Per-Capita Impact Fee Alternative

Prepared for Completion of Urban Planning M.S.

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Executive summary

Per unit or per capita impact fees insufficiently address access and increasing intensity of use of park and open space land in municipal corporations with no intention of boundary expansion. Additionally, the use of impact fee zones exacerbates inequitable access to parks and open space by keeping revenue generated from high development areas from areas seeing little to no development. This paper examines the current state of the Madison city impact fee ordinance and identifies its weaknesses. I then proceed to develop an alternative to address these weaknesses.

I used a differential systems modeling software to project population, housing units, cash flow, and park and open space acreage, to follow the assumptions of Madison's parks and open space plan and impact fee ordinance to their conclusion. I then draw upon a wide educational background including public policy, and transportation management, to propose an alternative formation of fee assessment. The aforementioned model produces nonsensical results. The model predicts a City with increasing population, increasing housing unit development, and a city that somehow manages to convert urban land to park and open space.

Utilizing a single fee district, basic transportation modeling software, and what-if analyses, a developer can fully internalize their impacts on access and intensity of use of park and open space. I recommend utilizing modern software, better trained professionals, and long-range thinking to develop a way of quantifying the impact developers have on access and intensity of use of park and open space. I also advocate for developer driven remediation and cost bearing.

Problem

The City of Madison (hereafter "the City," or "Madison City") currently requires land dedication or fees in lieu thereof (Madison General Ordinances §20.08(2)(a)(2014)) specifically for Parks and Open space when developers build housing units. The authority to require land dedication and to assess fees in lieu thereof in addition to impact fees is granted under Wis. Stat. §236.45(1)(2014) and Wis. Stat. §66.0617(2)(a)(2014) respectively.

The City's current Needs Assessment assesses dedication and fees in lieu thereof on a per unit (single or multi family) basis, without taking into account self imposed spatial boundary constraints (Parks, 8). Such boundary constraints intuitively form a negative feedback with housing unit construction. However, boundary constraints and the subsequent negative feedback are not addressed in the parks and open space plan, nor the municipal ordinance administering the fees. Assessing such requirements on a per unit basis, with the assumption that equal proportions of developers dedicate land and pay fees in lieu thereof, total receipts (credits) to the City forms a function linear in housing units:

Parkland = (1/2) * Total housing units + Initial Parkland.

A linear specification for a closed system does not work. Eventually Madison requires more parkland than available within the City proper. The problem lay in sufficient specification of the current system to convince policy makers and City officials to allocate additional resources and research into a sustainable method to maintain City Parkland service level standards. The problem summarized: Do current Madison City Fee, Parkland Dedication ordinance and Park and Open Space Plan meet future City needs and how can planners accommodate these predicted needs.

Model

Specification

To initially characterize the current Madison City Parkland dedication and fee system, I broke the system into the following major components and specified each separately: Population, Housing, Fees, Units to dedications, and Land ration and constraints. I constructed the system using the dynamic systems modeling software package, STELLA by isee Systems. Each component of the overall model links to the other by "ghosting" (replicating) certain elements of other components. The software follows the basic premise of any differential system, that of stocks and flows.

The entire model relies on predicted population growth and the number of people in each cohort. Fertility rates (WDHS, 2012), number of males and females by age group, and migration numbers were taken from U.S. Census data (Census, 2014), and mortality rates were taken from the CDC life tables(CDC, 2012). It is important to note that without migration, the entire population reaches a significantly lower than present day equilibrium and therefore all figures were created with and then without the effects of migration. To illustrate the impact of immigration on City population see Figure 1, and Figure 2. For a stock and flow visual of each model sector, see Appendix A. For a full differential equations specification of the model, see Appendix B.

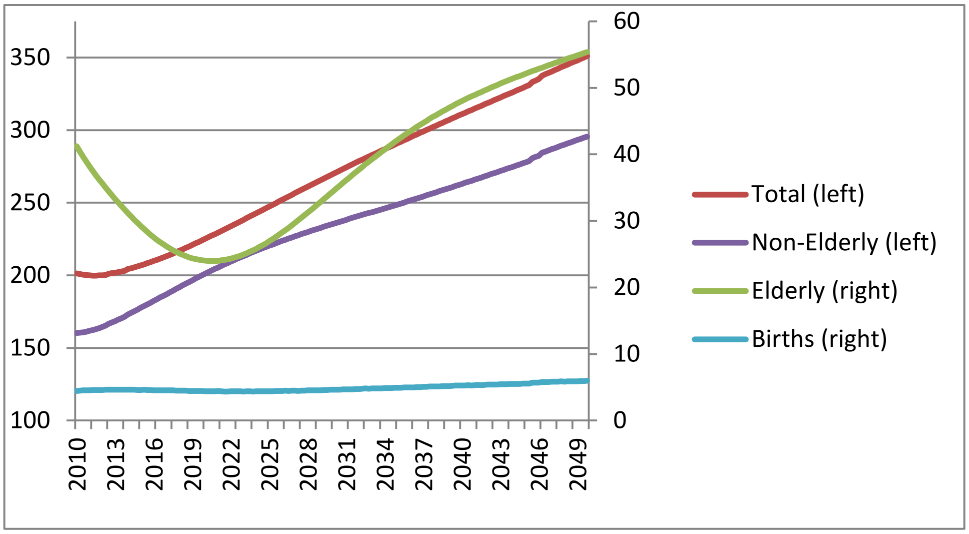


Figure 1 Population over time (migration). Scales in thousands. Author.

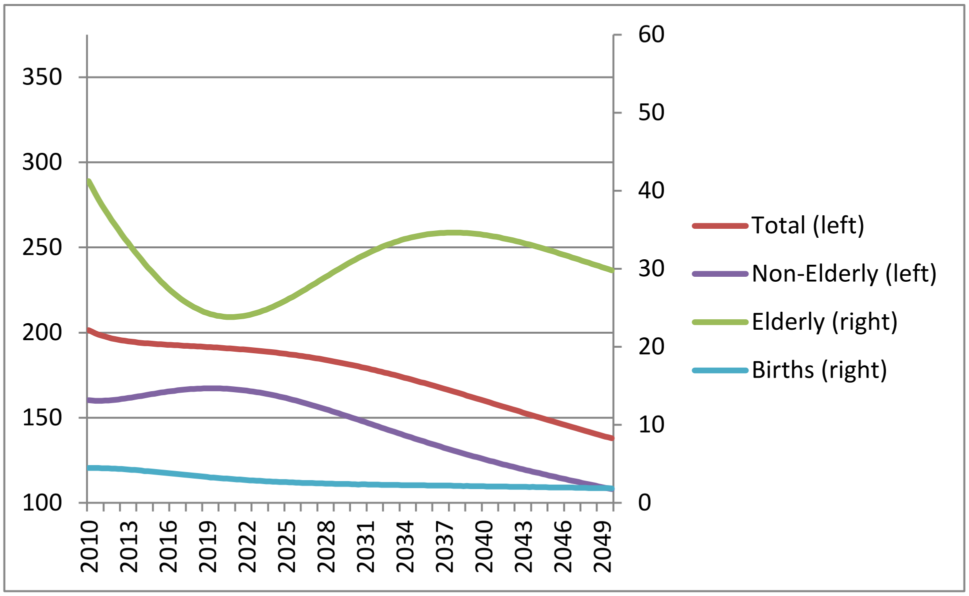


Figure 2 Population over time (no migration). Scales in thousands. Author.

Inferences

Population

With positive net immigration (see Figure 1), total births stay relatively constant. Constant births in addition to positive net immigration leads to an increase in the non-elderly population over time. As people progress through their life years, the population ages. This aging manifests in an increasing elderly population over time. This increase in total population sets the stage for our analysis of the inadequacies of assessing land dedications and impact fees on a per-housing unit basis. The complete converse of these growth trends appears with no net immigration (see Figure 2).

Housing market

Without migration, declining population (Figure 2) eventually results in no new housing units and therefore equilibrium between both housing unit types (Figure 4). With migration and therefore increasing population, the housing market booms, busts, and then equilibrates (Figure 3). Therefore, population drives the housing market. The housing units produced in the housing market form the basis for the resultant cash flow from the impact fees, fees in lieu of dedication, and acres of parkland. For an examination of the housing market's effects on vacancy and population density, see Figure 10, and Figure 11 in Appendix C.

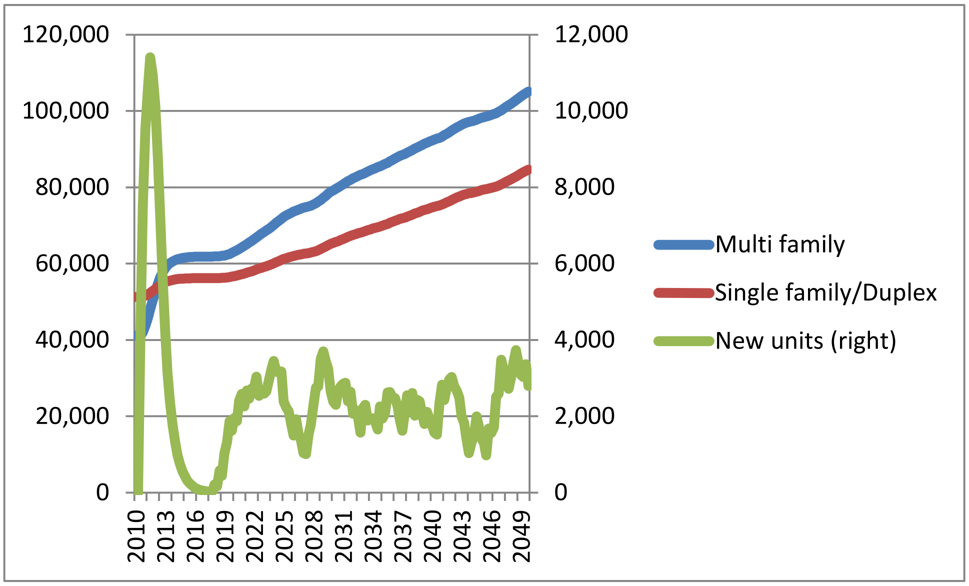


Figure 3 Housing market (migration). Author.

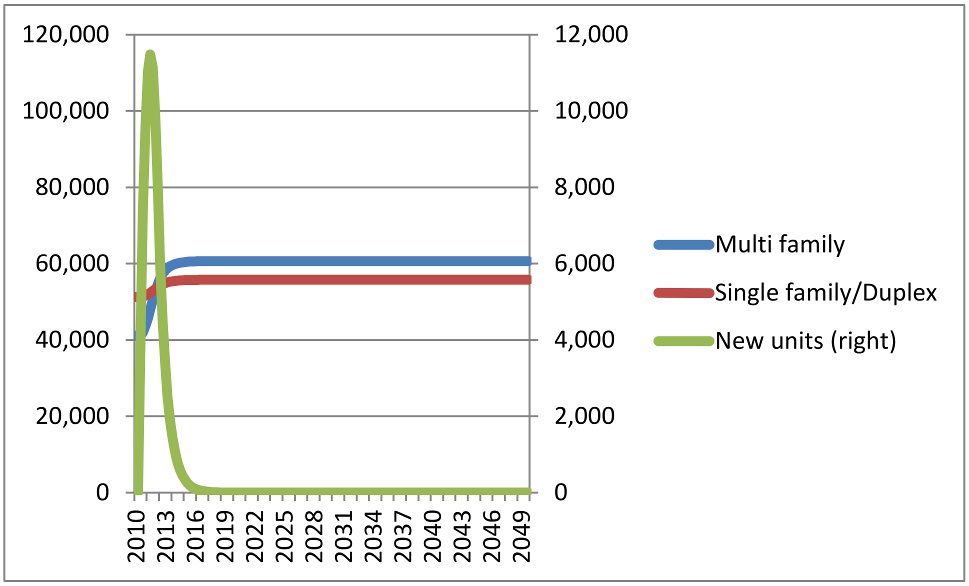


Figure 4 Housing market (no migration). Author.

Cash flow

Due to the current assessment of the fee on new units, the components of the fee and therefore total revenues decrease over time without migration (see Figure 6). The inverse is true with migration (see Figure 5). One additional caveat specific to Madison City's Park impact fee, is the utilization of impact fee districts pursuant to Wis. Stat. §66.0617(5)(b) (2015). This precludes the expenditure of revenues in a district different from which they were generated. This self imposes a reduction in the financial flexibility the City exercises whereupon areas with larger developments receive larger investments and areas with lesser development receive lesser investments. In practice, this prevents the investment of revenues in the poor, mostly minority areas of Madison City which already lack Park and Open space.

Figure 5 Cash flow (migration). Scale in millions. Author.

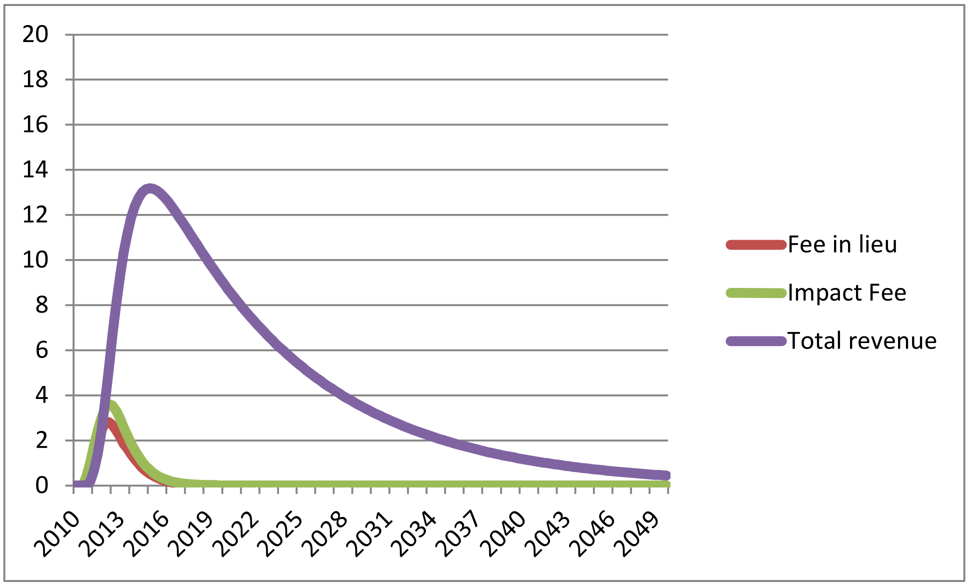


Figure 6 Cash flow (no migration). Scale in millions. Author.

Parkland

The current ratio of parkland to total City land is quite small. The effect increases without migration (Figure 8) and even more with migration (Figure 7). However, with migration, unless population equilibrates in the near future and beyond the scope of predicted years in this model (Figure 1), a large portion of the City must convert to Parkland while still accommodating a significant increase in housing units (Figure 3). Therein lay the inadequacies of assessing the fee on a per unit basis while still offering land dedication requirements in a City with no intentions of expanding its corporate boundaries.

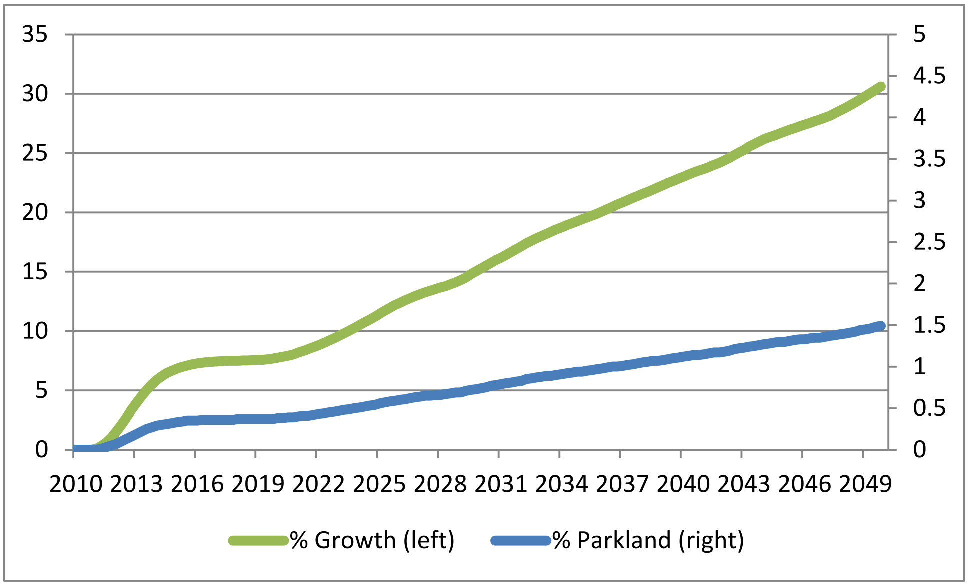


Figure 7 Parkland growth as % of total City land (with migration). Author.

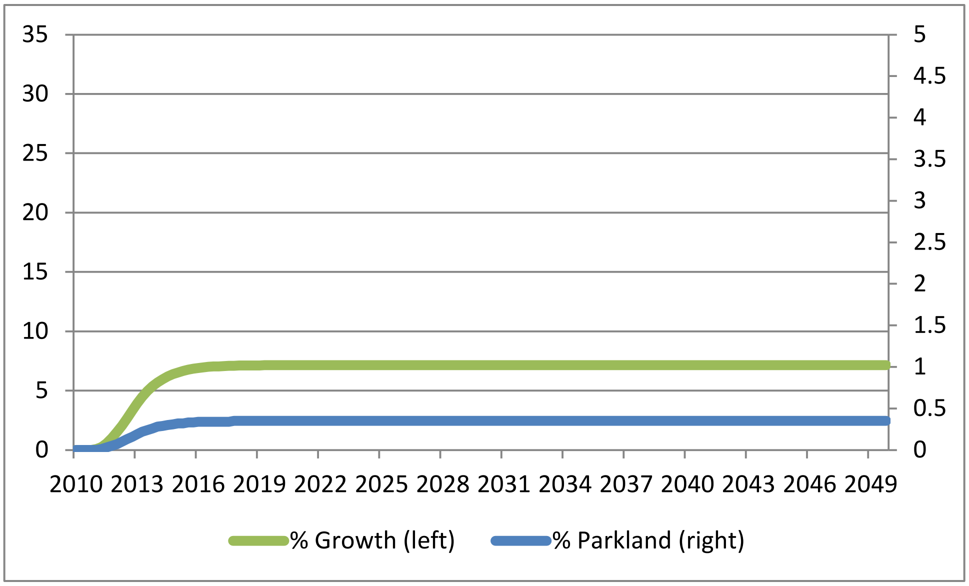


Figure 8 Parkland growth as % of total City land (without migration). Author.

Summary

The above model is inherently one-dimensional. Despite increasing population (Figure 1) and subsequent increasing housing units (Figure 3), the model assumes the City can accommodate such changes. Madison City does not intend to expand its corporate boundaries aside from a small increase in total land due to a planned annexation of the Town of Madison. This weakness of the model follows the weakness of the thought process behind the construction of the fee: the City will not expand and therefore a fee cannot base itself upon limitless urban land.

Without population equilibrium, the entire City must support a vast population, limitless housing units, and become a massive park. The conclusion is nonsense. The intention of the fee must face the following realities:

- Increased population will increase demands for Park and open Space;
- Increased housing units will increase the cost of land to both the private and public sectors;
- The municipal corporation is highly unlikely to obtain new parkland due to increased costs of purchase and maintenance;
- The municipal corporation must seek to increase revenue streams and invest in increasing uses of existing parkland;
- The municipal corporation must ensure total financial flexibility to invest revenues anywhere within its boundaries.

The above list of realities forms the basis upon which we explore a stronger, long-range thinking, realistic alternative.

The alternative

The list of realities in the above Summary naturally addresses the weaknesses of the current structure of the per capita impact fee. A fruitful alternative addresses these in full and has a natural dichotomy: Regulatory Environment, and Measurement and remediation. Regulatory Environment addresses impact fee districts and focuses the alternative on cash flow rather than dedication requirements. Measurement and remediation focuses on quantifying the impact of a proposed development on the current state of affairs, and forms the basis upon which the developer can propose remediation at their expense. This dichotomy is explored below.

Regulatory Environment

Impact fee districts

The current impact fee disaggregates the city into numerous impact fee districts pursuant to Wis. Stat. §66.0617(5)(b) (2015) (see Figure 9). In theory, this provides the perception that fees exacted from developers will be spent in a similar geographical location. This linking of revenue source and expenditure target enhances the legal requirement that a levied fee bear a rational nexus between its trigger and its purpose.

The detriment of utilizing districts is the uneven location of development with a City over time. In Madison City, the Tenney Law & James Madison, and Vilas-Brittingham districts (districts 6 and 7 in Figure 9) see a significantly greater number of development and therefore fees and dedications than any other location in the City. However, this area is seeing gentrification of poor and minority residents away from these districts. Therefore the least financially capable,

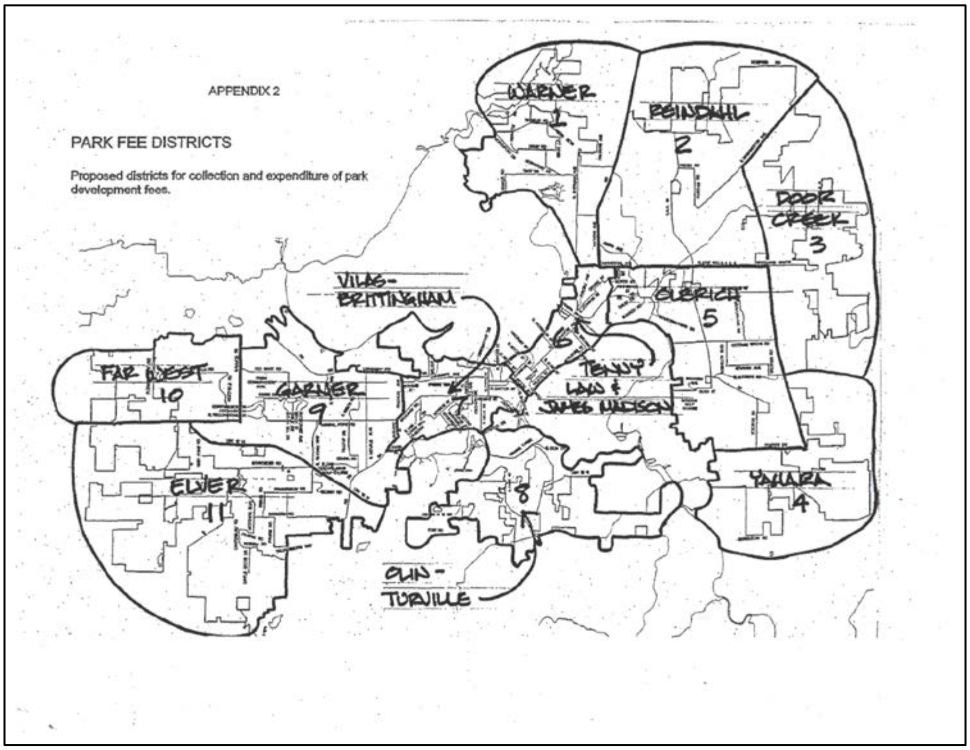


Figure 9 Impact Fee Districts. (Parks, 2002)

and least served areas and populations of the City are unable to form the targets of the vast majority of cash generated from districts 6 and 7.

Impact fee districts therefore naturally perpetuate, and exacerbate unequal access to parkland and open space in the City. Therefore, the proposed alternative has one district: the corporate boundaries of the City. This single district provides the most financial flexibility to the City for the utilization of revenue generated from the impact fee. Additionally, this allows the entire City to form the basis for suggested analyses and subsequent remediation (see Measurement and remediation) providing for more just access to parks and open space.

Dedications

The current impact fee ordinance requires developers to dedicate a certain number of square feet, or pay an exaction in lieu thereof pursuant to a linear function of proposed unit development. However, the simple analysis in the Model section of this paper projects an increasing population (Figure 1), and increasing subsequent unit development (Figure 4). Additionally, if we follow the assumptions of the ordinance to their logical conclusion, despite increasing population and housing units, a large percentage of the City will convert to parkland (Figure 7). With the aforementioned projected demographic and economic background, price of urban land will likely increase.

If the City must purchase additional parkland within its own boundaries, it will face significantly greater costs over time than the current state of affairs suggests. Therefore, purchase of urban land in the city proper is not financially viable over time given the current fee structure, regardless of adjustments for inflation. The alternative must focus on increased revenue generation over time in addition to forcing developers to remediate their impact on access to parkland and open space. This additional revenue allows the City to pursue enhanced maintenance of existing parkland, and to invest in capital on such land to increase the potential intensity of use. The City or the developer may also suggest park specific capital investments to address projected increased demand for parks. This is the only avenue available to urban areas with no intent for spatial growth. City's must increase the intensity of parkland and open space use and access to existing spaces rather than increasing absolute availability of land.

Measurement and remediation

A fee levied by a City must bear a rational nexus between its generation and its target. A per unit impact fee is a rough proxy to this effect and given advanced technologies, availability of data, and increasingly better trained planning professionals, a significantly better proxy is proposed within this alternative. This proxy includes: quantifying the current state of affairs (Index), conducting before and after development analyses given ex-ante knowledge (Impact analysis), and forcing developers to remediate any projected deficiencies (Remediation).

Index

Madison City is greatly concerned with access to existing Parks and Open space. Additionally, the City is concerned with disparate access by location of residence, race, and income. Therefore the logical basis upon which to form decisions is that of impacts of development on access taking into account sub-populations demarcated by: space, race, and income. Municipal Planning Organizations, Municipal Planning Divisions, and Municipal Engineering Divisions are more than capable of measuring access to areas within a City down to the census block according to the below proposal. The census block is the unit of analysis for the index described below.

Each census block within the City containing park and open space can have its accessibility quantified. The alternative will measure the amount of time it takes to go from census block a to census block b. Census block a or b can be flagged by majority race, or majority income. The measurements of time, broken down by income or race at the inception of the index provide the baseline upon which to measure impacts of proposed development. This prevents the City from forcing developers to cure existing deficiencies.

This analysis also allows the City to predict demand for certain parks and open space. Measuring time from census block a and census block b is usually accorded to the gravity model of trip origins and destinations. Although access looks at the amount of time a trip takes, demand for a particular destination park manifests as the total number of trips with destination in census block b. Therefore all census blocks containing a park and open space can be ranked according to their demand approximated by the number of times a trip destination lay in the census block. This proxy for demand, when considered in an ex ante Impact analysis, provides a natural baseline to select which parks are likely to have increased use demand due to a development.

Impact analysis

Given a proposed development, the Index can be re-run with parameters which quantify the projected impact of the proposed development on access and impact to existing parks and open space. The time estimates can be compared to the baseline time estimates. Increases in time for particular census blocks, or for particular sub-populations, or net increased number of trips ending in a census block containing a park or open space form the rationale for the City to approach converse with the developer.

This City can enumerate projected impacts of their development on access to parks and open space and then request the developer remediate these impacts. The City can either propose a way to remediate the impacts and then assess the fee accordingly to cover the costs, or allow the developer to propose and cover the costs of the remediation. For those parks with projected increased intensity of use, the City or the developer can propose capital investments in the parks to accommodate the increased demand.

Remediation

Any proposed measures to remediate the projected impacts can be re-run in the analysis to see if they are sufficient. Then the remediation measures can proceed as planned at the expense of the City offset by a fee to the developer, or purely by the developer. This provides a complete nexus between the source of the fee and its target. The fee is completely based off of addressing the impact the developer has to access and use intensity of parks and open space to every other resident in the City. This method also addresses the reality that space does not confine individual transportation behaviors and therefore should not dictate the relationship of revenue generation and expense for impact remediation.

Summary

The alternative has a natural dichotomy: Regulatory Environment, and Measurement and remediation. The former consolidates all impact fee districts to a single district encompassing the City. This provides ultimate financial flexibility to the City and eliminates the narrow geographical relationship between fee generation and target. The latter focuses on measuring baseline access and demand for all parks and open space, predicting impact of developments on access, and pursuing remediation as necessary. The entirety of the alternative thus far isolates the impact of the development and levies all costs associated with remediation on the developer.

This alternative addresses the weaknesses of the current state as illustrated by the earlier addressed Model.

Conclusion

Madison City's current park impact fee ordinance, park and open space plan, and dedication requirements produce nonsensical results when followed to their logical conclusion (see Summary). This stems from the false belief that location is the only rational nexus between a fee and its target expenses in addition to shortsighted time horizons. For a City dedicated to access to parks and open space, the City legislature has exacerbated investment inequality in their parks and open space by tying their financial flexibility through the use of impact fee districts. The alternative proposed in this paper (The alternative) addresses these weaknesses by:

1. Increasing financial flexibility through district consolidation; and
2. Marrying access and demand to proposed development rather than just rough location.

The alternative leverages increasingly trained planning professionals and basic transportation modeling software to proxy access and demand. The alternative goes further in allowing the developer to remediate projected impacts rather than the City simply collecting revenue. This is superior to a simple fee schedule. However, I believe we can achieve a superior result. Most transportation modeling software utilizes large land aggregates (Transportation Area Districts, "TADs") and their basic characteristics to develop how many trips a TAD develops, and how many trips a TAD attracts. It then utilizes an algorithm, likely the gravity model, to distribute these trips until equilibrium. A feasible, mathematically superior, and shockingly more accurate method is the use of cellular automata models stemming from spatial econometrics.

Spatial econometrics bridges spatial and social data. Social scientists historically ignored space due to lack of data. This is no longer an excuse. However, the relevant unit of analysis is not space, but individual agents and the rules under which they operate. Endogenous and exogenous variable specifications dictate if a model may estimate "what-if" scenarios relevant to policy and decision makers.

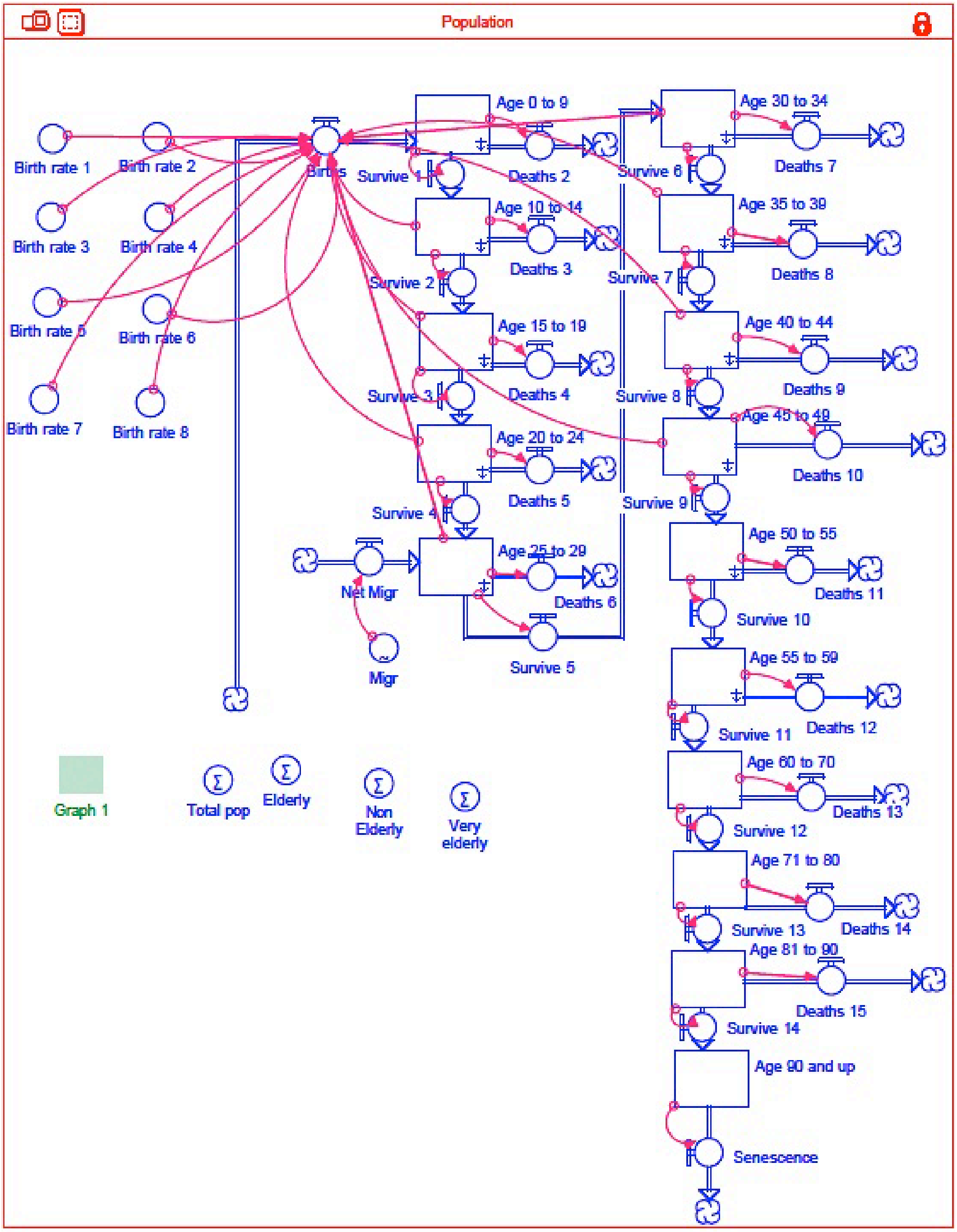
Geographic/spatial only models assume automata interaction. Automata are spatial units with dependent variables specified by physical characteristics such as geo-morphology, topology, current usage, distance to other automata and maybe basic economic variables such as distance to nearest urban core. These models lack structural specification of non-physical social information such as agent behavioral rules, time, income, etc. They furthermore do not include local zoning rules, tax treatments, etc. These variables appear in economic models.

Economic models focus on structural relationships of social data specifically related to choice. They are inherently concerned with human behavior. These models help predict future agent decision choices. Economic models usually oversimplify complex spatial relationships. E.g., concentric rings with agents in the same intra-ring space treated similarly. This does not allow exploration of zoning and preferential taxation impacts over space. Parcels of land are not relevant in such specifications.

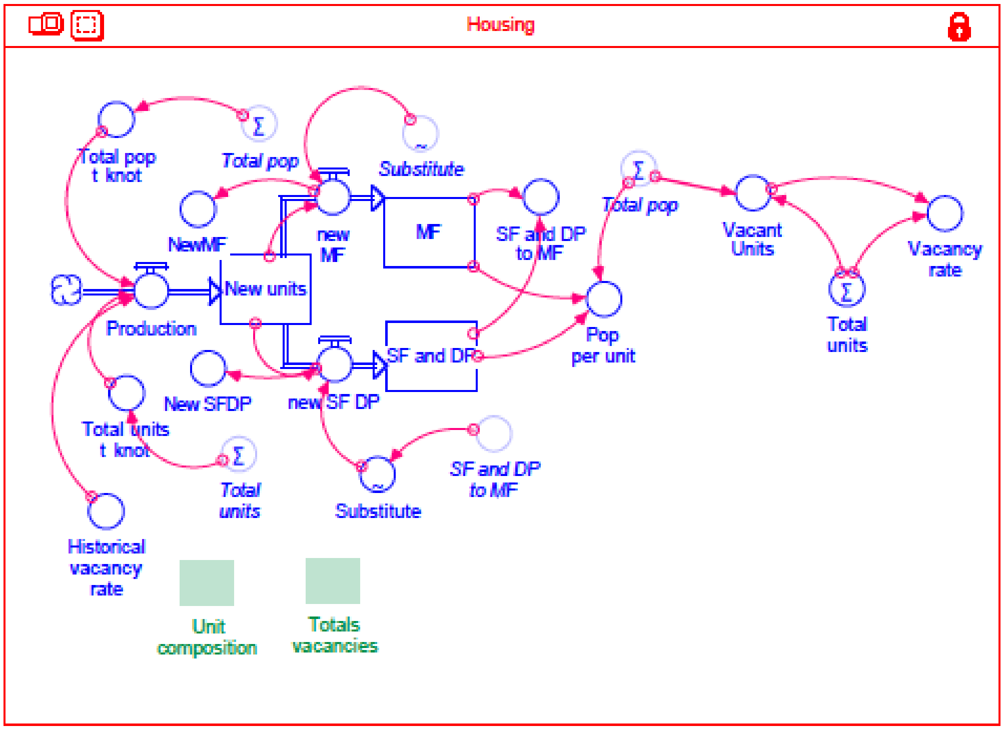
Spatial econometrics marry these two automata model types. These models specify agent behavior through probability rules taking into account numerous social *and* physical characteristics. Agent behavior cognizant of spatial relationships determines parcel future states. This allows informed prediction of agent imposed land changes over space and time in reaction to zoning, tax preference, etc., a deterministic estimation method relevant to policy and decision makers. It is this exact type of model that would allow highly accurate projections of the impact of development on transportation networks, demand for parks and open space, and even where additional development pressure may exist. I believe further research into such model construction is crucial to ensuring a more just and equitable City generally, and enhanced access to parks and open space specifically.

Appendix A

Population

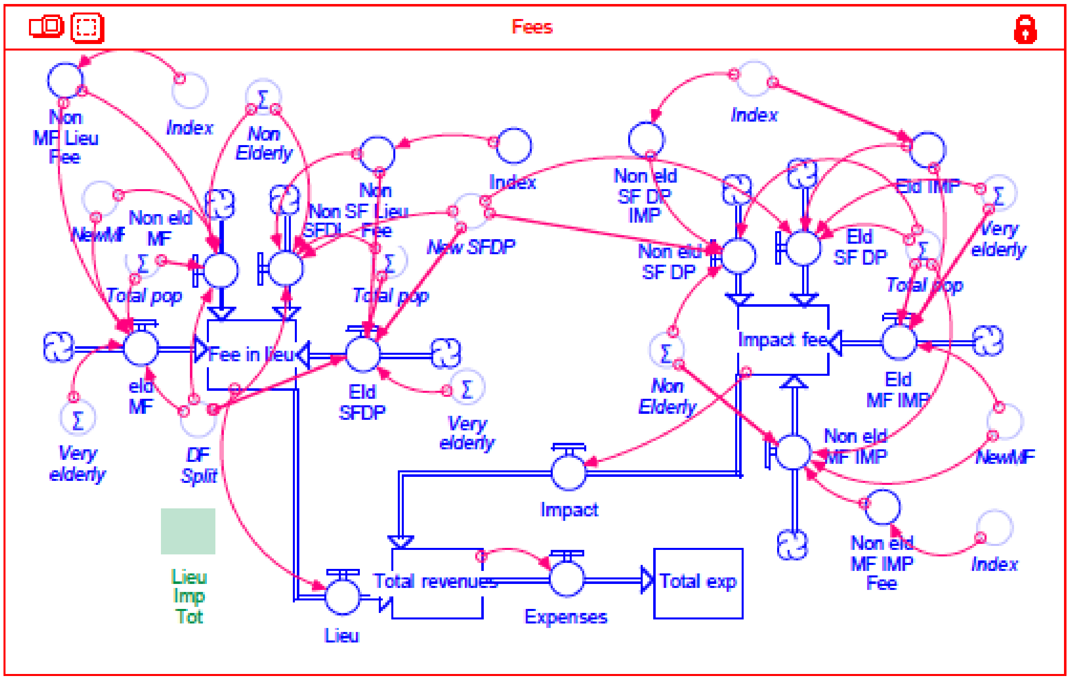


Housing



Housing
Total pop t knot
Total pop
Substitute
NewMF
new MF
MF
SF and DP to MF
Total pop
Vacant Units
Vacancy rate
Total units
Production
New units
Pop per unit
SF and DP
New SFDP
new SF DP
Total units t knot
Total units
SF and DP to MF
Substitute
Historical vacancy rate
Unit composition
Totals vacancies

Fees


Fees
Non MF Lieu Fee
Index
Non Elderly
Non SF Lieu SFDL Fee
Index
New SFDP
Non eld MF
NewMF
Total pop
Total pop
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eld MF
Eld SFDP
Very elderly
Very elderly
DF Split
Lieu Imp Tot
Non eld SF DP IMP
Index
Eld IMP
Very elderly
Non eld SF DP
Eld SF DP
Total pop
Impact fee
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Impact
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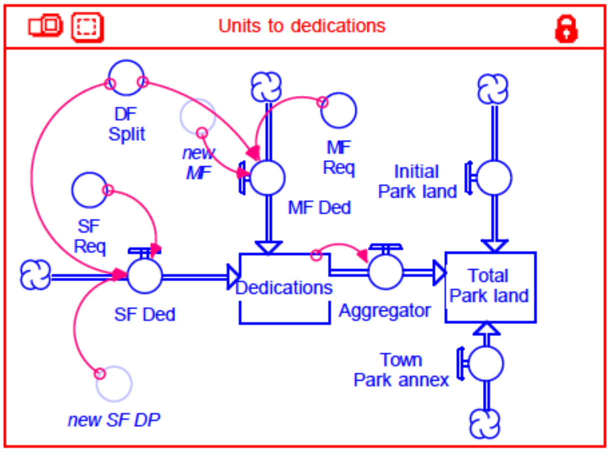
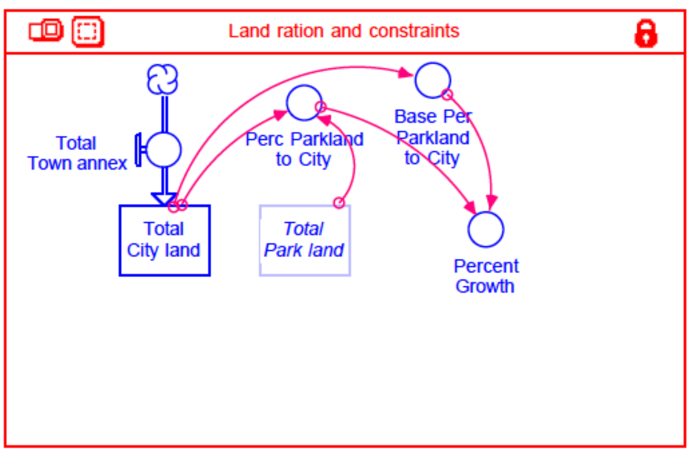
Total revenues
Expenses
Total exp
Lieu

Units to dedications



Land ration and constraints



Appendix B

Age_0_to_9(t) = Age_0_to_9(t - dt) + (Births - Deaths_2 - Survive_1) * dt

INIT Age_0_to_9 = 24902

INFLOWS:

Births = (1/2)*((Age_10_to_14/1000)*Birth_rate_1+(Age_15_to_19/1000)*Birth_rate_2+

(Age_20_to_24/1000)*Birth_rate_3+(Age_25_to_29/1000)*Birth_rate_4+(Age_30_to_34/1000)

*

Birth_rate_5+(Age_35_to_39/1000)*Birth_rate_6+(Age_40_to_44/1000)*Birth_rate_7+

(Age_45_to_49/1000)*Birth_rate_8)

OUTFLOWS:

Deaths_2 = (1-99248/100000)*Age_0_to_9

Survive_1 = (1/9)*Age_0_to_9

Age_10_to_14(t) = Age_10_to_14(t - dt) + (Survive_1 - Survive_2 - Deaths_3) * dt

INIT Age_10_to_14 = 1958

INFLOWS:

Survive_1 = (1/9)*Age_0_to_9

OUTFLOWS:

Survive_2 = (1/4)*Age_10_to_14

Deaths_3 = (1-99185/99248)*Age_10_to_14

Age_15_to_19(t) = Age_15_to_19(t - dt) + (Survive_2 - Deaths_4 - Survive_3) * dt

INIT Age_15_to_19 = 16508

INFLOWS:

Survive_2 = (1/4)*Age_10_to_14

OUTFLOWS:

Deaths_4 = (1-98961/99185)*Age_15_to_19

Survive_3 = (1/4)*Age_15_to_19

Age_20_to_24(t) = Age_20_to_24(t - dt) + (Survive_3 - Deaths_5 - Survive_4) * dt

INIT Age_20_to_24 = 34919

INFLOWS:

Survive_3 = (1/4)*Age_15_to_19

OUTFLOWS:

Deaths_5 = (1-98550/98889)*Age_20_to_24

Survive_4 = (1/4)*Age_20_to_24

Age_25_to_29(t) = Age_25_to_29(t - dt) + (Survive_4 + Net_Migr - Deaths_6 - Survive_5) * dt

INIT Age_25_to_29 = 25967

INFLOWS:

Survive_4 = (1/4)*Age_20_to_24

Net_Migr = Migr+Migr*POISSON(.1)

OUTFLOWS:

Deaths_6 = (1-98158/98464)*Age_25_to_29

Survive_5 = (1/4)*Age_25_to_29

Age_30_to_34(t) = Age_30_to_34(t - dt) + (Survive_5 - Deaths_7 - Survive_6) * dt

INIT Age_30_to_34 = 19666

INFLOWS:

Survive_5 = (1/4)*Age_25_to_29

OUTFLOWS:

Deaths_7 = (1-97790/98087)*Age_30_to_34

Survive_6 = (1/4)*Age_30_to_34

Age_35_to_39(t) = Age_35_to_39(t - dt) + (Survive_6 - Deaths_8 - Survive_7) * dt

INIT Age_35_to_39 = 14632

INFLOWS:

Survive_6 = (1/4)*Age_30_to_34

OUTFLOWS:

Deaths_8 = (1-97297/97706)*Age_35_to_39

Survive_7 = (1/4)*Age_35_to_39

Age_40_to_44(t) = Age_40_to_44(t - dt) + (Survive_7 - Deaths_9 - Survive_8) * dt

INIT Age_40_to_44 = 2496

INFLOWS:

Survive_7 = (1/4)*Age_35_to_39

OUTFLOWS:

Deaths_9 = (1-96542/97171)*Age_40_to_44

Survive_8 = (1/4)*Age_40_to_44

Age_45_to_49(t) = Age_45_to_49(t - dt) + (Survive_8 - Deaths_10 - Survive_9) * dt

INIT Age_45_to_49 = 2725

INFLOWS:

Survive_8 = (1/4)*Age_40_to_44

OUTFLOWS:

Deaths_10 = (1-95367/96346)*Age_45_to_49

Survive_9 = (1/4)*Age_45_to_49

Age_50_to_55(t) = Age_50_to_55(t - dt) + (Survive_9 - Deaths_11 - Survive_10) * dt

INIT Age_50_to_55 = 16455

INFLOWS:

Survive_9 = (1/4)*Age_45_to_49

OUTFLOWS:

Deaths_11 = (1-93082/95063)*Age_50_to_55

Survive_10 = (1/4)*Age_50_to_55

Age_55_to_59(t) = Age_55_to_59(t - dt) + (Survive_10 - Survive_11 - Deaths_12) * dt

INIT Age_55_to_59 = 8091

INFLOWS:

Survive_10 = (1/4)*Age_50_to_55

OUTFLOWS:

Survive_11 = (1/4)*Age_55_to_59

Deaths_12 = (1-90772/93082)*Age_55_to_59

Age_60_to_70(t) = Age_60_to_70(t - dt) + (Survive_11 - Survive_12 - Deaths_13) * dt

INIT Age_60_to_70 = 18492

INFLOWS:

Survive_11 = (1/4)*Age_55_to_59

OUTFLOWS:

Survive_12 = (1/10)*Age_60_to_70

Deaths_13 = (1-78965/90066)*Age_60_to_70

Age_71_to_80(t) = Age_71_to_80(t - dt) + (Survive_12 - Survive_13 - Deaths_14) * dt

INIT Age_71_to_80 = 8135

INFLOWS:

Survive_12 = (1/10)*Age_60_to_70

OUTFLOWS:

Survive_13 = (1/9)*Age_71_to_80

Deaths_14 = (1-57445/77347)*Age_71_to_80

Age_81_to_90(t) = Age_81_to_90(t - dt) + (Survive_13 - Survive_14 - Deaths_15) * dt

INIT Age_81_to_90 = 5450

INFLOWS:

Survive_13 = (1/9)*Age_71_to_80

OUTFLOWS:

Survive_14 = (1/9)*Age_81_to_90

Deaths_15 = (1-26544/54656)*Age_81_to_90

Age_90_and_up(t) = Age_90_and_up(t - dt) + (Survive_14 - Senescence) * dt

INIT Age_90_and_up = 1064

INFLOWS:

Survive_14 = (1/9)*Age_81_to_90

OUTFLOWS:

Senescence = (1/19)*Age_90_and_up

Dedications(t) = Dedications(t - dt) + (MF_Ded + SF_Ded - Aggregator) * dt

INIT Dedications = 0

INFLOWS:

MF_Ded = new_MF*MF_Req*DF_Split

SF_Ded = new_SF_DP*SF_Req*DF_Split

OUTFLOWS:

Aggregator = Dedications

Fee_in_lieu(t) = Fee_in_lieu(t - dt) + (eld_MF + Non_eld_MF + Non_SFDP + Eld_SFDP -

Lieu) * dt

INIT Fee_in_lieu = 0

INFLOWS:

eld_MF = ((Very_elderly/Total_pop)*NewMF*Non_MF_Lieu_Fee)*(1-DF_Split)

Non_eld_MF = ((Non_Elderly/Total_pop)*Non_MF_Lieu_Fee*NewMF)*(1-DF_Split)

Non_SFDP = ((Non_Elderly/Total_pop)*New_SFDP*Non_SF_Lieu_Fee)*(1-DF_Split)

Eld_SFDP = ((Very_elderly/Total_pop)*New_SFDP*Non_SF_Lieu_Fee)*(1-DF_Split)

OUTFLOWS:

Lieu = Fee_in_lieu

Impact_fee(t) = Impact_fee(t - dt) + (Non_eld_SF_DP + Eld_SF_DP + Non_eld_MF_IMP +

Eld_MF_IMP -

Impact) * dt

INIT Impact_fee = 0

INFLOWS:

Non_eld_SF_DP = (Non_Elderly/Total_pop)*Non_eld_SF_DP_IMP*New_SFDP

Eld_SF_DP = (Very_elderly/Total_pop)*Eld_IMP*New_SFDP

Non_eld_MF_IMP = (Non_Elderly/Total_pop)*Non_eld_MF_IMP_Fee*NewMF

Eld_MF_IMP = (Very_elderly/Total_pop)*Eld_IMP*NewMF

OUTFLOWS:

Impact = Impact_fee

MF(t) = MF(t - dt) + (new_MF) * dt

INIT MF = 41084 {three or more families}

INFLOWS:

new_MF = Substitute*New_units

New_units(t) = New_units(t - dt) + (Production - new_MF - new_SF_DP) * dt

INIT New_units = 0

INFLOWS:

Production = (Total_pop_t_knot/1.9)-Total_units_t_knot+Historical_vacancy_rate*

Total_units_t_knot

OUTFLOWS:

new_MF = Substitute*New_units

new_SF_DP = (1-Substitute)*New_units

SF_and_DP(t) = SF_and_DP(t - dt) + (new_SF_DP) * dt

INIT SF_and_DP = 44565 {single famil}+5739 {two family}+965{mobile homes}

INFLOWS:

new_SF_DP = (1-Substitute)*New_units

Total_City_land(t) = Total_City_land(t - dt) + (Total_Town_annex) * dt

INIT Total_City_land = 94.03*640 {mi^2 to acres}

INFLOWS:

Total_Town_annex = if (time = 1) then 0 else 0

Total_exp(t) = Total_exp(t - dt) + (Expenses) * dt

INIT Total_exp = 0

INFLOWS:

Expenses = (1/10)*Total_revenues

Total_Park_land(t) = Total_Park_land(t - dt) + (Aggregator + Initial_Park_land +

Town_Park_annex) * dt

INIT Total_Park_land = 0

INFLOWS:

Aggregator = Dedications

Initial_Park_land = if (time = 1) then 29.26 {acres} else 0

Town_Park_annex = if (time = 0) then 1 else 0

Total_revenues(t) = Total_revenues(t - dt) + (Lieu + Impact - Expenses) * dt

INIT Total_revenues = 0

INFLOWS:

Lieu = Fee_in_lieu

Impact = Impact_fee

OUTFLOWS:

Expenses = (1/10)*Total_revenues

Base_Per_Parkland_to_City = (29.26/Total_City_land)*100

Birth_rate_1 = normal(0.3,0.1)

Birth_rate_2 = normal(26.2,.5)

Birth_rate_3 = NORMAL(78.8,.5)

Birth_rate_4 = NORMAL(117.6,.5)

Birth_rate_5 = normal(105,.5)

Birth_rate_6 = NORMAL(42,.5)

Birth_rate_7 = normal(7.8,.5)

Birth_rate_8 = normal(0.4,.1)

DF_Split = random((0.5-0.1),(0.5+0.1))

Eld_IMP = Index*225

Historical_vacancy_rate = random((0.039-.02),(0.039+.01))

Index = 1

MF_Req = 700/43560 {ft^2 to acres}

Migr = GRAPH(TIME)

(2010, 1672), (2011, 1833), (2012, 2186), (2013, 2283), (2014, 2412), (2015, 2733), (2015, 2894),

(2016, 3087), (2017, 3312), (2018, 3392), (2019, 3601), (2020, 3666), (2021, 3730), (2022, 3826),

(2023, 3987), (2024, 4068), (2025, 4148), (2025, 4244), (2026, 4293), (2027, 4341), (2028, 4405),

(2029, 4469), (2030, 4518), (2031, 4566), (2032, 4598), (2033, 4652), (2034, 4705), (2035, 4759),

(2035, 4887), (2036, 4984), (2037, 5016), (2038, 5048), (2039, 5096), (2040, 5145), (2041, 5177),

(2042, 5209), (2043, 5241), (2044, 5273), (2045, 5305), (2045, 5338), (2046, 5370), (2047, 5402),

(2048, 5434), (2049, 5498), (2050, 5547), (2051, 5595), (2052, 5627), (2053, 5627), (2054, 5659),

(2055, 5691), (2055, 5691), (2056, 5723), (2057, 5740)...

NewMF = new_MF

New_SFDP = new_SF_DP

Non_eld_MF_IMP_Fee = Index*450

Non_eld_SF_DP_IMP = Index*700

Non_MF_Lieu_Fee = Index*643

Non_SF_Lieu_Fee = Index*1010

Percent_Growth = Perc_Parkland_to_City/Base_Per_Parkland_to_City

Perc_Parkland_to_City = (Total_Park_land/Total_City_land)*100

Pop_per_unit = Total_pop/(SF_and_DP+MF)

SF_and_DP_to_MF = SF_and_DP/MF

SF_Req = 1100/43560 {ft^2 to acres}

Substitute = GRAPH(SF_and_DP_to_MF)

(0.00, 0.00), (0.105, 0.0129), (0.211, 0.0289), (0.316, 0.0804), (0.421, 0.113), (0.526, 0.174), (0.632,

0.212), (0.737, 0.419), (0.842, 0.637), (0.947, 0.756), (1.05, 0.819), (1.16, 0.859), (1.26, 0.891), (1.37,

0.922), (1.47, 0.941), (1.58, 0.947), (1.68, 0.963), (1.79, 0.988), (1.89, 1.00), (2.00, 1.00)

Total_pop_t_knot = previous(Total_pop,0)

Total_units_t_knot = previous(Total_units,0)

Vacancy_rate = Vacant_Units/Total_units

Vacant_Units = if (Total_units>Total_pop/1.9) then (Total_units-Total_pop/1.9) else 0

Elderly = Age_55_to_59 + Age_60_to_70 + Age_71_to_80 + Age_81_to_90 + Age_90_and_up

Non_Elderly = Age_0_to_9 + Age_10_to_14 + Age_15_to_19 + Age_20_to_24 + Age_25_to_29 +

Age_30_to_34 + Age_35_to_39 + Age_40_to_44 + Age_45_to_49 + Age_50_to_55

Total_pop = Age_0_to_9 + Age_10_to_14 + Age_15_to_19 + Age_20_to_24 + Age_25_to_29 +

Age_30_to_34 + Age_35_to_39 + Age_40_to_44 + Age_45_to_49 + Age_50_to_55 +

Age_55_to_59 +

Age_60_to_70 + Age_71_to_80 + Age_81_to_90 + Age_90_and_up

Total_units = MF + SF_and_DP

Very_elderly = Age_71_to_80 + Age_81_to_90 + Age_90_and_up

Appendix C

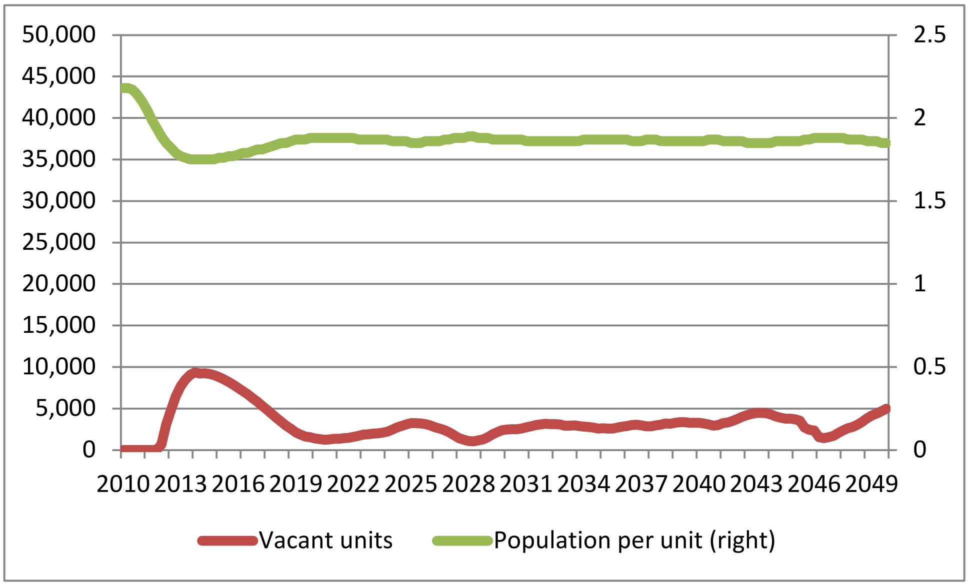


Figure 10 Vacancy and population density (migration). Author.

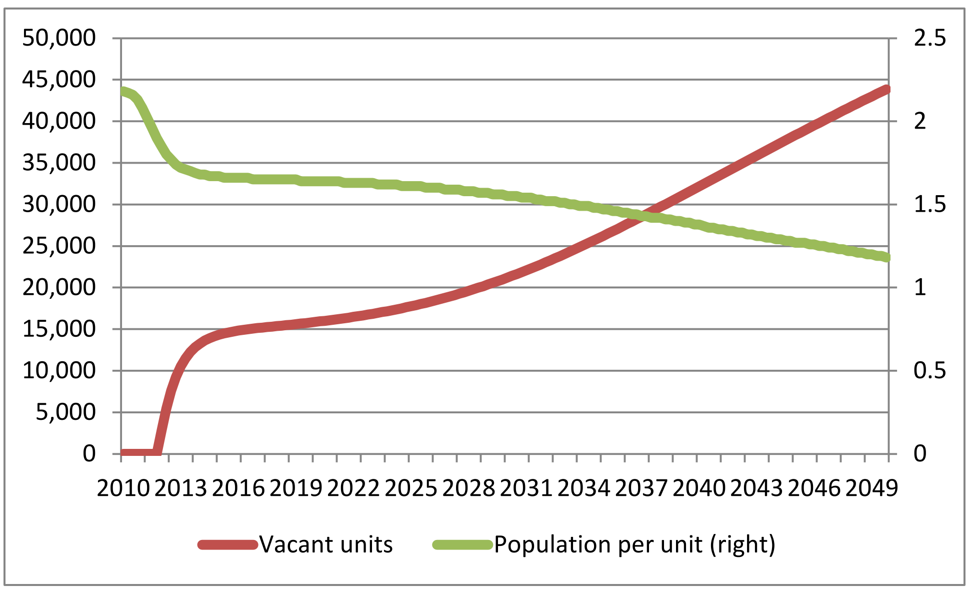


Figure 11 Vacancy and population density (no migration). Author.

WORKS CITED

Center for Disease Control and Prevention (CDC). “Table WI-1.” *United States Decennial Life Tables, 1999-2001:State Life Tables.* Vol. 60. No. 9. Hyattsville, MD: National Center for Health Statistics, Division of Vital Statistics, 2012. 1. Print.

City of Madison, Wisconsin. Parks Division (Parks). *Needs Assessment for Park Dedication and Development Impact Fees.* Madison: Clerk’s Office: 2002. Print.

United States. Census Bureau (Census). “Table PCT12 – SEX BY AGE.” *United States Census 2010*. Washington: U.S. Census Bureau, 28, Jul. 2011. Web. 8 Dec. 2014.

Wisconsin Department of Health Services (WDHS), Division of Public Health, Office of Health Informatics. Wisconsin Births and Infant Deaths, 2010 (P-45364-10). January 2012.