A-E, rating the land on its overall quality in terms of agricultural productivity. The County of Hawai'i does not have any lands classified as A soil type, and only about 1.8% of the County land area falls within class B soil areas. Classes B-D account for 32.2% of the County land area, or about 830,000 acres.
- Agricultural Lands of Importance to the State of Hawai'i (ALISH): This is a State level classification system designed to assist in identifying prime, unique and other important agricultural lands. It was developed as part of a national classification effort in 1977. About 22% of the County land area is designated in this effort, with about 4.5% of County land area in the

Prime Agricultural Lands designation. This data mostly overlaps with the SLU Agriculture district with some deviations.

- Land Use Pattern Allocation Guide (LUPAG): The current County General Plan establishes land use, including agricultural areas, under the LUPAG map. There are designations for orchards (ORC), extensive agriculture (EA) and important agriculture lands (IAL). About 40% of the County land area falls within these land use classes. EA "includes lands that are not capable of producing sustained, high agricultural yields without the intensive application of modern farming methods and technologies due to certain physical constraints such as soil composition, slope, machine tillability and climate." Orchards make up a relatively small amount of county land area (just over 3/10ths of a percent). Looking at just IAL, about 15% of County land area is within IAL, and that area falls mostly within the SLU Agriculture district.
- UHH Crops and Pastures 2012: In 2012, the University of Hawai'i at Hilo prepared a study on food production in the State of Hawai'i, *Hawai'i County Food Self-Sufficiency Baseline 2012*. This study focused on active crops and pasture within the State and did an extensive mapping effort of lands with current productive operations. About 1.9% of County land area, almost 50,000 acres, was identified as having active crop activity. 24.8% of the County land area was determined to be pasture lands.
- UHH Crops, Commercial Forestry and Pastures 2015: UHH prepared an update to the 2012 study, which was made publicly available in February 2016. This data shows about 2.4% of County land area is now in active crops and commercial forestry. Pasture lands mapped in this current effort appear to have tightened up, eliminating some of the fragmented land areas shown in the 2012 effort. This brings the pasture lands down from 2012 to around 21.5% of County land area. Whether this is due to a change to the mapping methods or a true loss in pasture areas is unclear at this time.

These various classification systems provide a number of ways of interpreting agricultural lands from a scenario modeling perspective. The goals of the Agriculture scenario are to strategically preserve known, productive agricultural land from non-productive residential subdivision. Historically, agricultural operations have required larger tracts of land to be successful and productive. While this is still true for many crops (commercial forestry, macadamia nuts, etc.), agriculture in the County of Hawai'i and in many other places has been evolving. The UHH study recognized that both land ownership patterns and agricultural trends have been shifting to small farms in many locations. To model this distinction in land required by crop type, two scales were chosen – small and large scale. County planners provided some initial sizes to test the regulatory impacts of setting minimum lots sizes for agricultural properties. Crops present in the County were then classified based on these scales:

- Small Scale (5 acre minimum lot size): coffee, diversified crop, flowers/foliage/landscape, taro, banana, dairy, papaya, pineapple and tropical fruits
- Large Scale (40 acre minimum lot size): commercial forestry, macadamia nuts, seed production, sugar and pasture lands.

All of the agricultural datasets provided challenges for working with the RPT parcels. Many crops are a portion of real property rather than the full property. Boundaries developed to capture priorities for agricultural regulation are based on crop locations as well as other cross- and sub-property data – soils, terrain, rainfall, etc. Additionally, the scale of existing crops did not offer immediate clues as to which properties would be most likely or best suited for future crops of this scale.

After reviewing the above analysis as well as a cluster analysis of 2015 crops (total and by scale), County planning staff provided guidance for the following modeling methods:

1. Productive Agricultural Lands (PAL): For the proposed boundary of what this policy would protect, it was decided to use the current LUPAG IAL plus pasture lands from the 2015 UHH study. This covered the existing GP policy areas and expanded to large pasture lands which have since been identified. Some of the smaller crops from the UHH study are not covered in this definition, but many are. This land area equates to about 28.1% of the County as a whole, or approximately 712,000 acres. Approximately 7,900 acres were excluded from this policy area based on location within the Urban or Conservation State Land Use class or where GIS topological errors depicted false overlaps with properties.
2. Scale for Minimum Lot Size: Crops and pasture lands provided some spatial clues as to general locations for future agricultural activities of the same scale, but many areas had a variety of crop activities at all scales. To classify properties containing PAL, the existing crop and pasture data were used, and potential future agricultural locations were scaled as follows:
    a. If an active crop is present, assume the scale of the current crop. In cases where there is more than one crop type present, assume the scale of the largest overlap.
    b. If pasture is present on a parcel, assume Large Scale.
    c. For all other PAL, use scale of closest crop or pasture area.

    Some small manual changes were done to reclassify crop scales that were out of character with the surrounding crops.

The Trend scenario was used as the starting point for the Agriculture scenario capacity and allocation. To incorporate the capacity changes under the Agriculture scenario, a parcel's PAL area was restricted to the minimum lot size of the scale of agricultural activity defined. Large scale PAL crop areas were assigned a 40 acre minimum lot size, and small scale crops were assigned a 5 acre minimum lot size. For example: A parcel is 100 acres in size and zoned A-20a (minimum lot size 20 acres). 40 acres of the parcel overlap with the PAL overlay. The 40 acres of PAL area is considered one productive agriculture feature. Because it is already at the minimum lot size for Large Scale PAL, no further subdivision is allowed. The remaining 60 acres would be subject to existing zoning rules for capacity.

Parcels that have already been subdivided to smaller than the minimum lot size would only be restricted in further subdivision, if applicable.

In all other aspects, the Agriculture scenario uses rules of the Trend scenario for capacity and desirability.

A map like those shown elsewhere for the other alternative scenarios is not available for the Agriculture scenario, but it shows patterns similar to the CDP scenario.

PDZ Scenario

The Priority Development Zone (PDZ) scenario follows some relatively basic rules to test the potential of steering growth to villages, towns and urban clusters. The goal is to put growth entirely (extreme case) or mostly within defined urban places to test how significant a change in likely outcomes would result in such a shift. This scenario defines urban areas using a criteria analysis to score places based on:

- Mix of residential and commercial zoning/uses
- Mix of housing types (single family and multifamily)

- County roads
- Road/intersection density
- Public or private water system
- Public facilities investment (school, park, or community center).

See Appendix A at the end of this document for a detailed explanation of PDZ criteria.

Based on the criteria score (though not perfectly aligned with the above), the following PDZ urban areas were chosen: Hilo, Kea'au, Pahoa, Volcano, Pāhala, Nāʻālehu, Captain Cook, Keauhou, Kailua-Kona, Kaiminani Area, Waikoloa Village, Hawi-Kapa'au, Waimea, Honokaʻa and Laupāhoehoe.

Generally the PDZ Urban area boundaries are defined as the outer extent of the SLU Urban and/or County urban zoning boundary that is not in flood/tsunami zones, projected SLR inundation areas (6 ft), or lava zones 1 or 2 (except in Pahoa), including areas contiguous to the "core" area with the highest urban score as well as areas in close proximity but separated from the core area and that meet the same criteria above. County staff provided further expertise on location specific boundary adjustments which best aligned with the goals of the PDZ concepts.

To analyze the possibilities of this scenario, the Urban Areas as defined were reviewed for existing capacity by FAZ. Looking at just the urban areas, or PDZs, there is existing capacity to meet the forecasted growth in most locations. In HPP-Orchidland, no PDZs were designated for this FAZ, so there is no PDZ capacity. Upper Puna also lacks enough PDZ capacity to accommodate anticipated growth. See the table below.

PDZ Residential Capacity and *Forecasted* Growth by FAZ

FAZ	Residential Capacity within PDZ Boundaries Under LUPAG Trend (Net dwelling units)	Forecasted Growth for FAZ as a Whole		
		Total Residential	Single Family	Multifamily
Hilo	25,578	3,785	2,952	833
North Hilo - Hāmākua Coast Villages	874	792	721	71
Honoka'a-Pa'auilo	1,996	927	871	56
Waimea	4,369	1,577	1,419	158
North Kohala	1,684	844	785	59
Kawaihae-Puako-Waikoloa-Waikoloa Resorts	8,821	2,675	1,338	1,338
North Kona	29,105	7,125	4,418	2,708
South Kona Villages	2,797	1,255	1,130	126
Ka'ū	2,791	2,247	2,135	112
Kea'au-Kurtistown	2,638	868	833	35
Upper Puna	2,614	3,477	3,373	104
HPP-Orchidland	0	7,583	7,431	152
Lower Puna	2,223	2,593	2,515	78
Total	**85,490**	35,748	29,921	5,830

For the first version of this scenario, the concept was to represent the extreme case of allocating all future development within PDZs, so capacity or allocation adjustments were necessary for FAZs that did not provide adequate capacity for anticipated growth. Puna including HPP-Orchidland happens to be one of the fastest growing locations on the island and was assigned more than 14,000 new dwelling units in the Trend scenario. To achieve the extreme 100% PDZ growth scenario, surrounding FAZs with additional PDZ capacity were re-assigned the anticipated growth from those with limited capacity. For the HPP-Orchidland area, anticipated growth was re-assigned to Kea'au-Kurtistown and Hilo. For Ka'ū, South Kona Villages and North Kona received anticipated growth that couldn't be accommodated in local PDZs. These overages were re-distributed based on the proportional share of growth for surrounding locations. When Kea'au-Kurtistown filled to capacity, the remaining growth was assigned to Hilo. After further discussion with CoH staff, a number of variations to the PDZ scenario were explored regarding the allocation of growth inside and outside of the PDZ designations. The purpose of this exercise was to develop an alternative that blended elements of the Trend Scenario with the PDZ scenario. These alternatives explored splitting future growth by shifting a proportion of Trend Scenario growth from outside of the PDZs to locations with capacity inside the PDZs. After looking at three alternatives, CoH staff selected a version where 50% of that growth that was to occur outside of the PDZ areas in the Trend Scenario was assigned to areas inside the PDZ and the remaining 50% was allocated outside of the PDZ areas. Abiding by this method required additional adjustments. Under the rules of this scenario model, a certain amount of development was now required to occur outside the PDZ. Capacity for multifamily residential and non-residential uses was limited in certain contexts (e.g.,

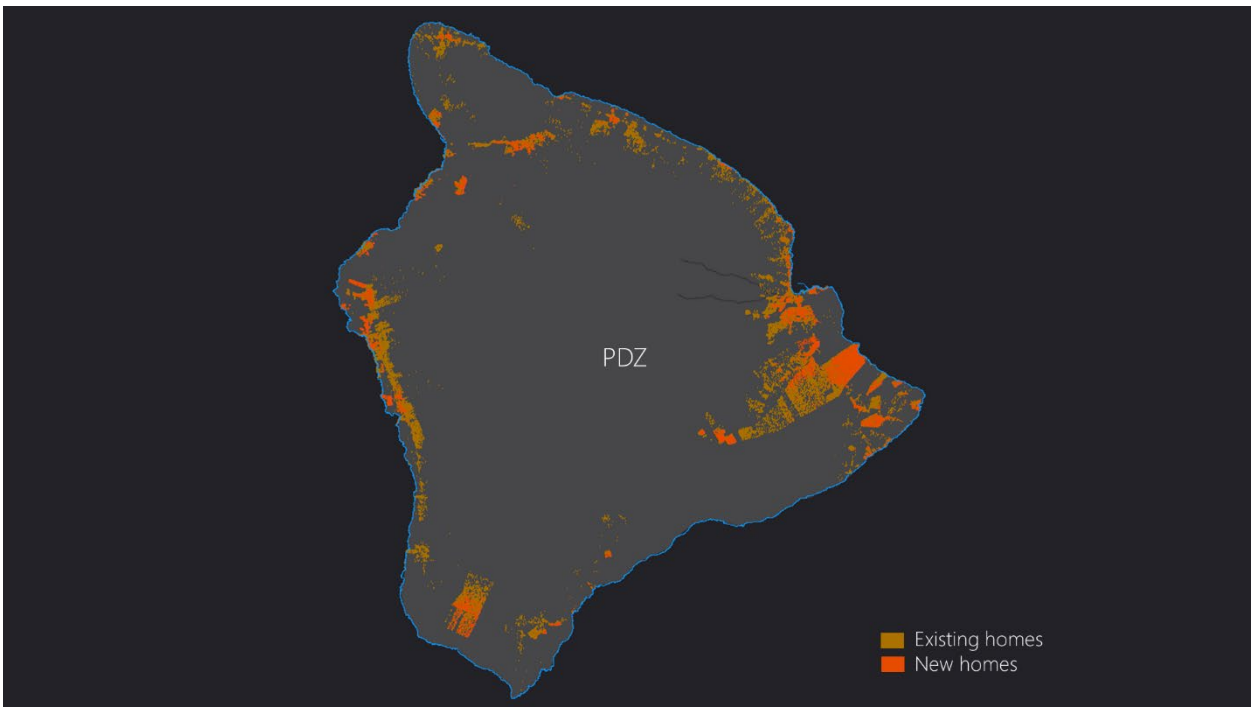
Lower Puna). In these instances, forecast growth was shifted back inside the PDZ or occasionally to the nearest PDZ which had available capacity (often Hilo or North Kona).

Residential PDZ Capacity and *Adjusted* Growth (Allocation Amounts) by FAZ

	Residential Capacity within PDZ Boundaries Under LUPAG Trend (Net dwelling units)	Revised 2040 Growth *outside of PDZs*	Revised 2040 Growth *within PDZs*		
		Total Residential	Total Residential	Single Family	Multifamily
Hilo	25,578	318	5,338	4,563	776
North Hilo - Hāmākua Coast Villages	874	361	418	392	26
Honoka'a-Pa'auilo	1,996	314	613	570	43
Waimea	4,369	475	1,103	952	151
North Kohala	1,684	264	580	539	41
Kawaihae-Puako-Waikoloa-Waikoloa Resorts	8,821	679	1,995	997	997
North Kona	29,105	959	6,167	3,824	2344
South Kona Villages	2,797	425	829	704	125
Ka'ū	2,791	882	1,365	1,297	68
Kea'au-Kurtistown	2,638	367	2,141	1,968	172
Upper Puna	2,614	1,611	1,866	1,809	57
HPP-Orchidland	0	3,716	0	0	0
Lower Puna	2,223	1,250	1,714	1,674	40
Total	85,490	11,622	24,128	29,921	5,827

By adjusting the FAZ level control totals for growth within the capacity limitations of the PDZ boundaries, the model explores an alternative future where growth is clustered in and around existing urban areas. Other components of the model remained unchanged from Trend. At the parcel level, growth was still determined by trend-based guidelines for desirable development locations, and parcels only fill to the density thresholds previous established for LUPAG.

The development pattern for PDZ is illustrated in the figure below. As expected, housing is increasingly concentrated in designated PDZ locations.



LUPAG Trend Scenario

Hawai'i County's current general plan includes the Land Use Pattern Allocation Guide (LUPAG) map: a broad, flexible design intended to guide the location and type of future developments in a coordinated manner. As a regulatory document, state land use boundary amendments, changes in zone, project districts, subdivisions, planned unit developments, use permits, variances, and plan approval must be consistent with the General Plan's LUPAG maps. However, the LUPAG's boundaries and policy prescriptions are not precisely applied to tax parcels and therefore some interpretation is required to translate the LUPAG into a land use scenario.

Very broadly, the LUPAG defines an urban growth boundary (UGB) and within the boundary allows for greater residential densities than typically prescribed by the zoning. In terms of a scenario model, this means that the LUPAG Trend scenario suggests locations where additional capacity are appropriate without restricting capacity that is currently defined by the zoning and reflected in the Trend Scenario. LUPAG does not prescribe additional non-residential capacity, so in the LUPAG Trend scenario, there is no change in non-residential development.

The previously developed Trend scenario (Zoning Trend) used capacity allowed under zoning regulations and historic density levels to guide a theoretical maximum development potential. This process to develop the Zoning Trend capacity included thorough review and accounted for realistic limitations on development (e.g. geographic constraints, density of existing development, etc.). In developing a Trend scenario based on the LUPAG classifications, the Zoning Trend scenario was used as a concrete, thoroughly developed base for island-wide capacity.

In applying LUPAG capacity, several options were weighed. One alternative was to use densities (where explicitly given) under LUPAG classifications and simply apply those to underlying land. Thus any property that might benefit from such a density boost would see capacity increase. In many cases,

however, the LUPAG densities depart significantly from the underlying zoning densities. This in many locations would have been negating realistic thresholds that were set in the initial Zoning Trend scenario. For example, the High Density Urban class allows for development of up to 87 dwelling units per acre. Based on analysis of what developments have achieved in terms of density even in very urban places on the island, this density applied to all HDU locations would have resulted in some unrealistic thresholds for future growth.

Another consideration is whether or not a property is developed currently. Since the LUPAG classes are designed to allow for redevelopment, it does make sense to account for some increases in density even in areas currently built-out. It seems unlikely, however, that the LUPAG densities will be achieved in all places, particularly in historic context. After review of the Zoning Trend capacity in urban places, it was determined that sufficient capacity was available to allow for redevelopment activity under the model without needing to apply LUPAG density bonuses.

Weighing these previous considerations, it was decided to use the land classes for existing development established under the Zoning capacity and existing conditions analysis as a guide for logical locations where LUPAG might influence the future potential capacity. The table below illustrates how these refinements were applied. LUPAG capacity was limited exclusively to greenfield parcels. Greenfield areas are those where existing development is absent or very sparse (i.e., vacant land). Parcels with residential redevelopment potential (i.e., residential development on parcels that are already developed) were not upzoned in the LUPAG Trend scenario. Some additional refinements to LUPAG capacity were made based on the ability of the parcel to further subdivide according to existing zoning rules. The LUPAG Trend Scenario does not add additional capacity in places where the zoning would otherwise preclude it (e.g., industrial areas, conservation areas, etc.). The LUPAG Trend Scenario does add additional capacity where it coincides with Agriculture State Land Use districts but not Conservation districts.

For residential development, the LUPAG prescribes densities using three urban classes: High, Medium and Low Density (HDU, MDU and LDU, respectively). An additional LUPAG class, Urban Expansion (UE) does not have a LUPAG density prescription but by reviewing existing densities within the UE zones, County planners determined that the densities implied by the Low Density Urban zone would be appropriate within this zone.

Application of LUPAG capacity rules to parcels

		Greenfield parcels *without* potential to subdivide	Greenfield parcels *with* potential to further subdivide	All other parcels
LUPAG Class	**High Density Urban**	Inside UGB: 87 units/ac; outside: use zoning	87 units/ac	Use Zoning
	Medium Density Urban	Inside UGB: 35 units/ac; outside use zoning	35 units/ac	Use Zoning
	Low Density Urban	Inside UGB: 6 units/ac; outside use zoning	6 units/ac	Use Zoning
	Urban Expansion	As LDU, 6 u/ac	As LDU, 6 u/ac	Use Zoning
	Rural	Use Zoning	Use Zoning	Use Zoning
	Resort	Use Zoning	Use Zoning	Use Zoning
	Resort Node	Use Zoning	Use Zoning	Use Zoning
	All Other LUPAG Categories	Use Zoning	Use Zoning	Use Zoning

The table below shows the differences in the residential capacity in dwelling units between the Trend Scenario and the LUPAG Trend scenario. During the initial calibration of the allocation model, it was decided to place caps on the capacity of individual parcels to limit the amount of development that could occur on any single parcel. Caps for residential development were identified by looking at the County's subdivision records and the 2004-2015 building permit data. This information revealed that the recent historical maximum was 600 units for residential development (the Capacity section of the Trend Allocation Technical Report goes into this topic in additional detail). Under the LUPAG classes, the residential capacity is significantly higher than in the Trend Scenario.

Capacity differences in LUPAG and Trend Scenarios

FAZ Name	Trend Net Residential Capacity (dwelling units)	LUPAG Net Residential Capacity (dwelling units)	Difference (dwelling units)
Hilo	23,482	43,811	20,329
North Hilo - Hāmākua Coast Villages	8,771	12,967	4,196
Honoka'a-Paauilo	9,730	16,837	7,107
Waimea	7,634	12,160	4,526
North Kohala	10,181	19,471	9,290
Kawaihae-Puako-Waikoloa-Waikoloa Resorts	19,052	33,685	14,633
North Kona	27,231	66,078	38,847
South Kona Villages	21,635	25,720	4,085
Ka'ū	27,059	33,149	6,090
Kea'au-Kurtistown	5,593	14,471	8,878
Upper Puna	25,421	27,337	1,916
HPP-Orchidland	9,996	11,893	1,897
Lower Puna	26,079	34,474	8,395
Total	221,864	352,053	130,189

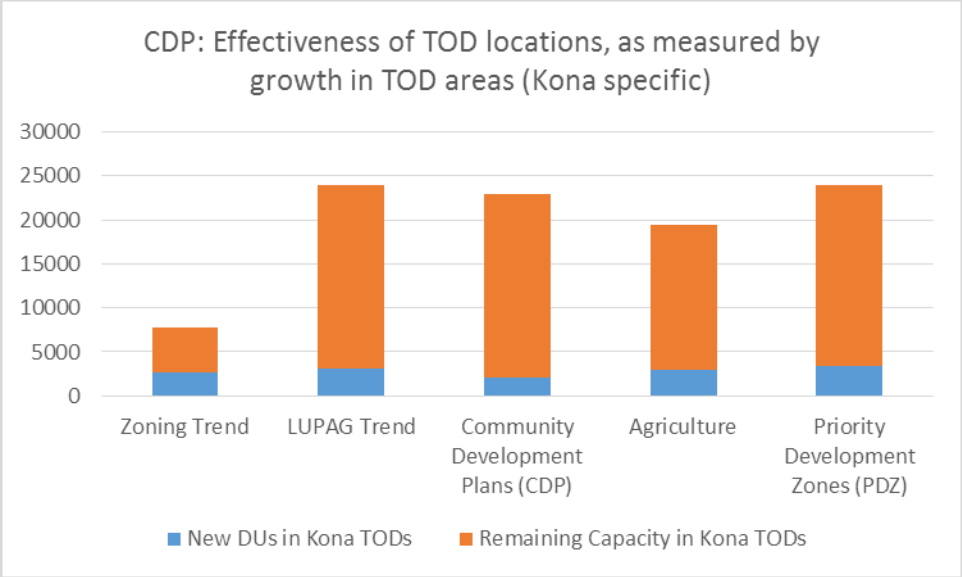
With the exception of capacity, residential and non-residential development were allocated to parcels using the same settings as in the Trend Scenario: desirability, randomness and calibration factors were all held constant. The number of net new dwelling units allocated to the LUPAG class areas are shown for the Trend and LUPAG Trend Scenarios in the table below. The effects of the increased capacity on the allocation are modest. As expected, High and Medium Density Urban areas gain additional dwelling units in the LUPAG Scenario but not at significant rates. LUPAG LDU areas draw fewer dwelling units than in the Trend Scenario. This result was unexpected but a deeper look at these results reveals that in most cases the LUPAG opens up so much capacity that other LUPAG classes (HDU, MDU) draw a greater share of residential growth (e.g., in Hilo, Kona). Another factor influencing these results is that substantial residential capacity exists beyond the LUPAG's UGB (e.g., Puna, Kea'au). Often in more desirable locations, this "non-LUPAG" capacity attracts substantial residential growth.

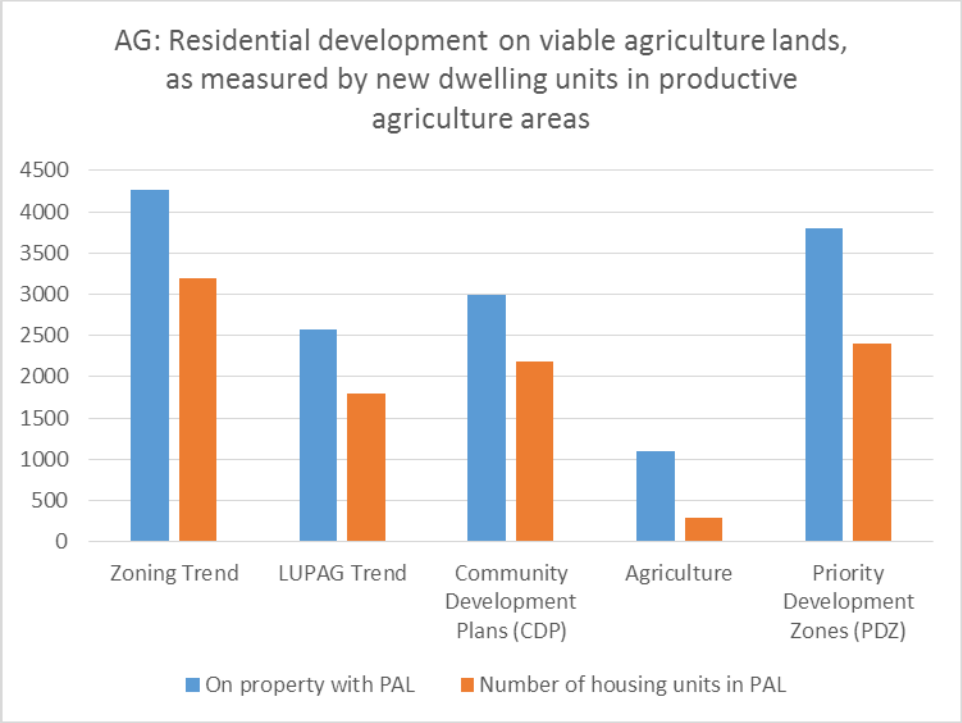
Allocated growth results by LUPAG class areas

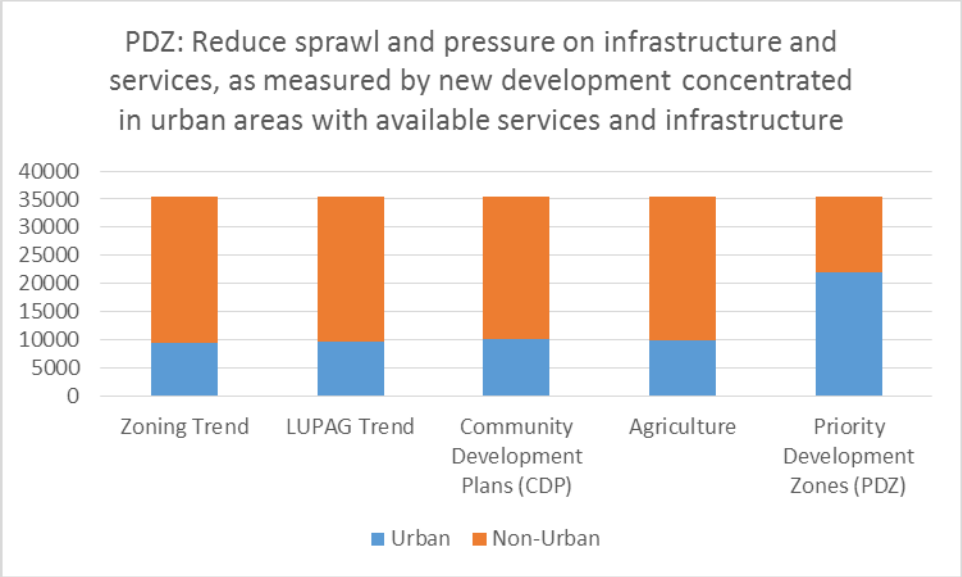
LUPAG Class	Trend Residential Allocation (dwelling units)	LUPAG Trend (dwelling units)	Difference (dwelling units)
High Density Urban	574	1,158	584
Medium Density Urban	2,897	6,805	3,908
Low Density Urban	10,603	10,189	-414
Urban Expansion	2,888	3,125	237
Other	18,526	14,322	-4,204
Total	35,488	35,599	111

Initial Conclusions

Later in the project, the scenarios were analyzed on a comprehensive series of measures, indicators, which are presented in a separate summary report. To test the scenario intent, a few simple measures were developed early on and are presented here. These initial scenario snapshots are also included in the scenario comparison CommunityViz analysis.







As preliminary results showed, the scenarios appeared to be addressing the specific goals set forth at a high level.

The Agriculture scenario greatly reduces new development on agriculture as compared to other alternatives.

The PDZ scenario, by design, places all new growth in urban areas. This compares with other scenarios less than 40% urban.

The CDP scenario achieves most of its goals, with some potential exceptions for TOD centers. While the CDP does increase capacity in the TOD centers, the CDP scenario is not showing more growth in CDP centers than other scenarios. There are multiple reasons for this result. While capacity is increased at the sites of the TOD centers, capacity is not decreased elsewhere and abundant capacity exists in other areas of Kona. In the case of the Kona TOD centers, abundant capacity and high desirability exists mauka of the planned TOD route.

The desirability of the parcels near TOD sites is in particular a significant factor. As stated in the description of CDP Scenario, desirability was boosted around CDP hot spots that included the TOD sites. Despite this boost in desirability, many of the TOD sites are located in areas where desirability is limited by other factors, primarily large parcel size. This factor was added during the calibration of the Trend Scenario desirability to penalize parcel size, reflecting known barriers to development. In order to develop larger parcels, developers have to undertake expensive and lengthy subdivision processes, infrastructure investments (roads, water, wastewater, etc.) that all tend to encumber the process of development. Smaller parcels lack many of these barriers so they are given priority in the desirability. This issue is described in greater detail in the Trend Allocation Technical Report. For a full measure of growth in all CDP centers, see the following tabular results.

Later in the project, the following tables was developed and are included here to provide a few more details on how some of the alternative scenarios performed. The Agriculture Scenario was not fully modeled, so its results are not shown here. More details are included in the Indicators Technical Report.

Conservation

	Existing	Trend	CDP	PDZ
Residences in sensitive ecological areas	3.5%	4.6%	4.0%	3.9%
Residences on open space	1.6%	1.1%	3.6%	1.2%
Residences on productive agricultural land	13.3%	11.9%	11.0%	11.2%

Hazard Avoidance

	Existing	Trend	CDP	PDZ
Residences in lava high hazard zones	10.0%	11.0%	10.6%	10.1%
Residences in sea level rise/tsunami caution areas	7.4%	6.8%	6.6%	6.8%
Residences in high wildfire risk zones	29.7%	28.1%	26.3%	28.8%

Building Blocks

	Existing	Trend	CDP	PDZ
Residences in water service area	64.9%	57.8%	59.5%	64.4%
Nonresidential near water infrastructure	49.4%	84.6%	84.5%	85.1%
Residences in wastewater service area	15.9%	15.2%	14.5%	17.4%
Nonresidential on wastewater infrastructure	49.4%	46.4%	46.2%	48.1%
Distance to emergency services (fire, police, hospital)	2.26	2.33	2.23	2.03
Residences on public roads	64.4%	57.3%	57.6%	63.1%
Residences within 1 mile of a County active park	50.0%	46.7%	48.3%	55.8%
Residences within 1/2 mile of bus route	74.1%	69.7%	71.8%	75.8%
New residences near congested arterials	28.1%	32.1%	33.4%	29.3%

Mixed Use Centers

	Existing	Trend	CDP	PDZ
Variety of housing sizes	2.73	2.63	2.96	3.37
Accessory and 'ohana units	39.7%	42.8%	39.0%	34.2%
Number of vacant lots	1.52	1.82	1.78	1.58
Development outside urban boundaries	1.79	2.00	1.92	1.62
Jobs:Housing mix ratio in existing towns	15.8%	21.4%	17.9%	15.6%

APPENDIX A: Specific Guidance on PDZ Urban Locations

General Criteria
Define PDZ Urban areas as areas that have these criteria (or meet a particular "urban score" threshold based on these criteria):

- Mix of residential and commercial zoning/uses
- Mix of housing types (single family and multifamily)
- COH road density
- Road/intersection density
- Public or private water system
- Public facilities investment (school, park, or community center).

PDZ urban areas are therefore:

- Hilo
- Kea'au
- Pahoa
- Volcano
- Pāhala
- Nā'ālehu
- Captain Cook
- Keauhou
- Kailua-Kona
- Kaiminani Area
- Waikoloa Village
- Hawi-Kapa'au
- Waimea
- Honoka'a
- Laupāhoehoe.

Then, generally define the PDZ Urban area *boundaries* as the outer extent of the SLU Urban and/or County urban zoning boundary that is not in flood/tsunami zones, projected SLR inundation areas (6 ft), or lava zones 1 or 2 (except in Pahoa), including areas contiguous to the "core" area with the highest urban score as well as other areas in close proximity but separated from the core area and that meet the same criteria above.

Place-Specific Refinement and Exceptions to Boundary Definitions
Hilo
Additions to SLU Urban core:

- Contiguous Puueo-Wainaku area (north of Wailuku river downtown)
- Non-SLU Urban area between Puainako and Mohouli up to and including Hilo Hillside (RA-zoned area at end of Kukuau).

SLU Urban area exclusions:

- Near intersection of Kaumana and Puainako

- Upper Amauluu (mauka of Puueo-Wainaku)
- Upper Kaiwiki (mauka of Puueo-Wainaku)
- Nani mau area (TMK 3-2-2-052:020 and contiguous SLU Urban parcels).

Kea'au
Rather than following SLU Urban, follow boundaries of CDP village town center, excluding Shipman industrial.

Pahoa
Rather than following SLU Urban, follow boundaries of CDP village town center and join the two nodes.

Volcano
SLU Urban area exclusions:
- Golf course area
- Makai side of highway

Pāhala
SLU Urban area exclusions: TMKs 396012012 and 96012027.

Nā'ālehu
Follow SLU Urban.

Captain Cook
Extent of SLU Urban core (i.e., exclude SLU Urban areas south and north): On the south end, start at Kealekekua Ranch Center (southern extent of commercially zoned area) and continue north to Kainaliu (Trousseau Rd).

Keauhou
Northern extent of SLU Urban core: Kahaluu (i.e., the ag-zoned area just north of the Kamehameha III intersection with the highway) to include TMK 7-8-010-002 + 004 extended to the shoreline.

Kailua-Kona
Southern extent of SLU Urban core: Lako Street Future Extension to Alii Drive (to include TMK Plat 7-7-021 and extension therefrom to Ali'i Drive).

Northern extent of SLU Urban core: North side of Honokahou Harbour TMK 7-4-008-003, along edge of National Park parcel, then running north along QueenKaahumanu Hwy to a point in line with the north boundary of TMK Plat 7-4-024 and extending that same line inland to the top of 7-4-008-057; then south and east to include all of TMK Plats (in clockwise order viewed from "mother" plat 7-4-008) 7-4-017, 018, 016, 009, 011,012, 013, from the lower (west) end of Plat 013, the line runs south-southeast to connect, then follow, the Hienaloli Road running along the top of TMK Plat 7-5-010. Continuing south, the line will extend to run along the top of TMK Plat 7-7-013, then seaward (west) along its south boundary to include TMK Plats 7-7-015 and 016, then across its bottom to join/end at south side of TMK Plat 7-7-021.

Kalaoa
Entire area (not limited to SLU Urban) bounded as follows:

- West extent: open-zoned area
- East extent: areas near (above) highway not zoned A-20a (not including Kaloko mauka area)
- North extent: Northern boundary of TMK Zone-Section 7-3; Contiguous SLU Urban (just south of Hamanamana St.) and including intervening areas not within SLU Urban
- South extent: Hina Lani, seaward (west) to a point fronting water tank site TMK 7-3-009-030; line will run north from there, along west (seaward) boundary of 7-3-009-007 and 008, and Plat 7-3-046; continuing north through Plat 7-3-052 to run along the top of the parcels within 7-3-010 (which forms the bottom of numerous residential house lot plats, to the point of beginning at the north extent.

Exclusions:

- TMK 73010042
- Areas south of development near Kaiminani (TMKs 73010006, 73010002, 73009005, and vicinity)
- SLU Urban makai, north, or south of Urban zoning in proximity to Kaiminani
- 73009019.

Waikoloa Village

SLU Urban area exclusions:

- Rural area adjacent to core
- All lands outside of the Waikoloa Village Rectangle, e.g., not including ʻĀina Lea.

Hawi-Kapaau

One PDZ: Hawi and Kapaau nodes connected by a narrow "barbell" corridor, following SLU Urban.

Waimea

Contiguous SLU urban (main area, not including separate areas to the west)

Honoka'a

Contiguous SLU Urban (not including two disconnected SLU Urban nodes)

Laupahoehoe

County urban zoning from Papaaloa Rd to north end (not including disconnected RS zone near gulch)