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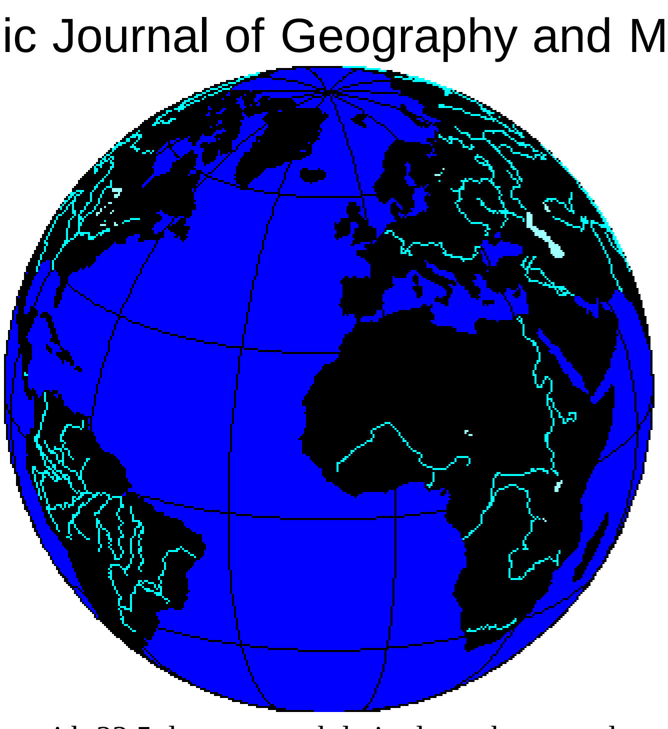

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Volume XIV
Number 1
June, 2003

Institute of Mathematical Geography (IMaGe)

SOLSTICE: AN ELECTRONIC JOURNAL OF GEOGRAPHY AND MATHEMATICS

http://www.imagenet.org

SUMMER, 2003

VOLUME XIV, NUMBER 1

ANN ARBOR, MICHIGAN

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The purpose of Solstice is to promote interaction between geography and mathematics. Articles in which elements of one discipline are used to shed light on the other are particularly sought. Also welcome are original contributions that are purely geographical or purely mathematical. These may be prefaced (by editor or author) with commentary suggesting directions that might lead toward the desired interactions.
Individuals wishing to submit articles or other material should contact an editor, or send e-mail directly to sarhaus@umich.edu.

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Recent Awards to Solstice Authors

- Jeffrey A. Nystuen, won the 2003 **Medwin Prize** in Acoustical Oceanography given by the Acoustical Society of America. The citation was "for the innovative use of sound to measure rainfall rate and type at sea". It is awarded to a young/mid-career scientist whose work demonstrates the effective use of sound in the discovery and understanding of physical and biological parameters and processes in the sea.
- Sandra L. Arlinghaus, William C. Arlinghaus, and Frank Harary. *Graph Theory and Geography: an Interactive View (eBook)*, published by John Wiley and Sons, New York, April 2002. Finished as a **Finalist** in the 2002 Pirelli INTERNETional Award Competition (in the top 20 of over 1200 entries worldwide). Link to Pirelli website, to Pirelli award flyer, and to downloaded pages concerning this particular competition: 1, 2, 3.

IN MEMORIAM

William D. Drake
April 13, 1936-June 13, 2003.

Professor, School of Natural Resources and Environment, The University of Michigan (with affiliated appointments in the Taubman College of Architecture and Urban Planning and in the School of Public Health)

http://www-personal.umich.edu/~wddrake

Community Systems Foundation, President:
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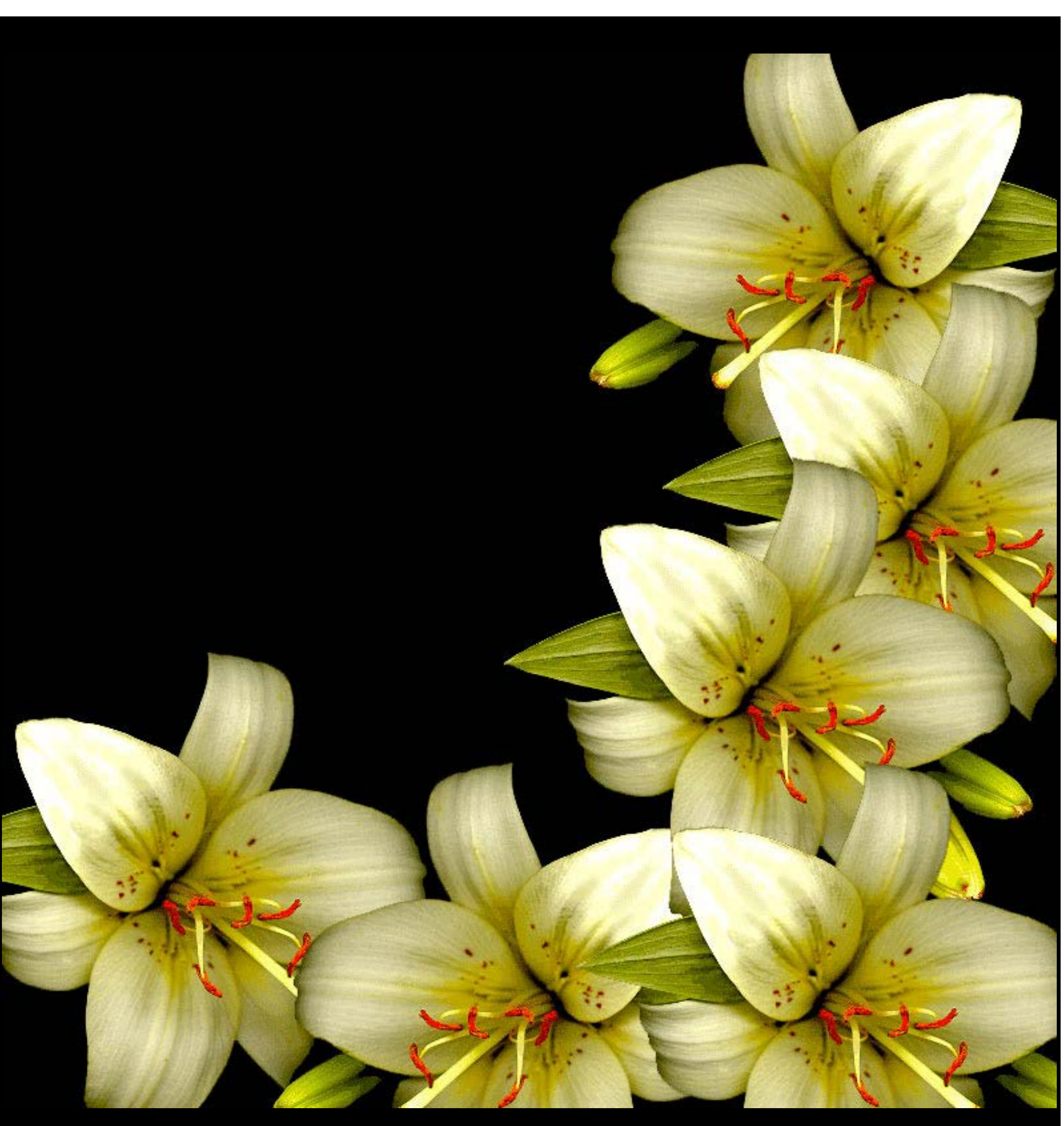

Animated Time Lines: Coordination of Spatial and Temporal Information

Sandra L. Arlinghaus, Michael Batty, and John D. Nystuen
with input from Naru Shiode*

Animation is important because it permits the portrayal of spatial information as a rapid sequence of snapshots. Thus, it integrates time with space. Many of us think of cartoons of cute animals bouncing around on a movie screen when we think of "animation." As is the case with most enduring ideas, this concept, too, has its amusing side as well as its scholarly side. Several aspects of the scholarly side have been explored in previous articles in this journal (see list of links, below), which by its internet transmission alone, lends itself as a fine medium in which to embed animations. In this paper we suggest the power of animation not only to simplify complexity, but also to coordinate sequences of information portrayed graphically.

Havlin [4] used data plots to measure differences between ranks [8] over time. He captured the differences in ranks, as a "Havlin score" on the vertical axis and the difference in time on the horizontal axis [2]. Vilensky [7] used Havlin plots to compare texts on the basis of word frequencies; books by the same author showed more in common on this factor than did books by different authors. The idea of measuring such differences is one that applies to a whole range of topics: from phase-shift diagrams, to word frequencies and authorship [7], to oil recovery [5], to agricultural applications [6], and beyond. Recently, Batty and Shiode [2] plotted populations for 459 British municipalities in Wales, Scotland, and England in 1901 by their rank differences every 10 years (Figure 1). Casual knowledge [2] suggests a British urban spatial system that is stable in form; most large cities entered the urban system by 1901. The single Havlin plot (Figure 1, Shiode created this original Havlin plot) displays a remarkably complex data set at a single glance. It also suggests the underlying stability of the dynamics of this urban system through similarity of successive pattern as one moves from left to right: color, only, serves as a guide to tracking the pattern.

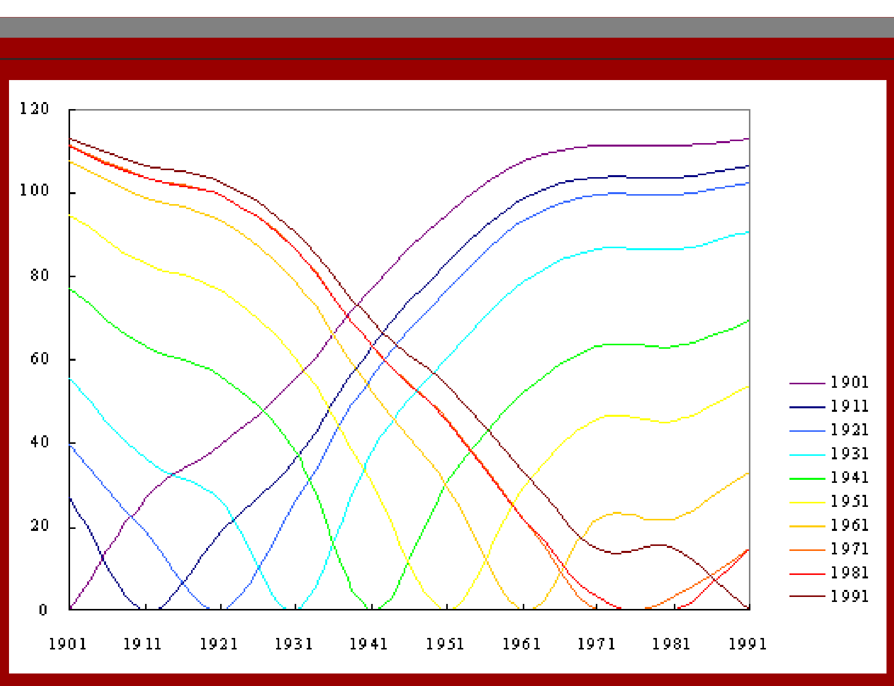

Figure 1. Static Havlin plot for rank differences in British population, 1901-1991 [2].

To gain a more focused look at this pattern, we animate the Havlin plot: a dynamic visual serves as a model for the underlying dynamic system (Figure 2). When the plot is animated, the time lines come into the picture in sequence; the corresponding sequence of dates for each time line is coordinated, using color, to enter the picture along with the curve. Coordination of sequences within a single image can underscore elements of that image's content. Figure 2 emphasizes the time at which a particular curve enters the system so that one can easily track the dynamics of the British urban spatial system through a complex data set. Note in particular that it is far easier to distinguish the 1971 curve from the 1981 curve in the animated figure than it is in the static figure.

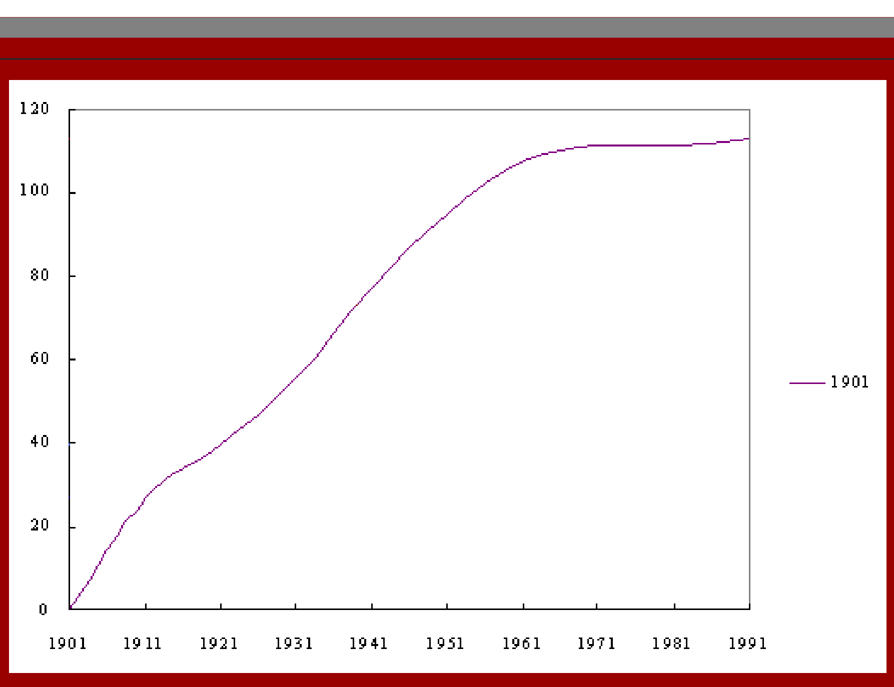

Figure 2. Animated Havlin plot coordinated with time legend.

The Havlin plot is an effective means of portraying complex urban dynamics in the British system because new cities do not enter the picture in any significant manner. If one wishes, instead, to look at a corresponding plot for United States cities, the problem of cities entering and leaving the system obscures meaning to the pattern. Thus, Batty [1] focuses instead on this entry/exit of cities from the broad urban system and expresses it in terms of half-life: the extent to which new cities enter the list of top 100 cities, at each time slice, and the extent to which cities already in this list leave the list. A plot of these values [1], tallied in a matrix, results in a somewhat inverted Havlin plot (Figure 3).

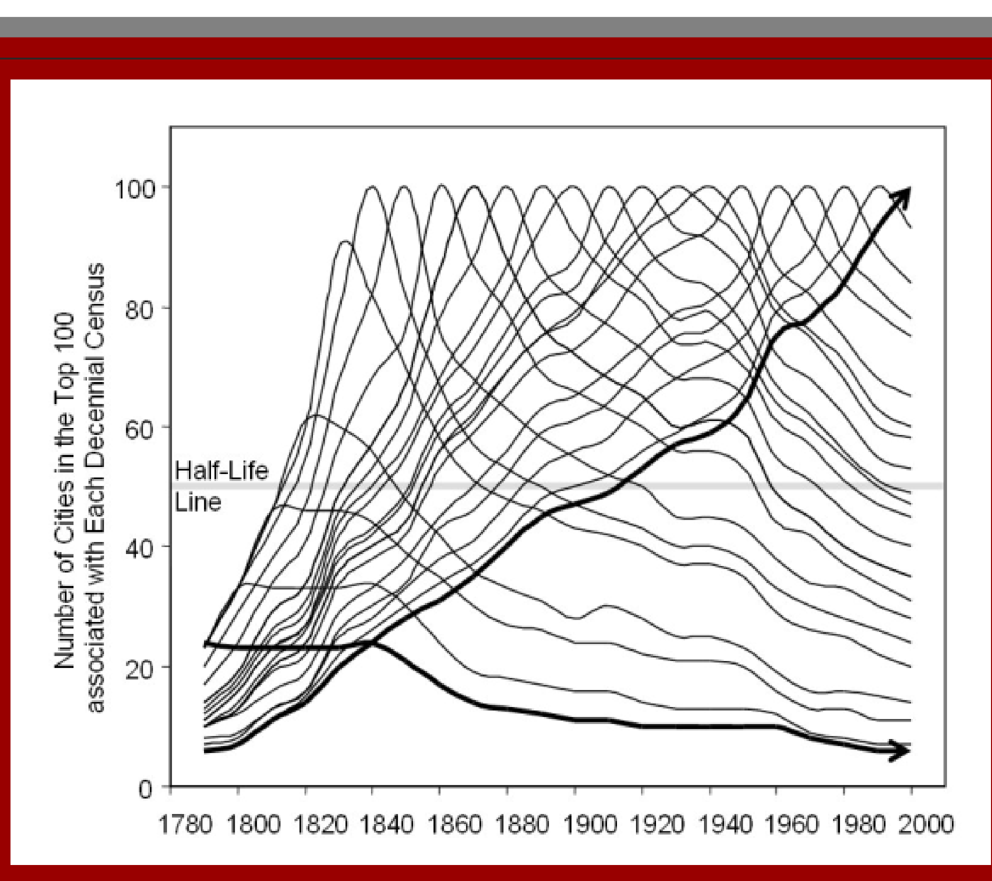

Figure 3. The Lives of US Cities from 1790 to 2000 [1].

Again, animation offers a dynamic view of a dynamic system. Time lines in Figure 4a portray an animated sequence of Figure 3: the moving blue line simplifies the otherwise complex visual pattern. The interested reader, of course, will ask about the derivation of these time lines. In conventional format, that reader might be referred to a matrix and left to run an eye up and down columns to understand the derivation of the plotted curves. Figure 4b imitates that eye movement with an animated matrix. The blue color of the curves in Figure 4a coordinates with the blue color of the matrix column outlines in Figure 4b to show clearly which column corresponds to which plotted curve: coordination of animations clarifies mathematical process. Coordination of images, each of which is itself an animated image, presents a sort of "meta" animation: an animation of animations. Thus, the transformation from the numerical to the geometric is emphasized.

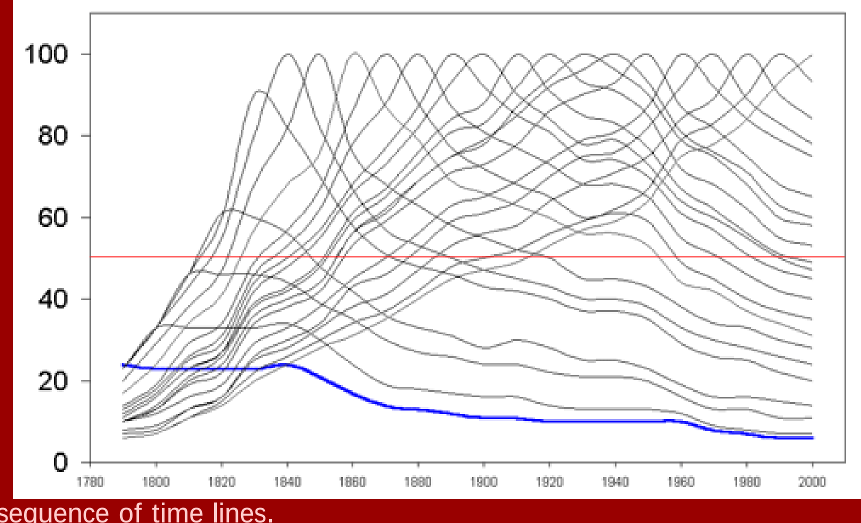

Figure 4a. Animated sequence of time lines.

	1790	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	
1790	24	23	23	23	23	23	20	17	14	13	12	11	11	10	10	10	10	10	8	7	6	6	314
1800	23	33	33	33	33	33	29	24	19	18	17	16	16	14	13	13	13	12	9	8	7	7	423
1810	23	33	46	46	46	43	38	34	29	26	25	23	23	21	20	20	19	16	13	13	11	11	579
1820	23	33	46	61	60	55	47	41	34	31	29	27	27	26	24	24	22	19	16	16	15	14	690
1830	23	33	46	60	90	80	68	57	49	46	44	42	39	38	36	36	34	29	26	25	22	20	943
1840	24	34	44	56	82	100	82	68	57	53	50	48	43	42	40	40	38	33	30	28	26	24	1042
1850	21	30	39	48	70	82	100	76	67	62	57	55	49	48	44	44	42	38	34	33	30	28	1097
1860	17	24	35	42	58	67	76	100	86	78	68	66	61	59	56	56	53	45	43	38	34	31	1193
1870	14	19	30	36	51	57	68	87	100	88	77	73	67	65	61	62	59	50	46	41	37	35	1223
1880	13	18	27	33	48	53	63	79	88	100	87	82	76	73	69	69	65	56	52	47	42	40	1280
1890	12	17	26	31	46	50	58	69	77	87	100	93	84	81	75	75	71	63	59	53	48	45	1320
1900	11	16	24	28	43	47	55	66	72	81	92	100	88	83	78	79	73	65	61	56	50	47	1315
1910	11	16	24	30	42	45	52	63	68	77	85	90	100	92	87	85	78	69	64	58	52	49	1337
1920	10	14	22	28	40	43	50	60	65	73	81	84	91	100	94	92	86	74	70	64	56	53	1350
1930	10	13	21	25	37	40	45	56	60	68	74	78	85	93	100	96	90	79	75	68	59	57	1329
1940	10	13	21	25	37	40	45	56	61	68	74	79	83	91	96	100	93	81	76	71	62	59	1341
1950	10	13	20	23	35	38	43	53	59	65	70	73	77	85	90	93	100	87	82	75	67	64	1322
1960	10	12	16	19	29	33	38	44	49	55	61	64	67	72	79	81	87	100	92	84	79	75	1246
1970	8	9	13	16	26	30	34	42	45	51	57	60	62	68	75	76	82	92	100	89	83	78	1196
1980	7	8	13	16	25	28	33	37	40	46	51	55	56	62	68	71	75	84	89	100	90	84	1138
1990	6	7	11	15	22	26	30	34	37	42	47	50	51	55	60	63	68	79	83	90	100	93	1069
2000	6	7	11	14	20	24	28	31	35	40	45	47	49	53	58	60	65	75	78	84	93	100	1023
totals	316	425	591	708	963	1037	1102	1194	1211	1268	1303	1316	1305	1331	1333	1345	1323	1256	1206	1148	1069	1020	

Figure 4b. Animated sequence of matrix columns.

Figure 4. Animated sequence of time lines (4a) coordinated with animated sequence of matrix columns (4b) to show derivation of plotted curves.

In the current Internet climate, this technique of image coordination can be effective only if the targeted audience is known to have high speed connections to the Internet or has the capability to download and view the image on a modern computer. Otherwise, the timing between successive images quickly goes out of kilter; fortunately, however, modern computing capability is rapidly becoming more affordable and more widespread. Figure 4, viewed as a single whole, displays this sort of synthesis of animations. Dynamic images of all sorts, including coordinated sets of images that are themselves dynamic, serve as models for dynamic systems.

*Naru Shiode (SUNY-Buffalo) produced the data for the Havlin plots (see http://www.casa.ucl.ac.uk/naru/portfolio/social.html)

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Links to previous articles in *Solstice*. Back to top.

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- Hyeyun Lee, The Relationship between Bicycle Accidents and Lanes of Travel at Downtown Ann Arbor Intersections Volume XIII, Number 1, 2002
- Jeanine Chura McCloskey, Beach Closures in Oakland County, Michigan: Using GIS as an Investigative Tool Volume XIII, Number 1, 2002
- Makoto Noguchi, The Possibility of Extending the Streetcar Line in Kagoshima City, JapanVolume XIII, Number 1, 2002
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  - The Lights Are On, All Over the World Volume XIII, Number 1, 2002
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  - Animaps, IV: Of Time and Place Volume XI, Number 1, 2000
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- Sandra Lach Arlinghaus.
  - Animated Four Color Theorem: Sample Map. Volume IX, Number 2, 1998
  - Animaps, II. Volume IX, Number 2, 1998
- Sandra L. Arlinghaus, William D. Drake, and John D. Nystuen with data and other input from: Audra Laug, Kris S. Oswalt, and Diana Sammataro. Animaps. Volume IX, Number 1, 1998
- Sandra L. Arlinghaus, Ruben De la Sierra. Revitalizing Maps or Images? Volume IX, Number 1, 1998

Viewing the relative importance of some surface parameters associated with pre-monsoon thunderstorms through Ampliative Reasoning

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Abstract

Instead of going into the physical detail of the pre-monsoon thunderstorms of north eastern India, a mathematical study has been done to discern the relative importance of some prominent surface parameters namely, surface temperature, relative humidity and air-pressure, in creating severe thunderstorms over the aforesaid region. The dataset associated with this weather phenomenon has been explored through the technique of Ampliative Reasoning. It has been finally found that surface temperature has the most important role in creating pre-monsoon thunderstorms. Relative humidity is less important and air-pressure is the least important.

Key words: Ampliative reasoning, Entropy, thunderstorms

Introduction:

The pre-monsoon thunderstorm, locally known as a Nor'wester, represents a mesoscale phenomenon. This kind of severe storm happens over the Northeastern part of India during the period of pre-monsoon (March-May). Since the pre-monsoon thunderstorms are generally accompanied by torrential rain, high wind speed, hail and so forth, an appropriate prediction with sufficient lead-time has continued to be a challenge to atmospheric scientists. Almost all experiments related to prediction of these storms have been based either upon statistical or numerical techniques (Murphy et al. 1989 [4], Wilks 1997 [5], Kumar et al. 1996 [3]). The complexity of the meteorological system and insufficient data has recurrently led to flawed results. Consequently, no method to date has proved sufficient to predict pre-monsoon thunderstorms over the Northeastern part of India.

The present paper uses the method of "Ampliative" reasoning (Klir and Folger, 2000) [2] to arrange, according to importance, some prominent surface parameters associated with this kind of thunderstorm. The percentage changes in the magnitudes of the corresponding parameters have been taken as the inputs for the study. Ampliative reasoning has been applied to discern the variation in the entropy associated with the probability distributions corresponding to the expected changes (%) in the magnitudes of the parameters under study. The parameter with maximum fluctuation in the entropy with change in the expected change in the magnitude (%) has been identified as the most important parameter associated with the pre-monsoon thunderstorm of the region. Surface parameters tested in this paper are: surface temperature, relative humidity, and air pressure.

Ampliative Reasoning:

Ampliative Reasoning is a probabilistic adaptation of a more general principle of reasoning in which the conclusions are not entailed in the given premises. This principle is based on two statements:

Knowing ignorance is strength.

Ignoring knowledge is sickness.

When applied within the framework of probability theory, this principle is made operational by employing Shannon entropy as the unique measure of information. Here, among all probability distributions that conform to the evidence, the chosen distribution needs to be ensured to have maximum uncertainty (i.e. minimal information) (Burg, 1967) [1]

Thus, the problem is to determine a probability distribution that maximizes the function:

$$H(p_1, p_{2,\ldots}, p_n) = -\sum_{i=1}^{n} p_i \ln p_i \quad \ldots\ldots(1)$$

The constraints are:

i) $p_i \geq 0 \forall i \in N$

ii) $\sum_{i=1}^{n} p_i = 1$

iii) $\mathrm{E}(x) = \sum_{i=1}^{n} p_i x_i$

We construct the Lagrangian,

$$L = -\sum_{i=1}^{n} p_i \ln p_i - \boldsymbol{a}\left(\sum_{i=1}^{n} p_i - 1\right) - \boldsymbol{b}\left(\sum_{i=1}^{n} p_i x_i - \mathrm{E}(x)\right) \ldots\ldots\ldots\ldots (2)$$

Where $\boldsymbol{a}$ and $\boldsymbol{b}$ are Lagrange Multipliers.

Partial differentiation of equation (2) yields:

$$\frac{\partial L}{\partial p_i} = -\lambda n p_i - 1 - \boldsymbol{a} - \boldsymbol{b} x_i = 0 \ldots\ldots\ldots\ldots (3)$$

$$\frac{\partial L}{\partial \boldsymbol{a}} = \quad 1 - \sum_{i=1}^{n} p_i \ldots\ldots\ldots\ldots (4)$$

$$\frac{\partial L}{\partial \boldsymbol{b}} = \mathrm{E}(x) - \sum_{i=1}^{n} p_i x_i \ldots\ldots\ldots\ldots (5)$$

Using (3) and i = 1,2,3,…,n

$$\left.\begin{aligned} p_1 &= \exp(-1 - \boldsymbol{a} - \boldsymbol{b} x_1) \\ p_2 &= \exp(-1 - \boldsymbol{a} - \boldsymbol{b} x_2) \\ \\ p_n &= \exp(-1 - \boldsymbol{a} - \boldsymbol{b} x_n) \end{aligned}\right\} \ldots\ldots\ldots\ldots (6)$$

So, $p_i = \dfrac{\exp(-\boldsymbol{b} x_i)}{\sum_{k=1}^{n} \exp(-\boldsymbol{b} x_k)}$ ……………………………………………………………..(7)

Therefore, $E(x) = \dfrac{\sum_{i=1}^{n} x_i \exp(-\boldsymbol{b} x_i)}{\sum_{i=1}^{n} \exp(-\boldsymbol{b} x_i)}$

$$\Rightarrow \sum_{i=1}^{n} \left[x_i - E(x)\right] \exp(-\boldsymbol{b} x_i) = 0 \ldots\ldots\ldots\ldots (8)$$

When (8) is solved for b and the solution is substituted in (7), maximum entropy probabilities are obtained and thus, maximum H ($p_1, p_2, ..., p_h$) is achieved.

Data and Analysis:

In the present study, thunderstorms occurring over Calcutta (Kolkata), Bhubaneswar, Agartala, Gopalpur have been considered. The number of thunderstorms considered in this study is 65. Values of the previously mentioned parameters before and after thunderstorms have been taken and percentage changes in the values due to thunderstorms have been calculated.

Results, Discussion, and Conclusion:

Equation (8) has been framed by varying n from 1 to 65 for each of the parameters. The expected changes (%) in the magnitudes of the parameters have been put in the place of $E(x)$. Each equation framed this way has a 'b' that has been found by using the Newton/Raphson method. Each solution for b has produced a maximum entropy probability distribution. Using these probability distributions, entropies as defined in (1) have been calculated for each equation. The summarized results have been displayed in Table-1. From this Table it follows that maximum fluctuation in the entropy value has occurred for surface temperature and minimum fluctuation has occurred in case of air pressure. Thus, as a consequence of severe thunderstorms of the pre-monsoon season, change in the value of surface temperature is more probable than change in the value of relative humidity and air-pressure. Feedback from these parameters into thunderstorm creation therefore suggests that surface temperature has the largest contribution (of the three parameters considered) in creating new severe thunderstorms.

Expected change in the magnitude of the parameter due to thunderstorm (%)	Entropy associated with surface temperature.	Entropy associated with relative humidity.	Entropy associated with air-pressure.
5%	13.0756	10.7634	16.0172
6%	11.0832	10.3211	15.9875
7%	10.0123	9.5674	15.0011
8%	9.1745	8.9921	14.9324
9%	7.2214	7.8764	14.1352
10%	5.3124	6.9342	14.0021
11%	3.1437	5.9873	13.5683

Table-1. A tabular presentation of the entropies associated with different expected magnitudes of changes (%) in some prominent parameters due to thunderstorms.

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ON L[1] –CONVERGENCE OF MODIFIED SINE SUMS

KULWINDER KAUR

Abstract. In this paper a criterion for L^1 –convergence of a new modified sine sum with semi-convex coefficients is obtained. Also a necessary and sufficient condition for L^1 –convergence of the cosine series is deduced as a corollary.

2000 Mathematics subject classification: 42A20, 42A32.

1. Introduction. Consider the cosine series

$$g(x) = \frac{a_0}{2} + \sum_{k=1}^{\infty} a_k \cos kx \tag{1.1}$$

with partial sums defined by $S_n(x) = \frac{a_0}{2} + \sum_{k=1}^{n} a_k \cos kx$

and

let $g(x) = \lim_{n\to\infty} S_n(x)$.

Concerning the L^1-convergence of cosine series (1.1) Kolmogorov [5] proved the following theorem:

Theorem A. *If $\{a_n\}$ is a quasi-convex null sequence, then for the L^1-convergence of the cosine series (1.1) it is necessary and sufficient that* $\lim_{n\to\infty} a_n \log n = 0$.

The case in which the sequence $\{a_n\}$ is convex, of this theorem was established by Young [9]. That is why, sometimes, this Theorem A is known as Young-Kolmogorov Theorem.

Definition[4]. A sequence $\{a_n\}$ is said to be semi-convex if $a_n \to 0$ as $n \to \infty$, and

$$\sum_{n=1}^{\infty} n|\Delta^2 a_{n-1} + \Delta^2 a_n| < \infty, \qquad (a_0 = 0) \tag{1.2}$$

where

$$\Delta^2 a_n = \Delta a_n - \Delta a_{n+1}$$

It may be remarked here that every quasi-convex null sequence is semi- convex.

Bala R. and Ram B. [1] have proved that Theorem A holds true for cosine series with semi-convex null coefficients in the following form:

Theorem B. *If $\{a_k\}$ is a semi–convex null sequence, then for the convergence of the cosine series (1.1) in the metric space L, it is necessary and sufficient that* $a_{k-1}\log k = o(1)$, $k \to \infty$.

Garret and Stanojevic [2] have introduced modified cosine sums

$$g_n(x) = \frac{1}{2}\sum_{k=0}^{n} \Delta a_k + \sum_{k=1}^{n}\sum_{j=k}^{n} (\Delta a_j) \cos kx$$

Garret and Stanojevic [3], Ram [7] and Singh and Sharma [8] studied the L^1-convergence of this cosine sum under different sets of conditions on the coefficients a_n.

Later on, Kumari and Ram [6], introduced new modified cosine and sine sums as

$$f_n(x) = \frac{a_0}{2} + \sum_{k=1}^{n}\sum_{j=k}^{n} \Delta\left(\frac{a_j}{j}\right) k \cos kx$$

and

$$g_n(x) = \sum_{k=1}^{n}\sum_{j=k}^{n} \Delta\left(\frac{a_j}{j}\right) k \sin kx$$

and have studied their L^1- convergence under the condition that the coefficients a_n belong to different classes of sequences. Also they deduced some results about L^1-convergence of cosine and sine series as corollaries.

We introduce here new modified sine sums as

$$K_n(x) = \frac{1}{2\sin x}\sum_{k=1}^{n}\sum_{j=k}^{n} (\Delta a_{j-1} - \Delta a_{j+1}) \sin kx.$$

The aim of this paper is to study the L^1 –convergence of this modified sine sum with semi-convex coefficients and to obtain the above mentioned result of Bala R. and Ram B. as a corollary.

2. Main Result. The main result is the following theorem:

Theorem 2.1. *Let $\{a_n\}$ be the semi-convex null sequence, then $K_n(x)$ converges to $g(x)$ in L^1-norm.*

Proof. We have

$$\begin{aligned}
S_n(x) &= \frac{a_0}{2} + \sum_{k=1}^{n} a_k \cos kx \\
&= \frac{1}{2\sin x}\sum_{k=1}^{n} a_k \cos kx 2\sin x \\
&= \frac{1}{2\sin x}\sum_{k=1}^{n} a_k[\sin(k+1)x - \sin(k-1)x] \\
&= \frac{1}{2\sin x}\sum_{k=1}^{n} (a_{k-1} - a_{k+1}) \sin kx + a_{n+1}\frac{\sin nx}{2\sin x} + a_n \frac{\sin(n+1)x}{2\sin x} \\
&= \frac{1}{2\sin x}\sum_{k=1}^{n} (\Delta a_k + \Delta a_{k-1}) \sin kx + a_{n+1}\frac{\sin nx}{2\sin x} + a_n \frac{\sin(n+1)x}{2\sin x}
\end{aligned}$$

Applying Abel's transformation, we have

$$S_n(x) = \frac{1}{2\sin x}\left(\sum_{k=1}^{n} (\Delta^2 a_k + \Delta^2 a_{k+1})\tilde{D}_k(x) + (a_n - a_{n+2})\tilde{D}_n(x)\right) + a_{n+1}\frac{\sin nx}{2\sin x} + a_n\frac{\sin(n+1)x}{2\sin x}.$$

Thus

$$\begin{aligned}
g(x) &= \lim_{n\to\infty} S_n(x) \\
&= \frac{1}{2\sin x}\sum_{k=1}^{\infty} (\Delta^2 a_k + \Delta^2 \Delta a_{k-1})\tilde{D}_k(x)
\end{aligned}$$

Also

$$\begin{aligned}
K_n(x) &= \frac{1}{2\sin x}\sum_{k=1}^{n}\sum_{j=k}^{n} (\Delta a_{j-1} - \Delta a_{j+1}) \sin kx. \\
&= \frac{1}{2\sin x}\left(\sum_{k=1}^{n} (a_{k-1} - a_{k+1}) \sin kx - (a_n - a_{n+2})\tilde{D}_n(x)\right)
\end{aligned}$$

Applying Abel's transformation, we have

$$\begin{aligned}
K_n(x) &= \frac{1}{2\sin x}\sum_{k=1}^{n} (\Delta a_{k-1} - \Delta a_{k+1})\tilde{D}_k(x) \\
&= \frac{1}{2\sin x}\sum_{k=1}^{n} (\Delta^2 a_k + \Delta^2 a_{k-1})\tilde{D}_k(x)
\end{aligned}$$

and

$$g(x) - K_n(x) = \frac{1}{2\sin x}\sum_{k=n+1}^{\infty}(\Delta^2 a_k + \Delta^2 a_{k-1})\tilde{D}_k(x)$$

$$= \lim_{m\to\infty}\left(\frac{1}{2\sin x}\sum_{k=n+1}^{m}(\Delta^2 a_k + \Delta^2 a_{k-1})\tilde{D}_k(x)\right)$$

Thus, we have

$$\int_{-\pi}^{\pi}|g(x) - K_n(x)|dx = O\Big(\sum_{k=n+1}^{\infty} k|(\Delta^2 a_k + \Delta^2 a_{k-1})|\Big)$$

$$= o(1), \text{by } (1.2).$$

This proves Theorem 2.1.

Corollary. *If $\{a_n\}$ be the semi-convex null sequence, then the necessary and sufficient condition for L^1-convergence of the cosine series (1.1) is $\lim_{n\to\infty} a_n \log n = 0$.*

Proof. We have

$$\|S_n(x) - g(x)\| \le \|S_n(x) - K_n(x)\| + \|K_n(x) - g(x)\|$$

$$= \|K_n(x) - g(x)\|$$

$$+ \left\|(a_n - a_{n+2})\frac{\tilde{D}_n(x)}{2\sin x} + a_{n+1}\frac{\sin nx}{2\sin x} + a_n\frac{\sin(n+1)x}{2\sin x}\right\|$$

Also

$$\left\|(a_n - a_{n+2})\frac{\tilde{D}_n(x)}{2\sin x} + a_{n+1}\frac{\sin nx}{2\sin x} + a_n\frac{\sin(n+1)x}{2\sin x}\right\|$$

$$= \|K_n(x) - S_n(x)\|$$

$$\le \|K_n(x) - g(x)\| + \|S_n(x) - g(x)\|,$$

and

$$|(a_n - a_{n+2})| = \left|\sum_{k=n}^{\infty}(\Delta a_k - \Delta a_{k+2})\right|$$

$$= \left|\sum_{k=n+1}^{\infty}\frac{k}{k}(\Delta a_{k-1} - \Delta a_{k+1})\right|$$

$$\le \frac{1}{n}\left|\sum_{k=n+1}^{\infty}k(\Delta^2 a_k + \Delta^2 a_{k-1})\right|$$

$$= o\left(\frac{1}{n}\right).$$

Since $\int_{-\pi}^{\pi}\frac{\tilde{D}_n(x)}{2\sin x}dx = O(n)$

Therefore

$$(a_n - a_{n+2})\int_{-\pi}^{\pi}\frac{\tilde{D}_n(x)}{2\sin x}dx$$

$$= O((a_n - a_{n+2})n),$$

$$= o(1).$$

Moreover,

$$\int_{-\pi}^{\pi}\left|a_{n+1}\frac{\sin nx}{2\sin x} + a_n\frac{\sin(n+1)x}{2\sin x}\right|dx$$

$$\le \int_{-\pi}^{\pi}a_n\left|\frac{\sin nx}{2\sin x} + \frac{\sin(n+1)x}{2\sin x}\right|dx$$

$$= a_n\int_{-\pi}^{\pi}|D_n(x)|dx$$

$$\sim (a_n \log n).$$

Since $\|K_n(x) - g(x)\| = o(1)$, $(n \to \infty)$. by Theorem 2.1

Therefore it follows that

$$\lim_{n\to\infty}\int_{-\pi}^{\pi}|g(x) - S_n(x)|dx = o(1),$$

if and only if $\lim_{n\to\infty} a_n \log n = 0$.

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Ann Arbor, Michigan:
Virtual Downtown Experiments

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The problem of where to locate tall buildings, with sensitivity to existing building types on adjacent and nearby lots, is a difficult one. In Ann Arbor, building height is currently limited by "floor area ratio" (FAR). The FAR is calculated as the ratio of floor area in a building divided by parcel area, times 100. If a given parcel has an FAR of 100, then a building footprint built lot line to lot line may have a height of 1 story. If a parcel has an FAR of 200, then a building footprint built lot line to lot line may have a height of 2 stories. Similarly, an FAR of 300 yields a building of height 3 stories covering the entire parcel. Thus, on a parcel with an FAR of 300, one might, instead, build a building on half of the lot area but of height six stories, or on a third of the lot area but of height 9 stories. On the same parcel, a 30 story building could be built only if its footprint covered one-tenth of the land area of the parcel. The FAR provides a height limit based on the size of foundation needed to support a tall building. It also offers subtle encouragement for preserving some amount of open space and visual variation in the region to which it applies. The drawback is that a tall building may get built with no regard to the broader context of how a new building will fit in with existing buildings on the surrounding parcels. A possible side effect of using FAR (alone) to limit height is that it might encourage parcel amalgamation by large developers, thereby driving out desired local small business owners. [Note: in Ann Arbor, there are also "premiums" designed to encourage residential construction, and other uses viewed as "desirable" in the downtown; these allow an increase in FAR. They will not be covered in this abstract discussion.]

The FAR is assigned by zoning type. In the downtown, there are currently parcels assigned to each of 22 different zoning categories (AG, C1, C1A, C1AR, C2A, C2AR, C2B, C2BR, C3, M1, M1A, M2, O, P, PL, PUD, R1D, R2A, R2B, R4B, R4C, R4D). Roughly speaking, any category beginning with C is a commercial category; M is for manufacturing; R is for residential. The AG category is for agricultural zoning, O is for office, P (except for PUD) is for Public Land (as for the University of Michigan which, as a State university, contributes no funds to the city taxpayer economic base), and PUD is for Planned Unit Development. In Figure 1, the animated map shows the City of Ann Arbor parcel map colored as a thematic map by zoning category: the broad PL zoning is part of the central campus of the University of Michigan. The curved line near the left side of the map. representing the Ann Arbor Railroad corridor, has most of the manufacturing parcels adjacent to it. Separate categories enter the picture in sequence, arranged according to alphabetical ordering of zoning category. The coloring scheme is exhaustive: every parcel is covered. It is also mutually exclusive: no parcel has more than one color. Thus, the zoning classification serves as a geometric partition of the parcels.

Figure 1. Zoning animation of 22 zoning categories:
AG, C1, C1A, C1AR, C2A, C2AR, C2B, C2BR, C3, M1, M1A, M2, O, P, PL, PUD, R1D, R2A, R2B, R4B, R4C, R4D. Zones enter the animation in alphabetical succession. Attached labels are added in the final frame.

Once an inventory of parcel categories is obtained by creating thematic maps, the groups of parcels will be removed in accordance with various ideas. The goal is to select targets of opportunity for taller projects as illustrated below.

Animated maps are useful for showing change; static maps are useful when one wishes to take a longer look at pattern without regard to change in pattern. Thus, Figure 2 shows the final frame of the animated map in Figure 1 along with a layer showing the boundary of the Downtown Development Authority (DDA) in yellow, the railline in black/yellow, the floodway (channel) outline of Allen's Creek in blue, and the floodplain outline of Allen's Creek in cyan.

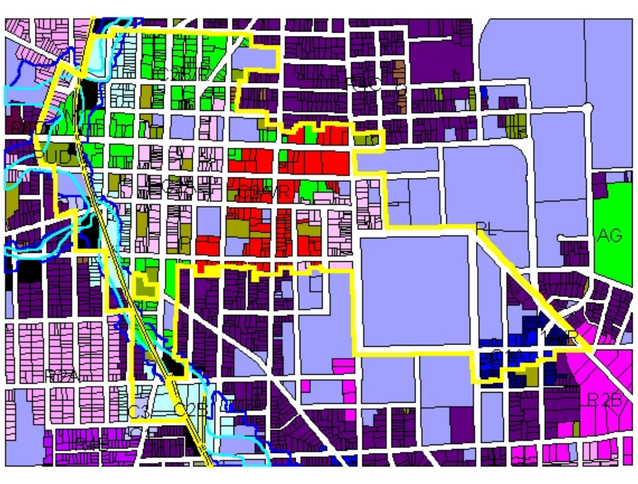

Figure 2. Zoning categories, DDA boundary, railline, floodway and floodplain.

The current interest is to consider only zoning categories, as the downtown "core," of C1A, C1AR, C2A, C2AR, C2BR as those containing parcels that are targets of opportunity for building structures of height greater than that permitted by FAR. The current FAR in these categories is either 200 or 300. The idea is that there may well be parcels within these core downtown areas that could support height in excess of that permitted by the FAR. In Figure 3, the shading is removed for these zoning categories; they are easily focused on as a grouping. When parcels containing historic district designation (and relatively short buildings) are superimposed on the pattern in Figure 3, further limitation of targets of opportunity is the result (Figure 4). The historic district parcels were inserted in a separate step because they overlap the standard zoning hierarchy and are not a part of the geometric partition noted above.

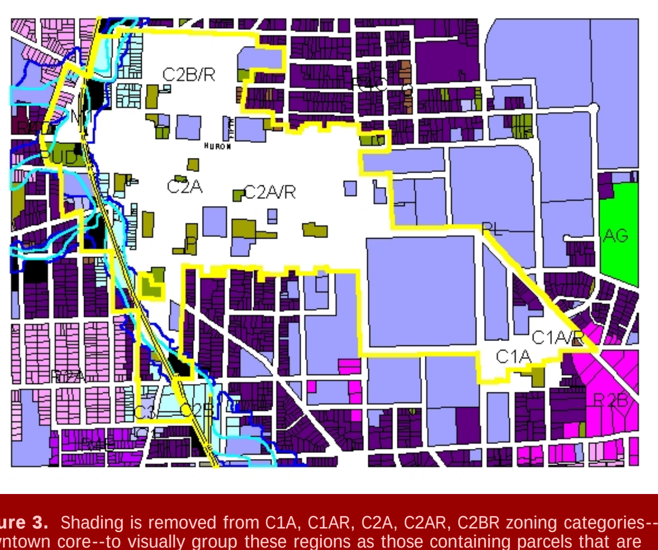

Figure 3. Shading is removed from C1A, C1AR, C2A, C2AR, C2BR zoning categories--the downtown core--to visually group these regions as those containing parcels that are targets of opportunity for height in excess of that permitted by the FAR.

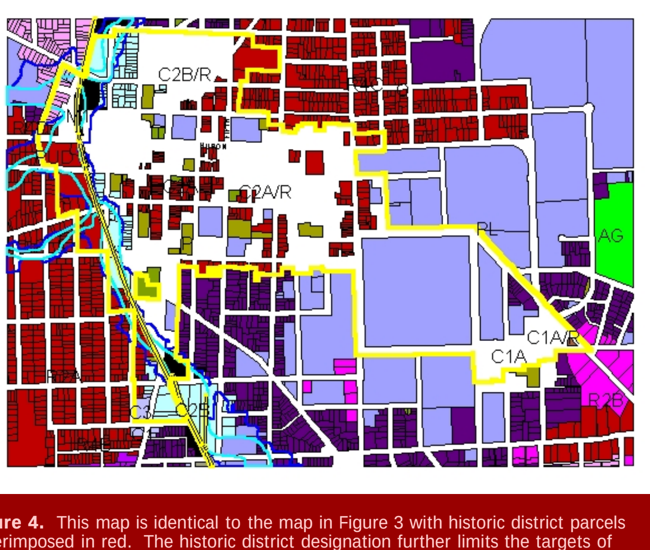

Figure 4. This map is identical to the map in Figure 3 with historic district parcels superimposed in red. The historic district designation further limits the targets of opportunity.

The white areas of the map in Figure 4 contain all the possible parcels in the downtown core that do not carry historic district designation. Some of them already have buildings built on them; others do not. Those with buildings on them may become eventual redevelopment targets; those with no buildings on them may be short-range targets. To take a closer look at the area, insert an aerial photo of the DDA behind the map in Figure 4 (as well as other items of possible interest, such as contours to identify steep slopes). Figure 5 shows a zoom-in on part of the white area; in that figure, however, the "white" area has been replaced with aerial so that one can see directly the current content of all parcels in the core that do not have historic district designation. One can see what is on each parcel and might determine, therefore, a strategy for targeting opportunities for development in excess of the FAR.

A current suggestion by the Planning Department staff and the Ordinance Revisions Committee is to use the street hierarchy to select general target areas: wider streets support taller nearby structures. Thus, the zoom-in of Figure 5 is on Huron Street, the widest street in the DDA. Use of the aerial not only permits quick determination of where parking lots and existing buildings are located but it also shows shadow pattern of existing buildings suggesting guidelines for upper story setbacks and other tools that limit reduction of light. Light in the streetscape is pedestrian-friendly (and vegetation-friendly), particularly at this mid-continental latitude. Highest priority immediate targets of opportunity for height in excess of that permitted by the FAR thus appear (from the abstract representation in Figure 5 alone) to be in the large parking lots visible along Huron Street, with suitable upper level setbacks to minimize shadow in the street. Further analysis is needed, however, to include steep slopes, opinion from members of the public and from developers, the will of governing bodies, and various other acadmic and non-academic factors.

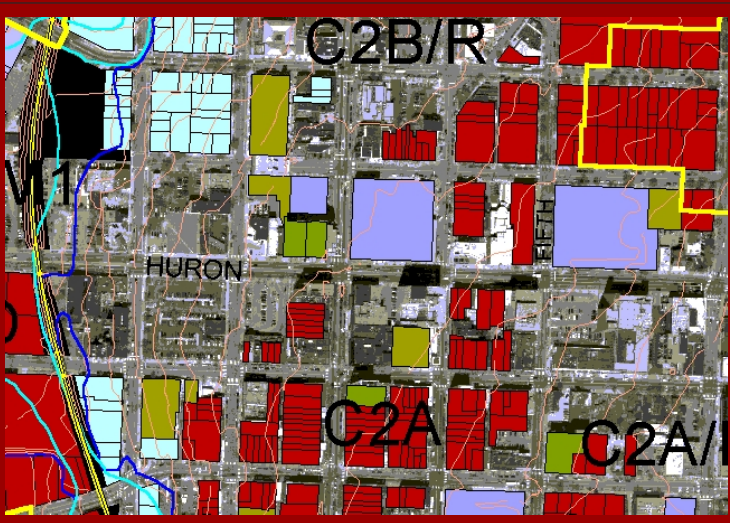

Figure 5. Zoom in--use the street hierarchy to suggest locales--notice the shadows leaning out into Huron Street as well as the content of the core area along Huron Street, from tall buildings to parking lots.

Dynamic maps, produced in Geographic Information Systems (GIS) software, when coupled with high quality aerial photography produces powerful visualization capability that can guide decision-makers. One limitation of this visual analysis is dimensional: even though the aerials are high quality, one still really has only a two-dimensional view of a three-dimensional scene. The ideal would be to have dynamic three dimensional models of the core area. Virtual reality (VR) affords such an opportunity in two different ways: through web-based virtual reality and through immersion in a virtual reality CAVE. Only the former technique can be displayed in this article. The plan, beyond the VR experiments in this article, is to take files such as these, place them in the CAVE in the Media Union at The University of Michigan North Campus in Ann Arbor, and invite policy makers to immerse themselves in the virtual reality created by alternative height scenarios (report to come in a subsequent issue of Solstice) in order to consider the issue of a maximum height ordinance or any other zoning issues in the downtown.

To view the VR experiments below (Figure 6), first download Cosmo Player and install it in your browser according to directions. Then, click on the links below and practice navigating through the streets of downtown Ann Arbor.

FAR Virtual Reality: : translucent buildings are superimposed, lot line to lot line on parcels in the downtown core zones. This VR experiment depicts the downtown with the simplest use of the FAR. [The DDA region is shown in black; the Allen Creek floodplain in blue.]

Actual height Virtual Reality: again, buildings are superimposed, lot line to lot line, on parcels in the downtown core zones. This VR experiment depicts the downtown using actual building heights, where known. [The DDA region is shown in gray; the Allen Creek flooplain and floodway in shades of blue; building color is according to height category.]

Figure 6. Virtual Reality experiments performed using ArcView GIS, v. 3.2, with Spatial Analyst Extension and 3D Analyst extension (from ESRI)..

The title of this article contains the word "experiment." There remain many directions one might move from these initial experiments in order to use maps, aerials, and virtual reality as a guide to decisions. Some of these next steps are enumerated below.

- Digitize the aerial photograph of the DDA so that VR can be constructed on actual building footprints rather than only on a parcel outline basis.
- Field-check building height measurements.
- Introduce final files into an immersion CAVE environment and invite policy-makers to immerse themselves in various 3D alternatives for height in the downtown.
- Consider other patterns for zoning in the downtown. For example, one might begin with the historic district designations and buffer these with fringe areas of various heights supporting gradually increasing heights away from historic buildings (as constrained by a number of variables such as with road width or street hierarchy, proximity to residential zoning, steep slopes, design standards, or various other factors). Thus, a new geometric partition of parcels, based on historic designation, would emerge.
- Recommendation and implementation of any policy for limiting height in the downtown is beyond the scope of any of this material.

The author acknowledges productive meetings with and assistance from

- her colleagues on the City of Ann Arbor Planning Commission (Sandra Arlinghaus (Chair), Kevin McDonald (Vice-Chair), Scott Wade (Secretary), Braxton Blake, Jean Carlberg, Kristen Gibbs, Christopher Graham, William Hanson, and Steve Thorp);
- the Ordinance Revisions Committee of that Commission (Hanson, Chair; Carlberg, Arlinghaus, Blake);
- the City of Ann Arbor Planning Department staff (Karen Hart, Planning Director; Wendy Rampson, Coy Vaughn, Donna Johnson, Jeff Kahan, Chandra Hurd, Alexis Marcarello, Chris Cheng, and Matt Kowalski);
- Merle Johnson, City of Ann Arbor, Information Technology Services;
- Heather Edwards, Historic District Preservation Coordinator, City of Ann Arbor; and,
- the Mayor of Ann Arbor, His Honor, John Hieftje.

Software used: ArcView GIS, v. 3.2, with Spatial Analyst Extension and 3D Analyst Extension. All from ESRI (Environmental Systems Research Institute, Redlands, CA).

Tornado Siren Location
Ann Arbor, Michigan

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Different strategies for locating systems of sirens exist in different locales across the nation. In Ann Arbor, and elsewhere, sirens noise is designed to alert citizens in the outdoors. Citizens who are indoors may hear the sirens but the requirement is that people outdoors be able to hear them. Thus, spacing requirements between sirens becomes important. When there are barriers to overcome (all else being equal), such as topography, buildings and street noise, one might expect sirens to be required to be more closely spaced than in flat, open countryside. Indeed, a brief review of municipal requirements on the world wide web reveals that Oakland County, Michigan views each siren to be capable of covering about a one mile radius. The Baltimore City Fire Department selects spacing at 3200 feet.

The sequence of animaps below, of Ann Arbor, suggests a locational strategy for pinpointing positions for new sirens.

In this first animated map, Figure 1,

- the red dots show the location of the existing system of sirens.
- The light green circles are buffers of radius 3200 feet, the Baltimore standard. Employing the Baltimore standard provides continuous central coverage with gaps at the perimeter.
- The light yellow circles are buffers of radius one mile, the Oakland County standard. Employing the Oakland County standard provides a continuous block of coverage. As new areas come in to the city in 2007, as per boundary agreements, new sirens will need to be added to maintain coverage.
- The red outlines of polygons, in a sort of bubble foam, are outlines of the Dirichlet tesselation on the fire stations. The Dirichlet polygons are mutually exclusive and cover the entire area in the one mile buffer. Pick any point within the one mile buffer. Note which Dirichlet polygon contains it. Thus, the siren in the same Dirichlet polygon as the selected point is the siren closest to that selected point. Each Dirichlet polygon contains all the points closest to the siren in that polygon.

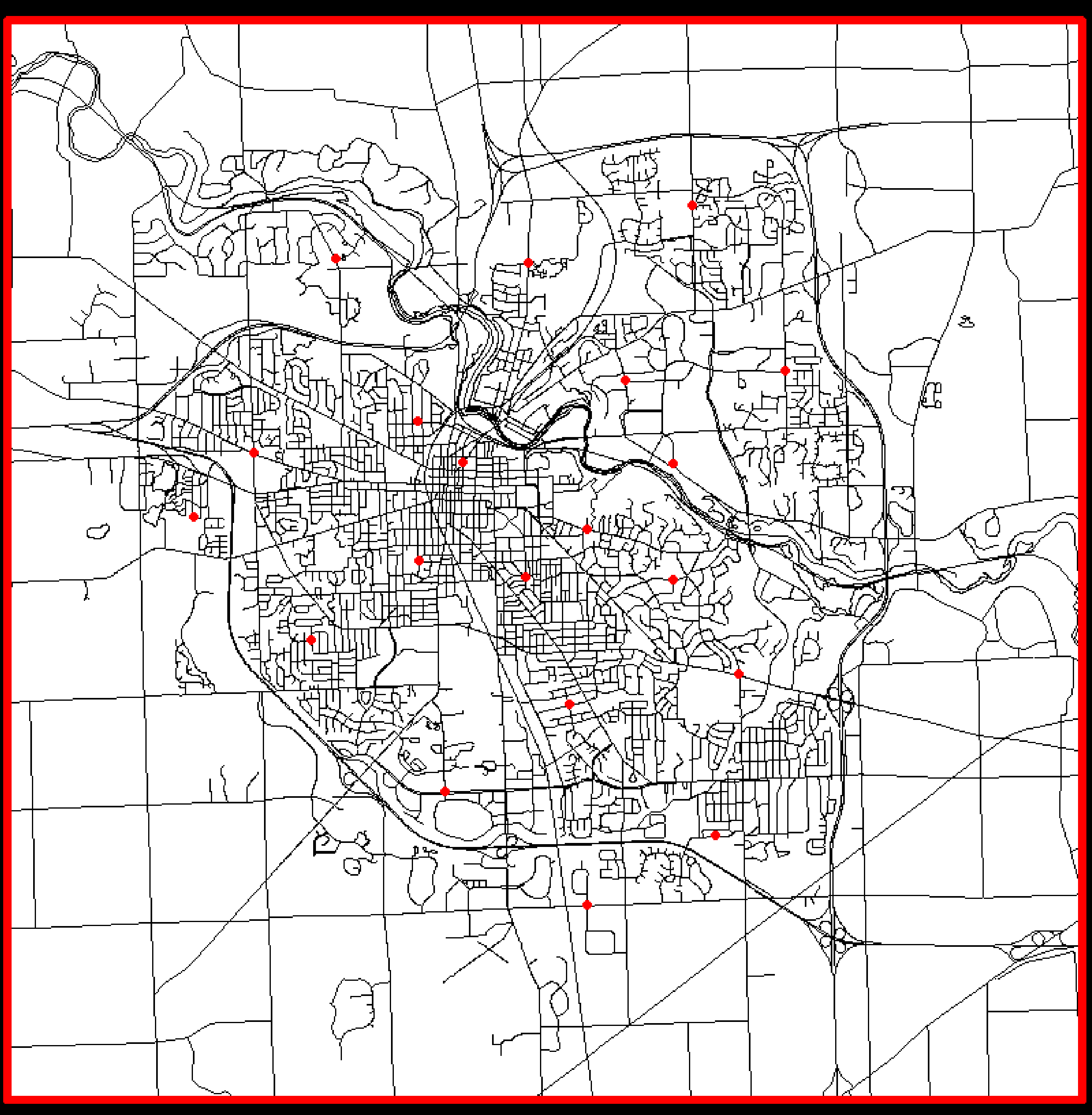


Figure 1. Red dots show existing tornado siren locations. Green circles use the coverage radius employed by Baltimore, MD; yellow circles use the coverage radius employed by Oakland County, MI.

In the second animated map, Figure 2,

- The red dots and the Dirichlet tesselation are as above.
- Successive buffers have radii of 1000, 2000, 3000, 4000, and 5000 feet.

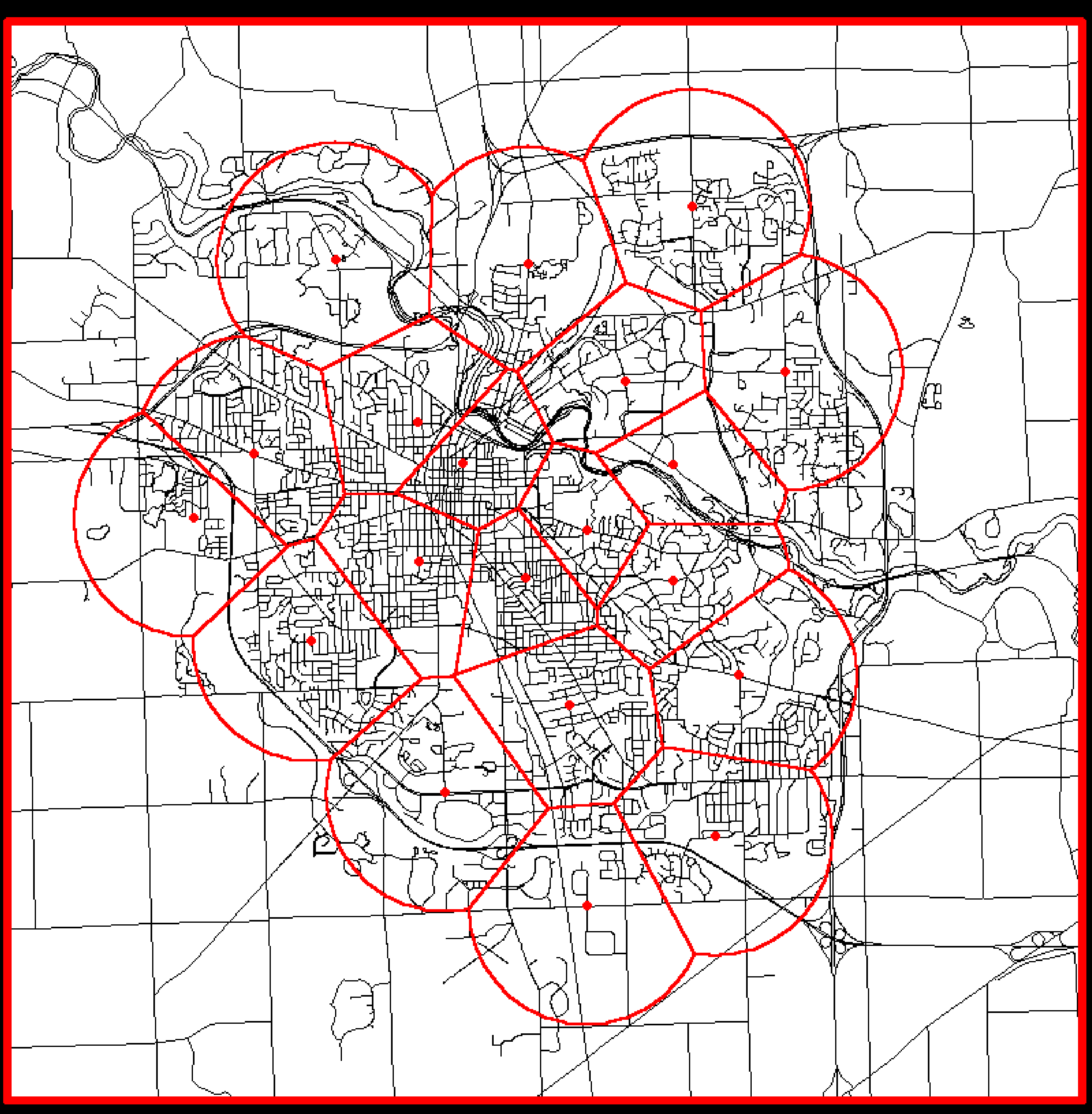


Figure 2. Spacing between successive buffers of sirens is 1000 feet.

In the third animated map, Figure 3,

- The red dots and the Dirichlet tesselation are as above. The white background has been removed, inverting the emphasis on the road network.
- Successive buffers have radii of 1000, 2000, 3000, 4000, and 5000 feet.
- Streets enter the picture along with buffers, showing zones of connectivity and perhaps suggesting emergency routes in the 3000 or 4000 foot buffer level. There is a northwest arterial that is entirely contained within the 4000 foot buffer. On the east side, routes through the southeast/central (Ann Arbor Hills) area show strong coverage.

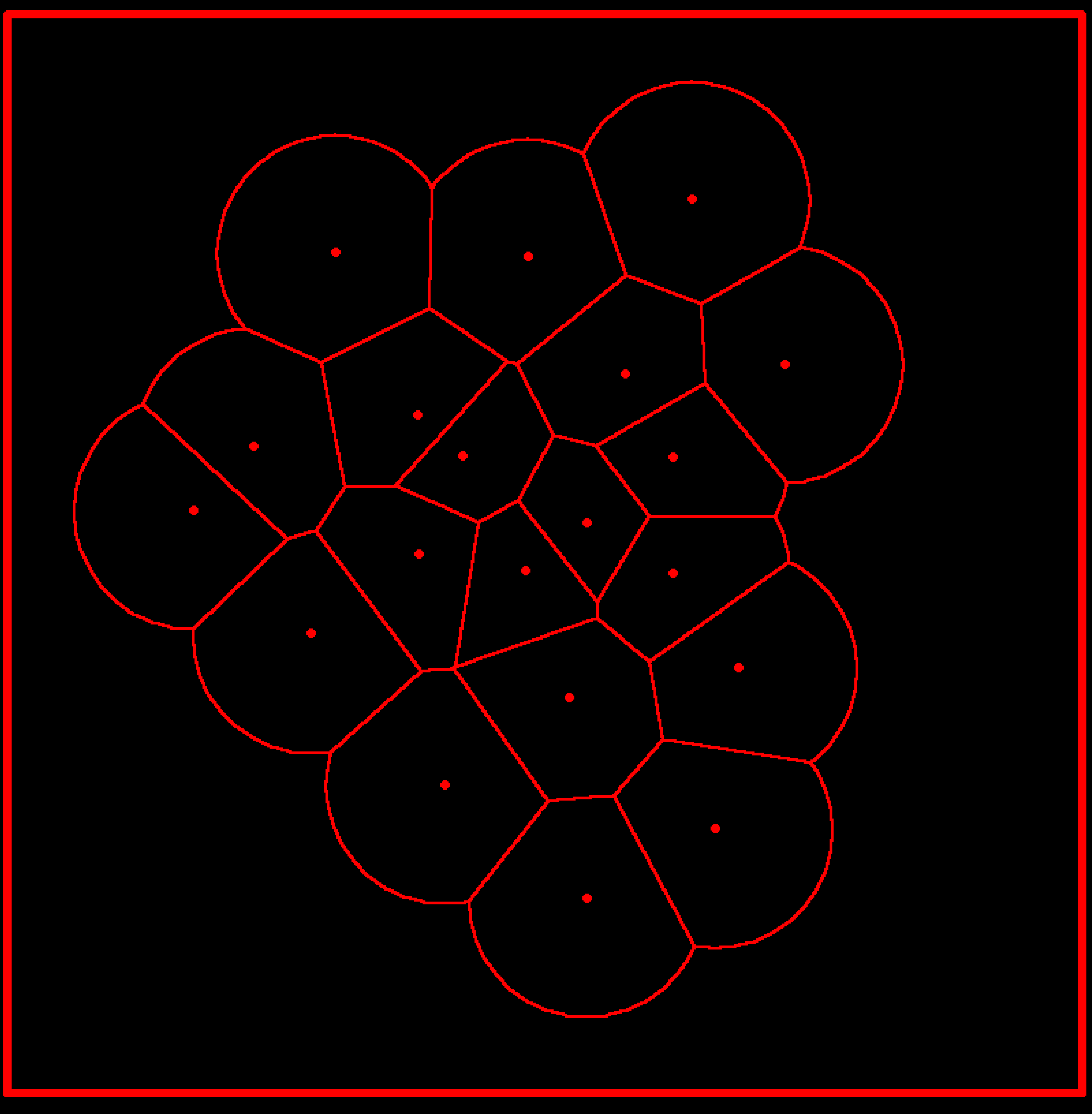


Figure 3. In this view, connectivity of the road network, already within earshot of existing tornado sirens, is emphasized.

Finally, where might one consider locating new sirens (Figure 4)?

- The 5000 foot view shows a gap in coverage just south of Pioneer High School, east to the U. of M. golf course.
- Within the Dirichlet tesselation, highest priority might therefore (all other things being equal) be given to putting a siren in the gap; indeed, golfers are an important target population!
- Outside the Dirichlet tesselation, highest priority might therefore be given to the gap at the right edge of the tesselation that is within the freeway ring but is as yet uncovered by a siren. The location for a new siren was found by digitizing the uncovered area, calculating the centroid of the digitized region, and then using the centroid as the proposed siren location. In implementation, it is likely that actual position will not follow centroid location exactly as one factors in property rights, ease of siren maintenance/access, and so forth.

The cyan (turquoise) sets of concentric circles in Figure 4 fill these two gaps.

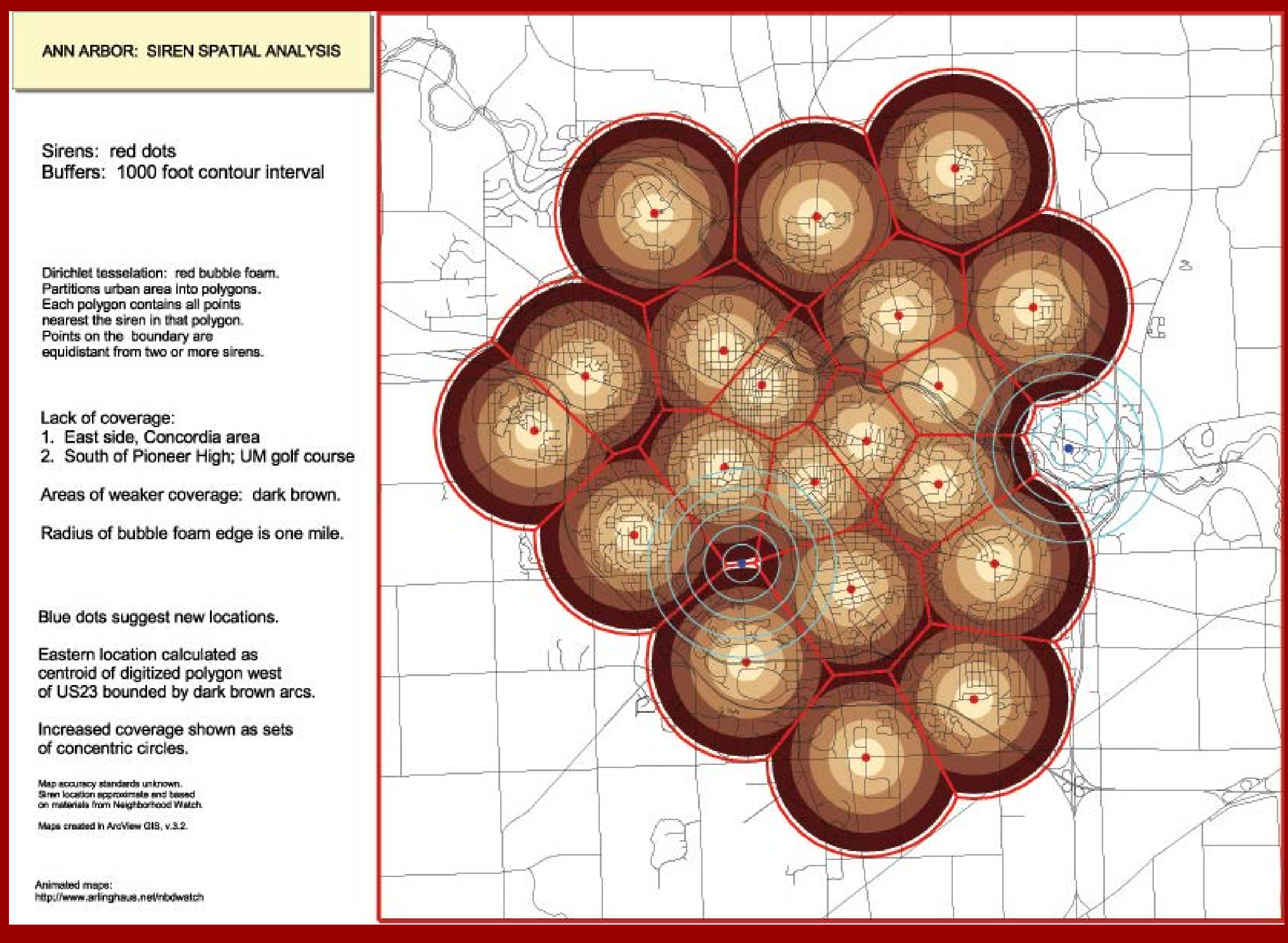


Figure 4. Cyan concentric circles targe locations for two new tornado sirens.

Click here for a link to an interactive map made using ImageMapper 3.1 from Alta4.com . Click on a dot on the linked map. Portions of the underlying database associated with that dot will pop up next to the map. The entries in the database are hypothetical and are present to suggest the range of power of this sort of map for organizing data. There is no need for any extra plug-in so that users who are NOT administrators of a machine may also have access to municipal files, from their local public library, public university, or elsewhere.

Directions for future research:

- Contour map of city
- Triangulated Irregular Network (TIN) made from contour map to show topography
- Superimposition of sirens on topographic map
- Recommendations for siren location or relocation based on this finer analysis.

Input from:

- Matthew Naud, Environmental Coordination Services, Director, City of Ann Arbor;
- Merle Johnson, Information Technology Services, City of Ann Arbor;
- Adele ElAyoubi, Neighborhood Watch Coordinator, City of Ann Arbor Police Department;
- Karen Hart, Planning Director, City of Ann Arbor.

Oakland County, Michigan
http://www.co.oakland.mi.us/ems/program_service/torn_siren.html

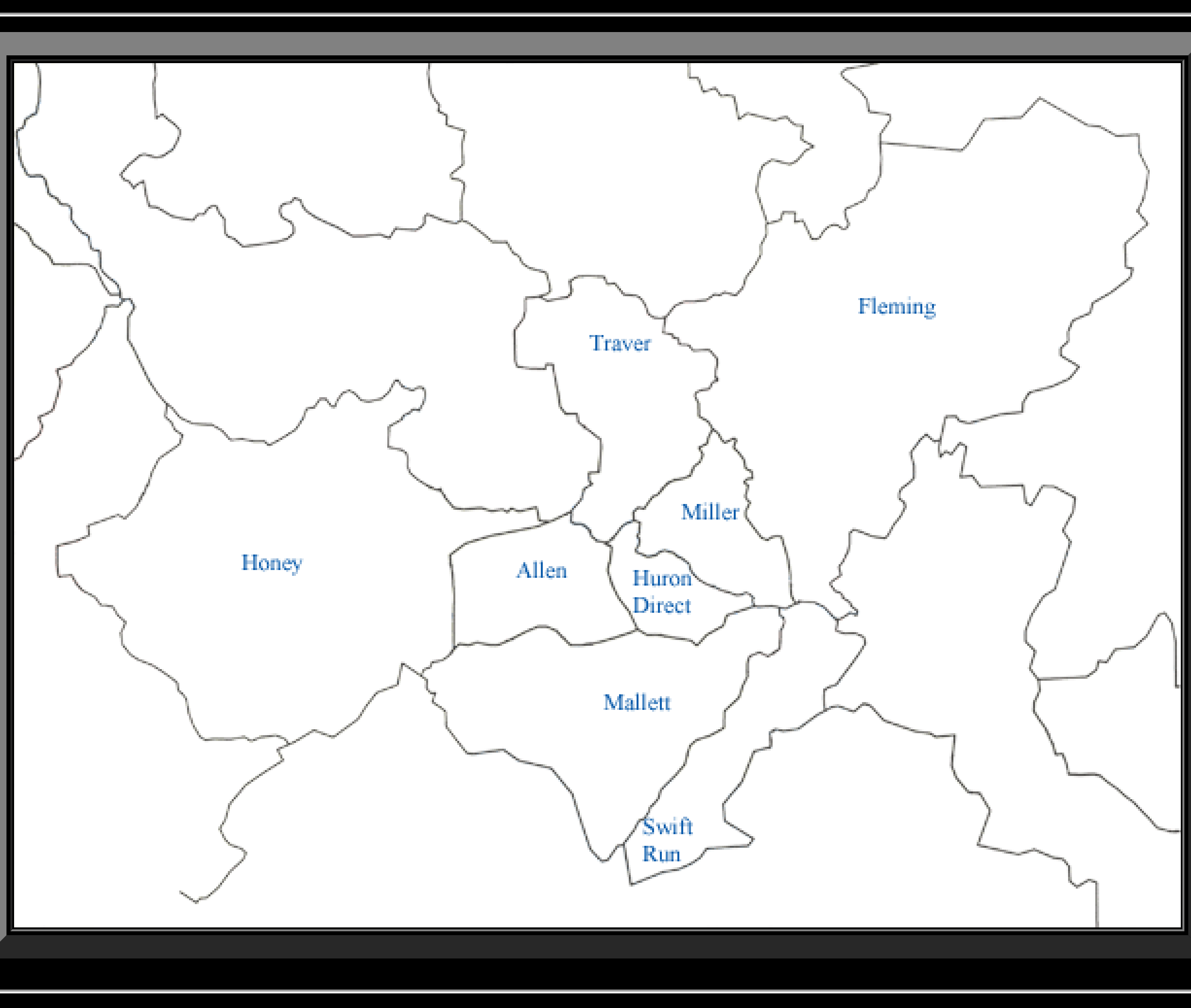
Baltimore, Maryland, Fire Department
http://www.ci.baltimore.md.us/government/fire/pr021016.html

Ann Arbor Creeksheds: Resource Website

Created by the City of Ann Arbor Environmental Commission, Water Subcommittee
on behalf of all of the citizens of Ann Arbor.

**Material presented to the Environmental Commission, June 26, 2003.
The EC voted unanimous support of a modified form of this resolution (which the Coordinator has) and directed that it be sent on to City Council.**

Click here for Feedback Form.
Start a Creekshed Resource Page.



To find out information by creekshed, click on the links below,
or click here to see a larger version of the colored map above that has been made clickable by creekshed.

Allen's Creekshed
Fleming's Creekshed
Honey Creekshed
Huron River, Direct
Mallett's Creekshed
Swift Run Creekshed
Traver Creekshed

Related Links

- City of Ann Arbor
- Huron River Watershed Council
- Ecology Center
- Huron Valley Sierra Club

- Floodplain and Floodway Land Use Summaries:

  Floodplain Analysis
  Maps
  Ann Arbor Planning Department
  June 5, 2001

- City-owned Properties in the Floodway/Floodplain
  Letter from Karen Hart
  Map, City of Ann Arbor Retail Land Use
  Map, Downtown Commercial Zoning Districts and Maximum Allowable Height

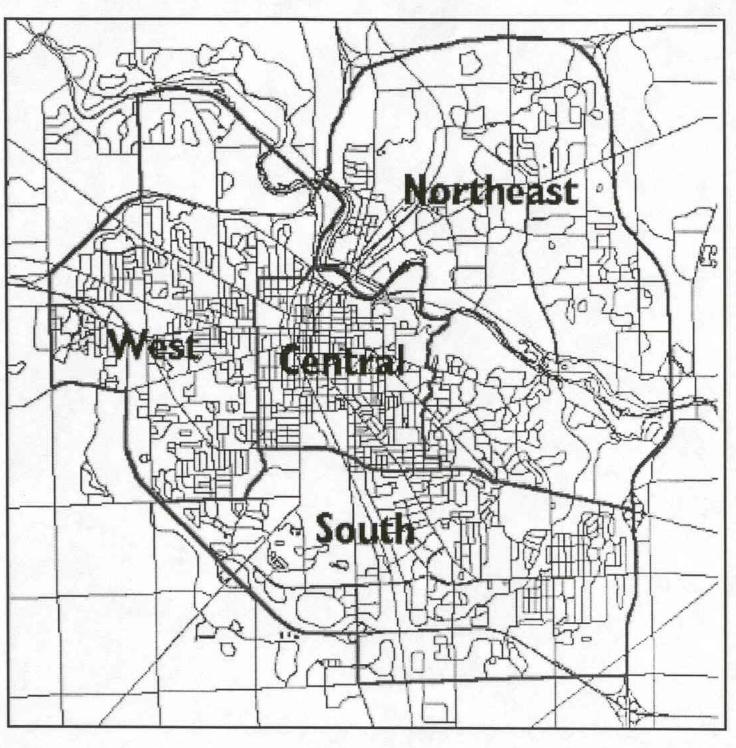
- Natural Features Ordinance Committee

Resolutions involving creeksheds:

- Resolution, City of Ann Arbor Planning Commission, Tuesday, July 10, 2001: Master Planning statement including a resolution to investigate the concept of planning by creekshed.
  "RESOLVED: That the City Planning Commission will work to develop an overall Master Plan update schedule and investigate the concept of creekshed-based planning in FY2001-2002."
  Page 1; page 2.
- Mallett's Creek, City Planning Commission Resolution
- Mallett's Creek, City Council Resolution

Selected maps and links to maps
(see attached pages for additional references):

Current Planning Areas, not based on creeksheds Central, South, Northeast, and West.



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To see clickable map, go to City of Ann Arbor website, Planning Department.

Selected references involving the general Ann Arbor area
(see attached pages for additional references)

Data on vacant land, July 10, 2001.

Letter from Elizabeth Worzalla, Huron River Watershed Council, to Karen Hart, Planning Director City of Ann Arbor, calling for creeksheds as planning units. May 1, 2001.

Ann Arbor Transportation Plan Update, Wendy Rampson, April 27, 2001.

Collaborative Project with the Scio Township Planning Commission, Karen Hart, April 26, 2001

Washtenaw County Drain Commissioner's Office (Harry) supplied materials on planning by creekshed, following meeting of WCDC with CPC, 1997.

Elements of Spatial Planning: Theory, Part I., S. L. Arlinghaus, *Solstice: An Electronic Journal of Geography and Mathematics*, Volume VI, Number 2, 1995. Article that calls for using the creekshed as a fundamental planning unit.

e-mail: Environmental Commission, water subcommittee webpage contact.

Comments concerning
"RESOLUTION TO USE CREEKSHEDS AS UNITS FOR APPROPRIATE LOCAL AND REGIONAL ENVIRONMENTAL ANALYSIS."
Draft resolution appears below (scroll down).

Bill Hanson, Washtenaw Land Trust wrote:

Willhan@aol.com wrote:

Sandy,
Thanks for your very kind note. I share your strong interest in planning based on creeksheds and environmental systems. I hope we can move that ball ahead together!

Best,
Bill

Karen Hart, Planning Director, City of Ann Arbor--statement below.

Subject: RE: Creekshed resolution draft
Date: Mon, 2 Jun 2003 16:09:53 -0400
From: "Hart, Karen" <KHart@ci.ann-arbor.mi.us>
To: "'Sandra Arlinghaus'" <sarhaus@umich.edu>

Very good. I may be mistaken, but I don't think Council directed the NFOC to prepare a NF master plan; I think the NFOC took that upon themselves.

Planning Director
City of Ann Arbor, Michigan
Phone: 734-994-2800
Fax: 734-994-2798
E-mail: KHart@ci.ann-arbor.mi.us

Chris Graham, NFOC--statement of strong support at the last Environmental Commission meeting.

Jesse Gordon, Mallett's Creek--statement of strong support at the last Environmental Commission meeting.

Gwen Nystuen, NFOC--inclusion of a related statement in Natural Features Master Plan.

Subject: Changes in the June DRAFT NFPlan
Date: Fri, 13 Jun 2003 03:48:49 -0400
From: Gwen Nystuen <gnystuen@umich.edu>
To:
HHerrell@ci.ann-arbor.mi.us, "Chris Graham <grahamz@umich.edu> Parma Yarkin" <grahamz@umich.edu>, Kim Waldo <mikkayak@yahoo.com>,
Margie Teall <mteall@ci.ann-arbor.mi.us>, Mary Borkowski <mborkowski@atwell-hicks.com>, Warren Attarian <wja1086@aol.com>,
Wendy Carman <wjcarman@umich.edu>, Sandra Arlinghaus <sarhaus@umich.edu>

Hello All,

I did find a copy of our 1994 charge from Council along with the 1994 letter from Heidi to Council. It is included as Section II.

The following modifications were made at the last meeting to respond to Chris and Sandy regarding creekshed-based planning, and climatic change,
diversity and control of invasive species. New language is underlined.

1) The following additions directed to creekshed-based planning;

We have incorporated creekshed planning as one of the first items in the Executive Summary and in section V. General Description and Protection Measures
primary goals, and also added it as a strategy under the Huron River and Its Tributaries. We have included map information on the location of the watersheds.

In Executive Summary under Huron River and Tributaries:

1) Work with local and regional partners to implement creekshed-based planning, environmental analysis and coordinated programs to protect the
Huron River.

In section V. General Description and Protection Measures primary goals:
1. Water Quality: Work with local and regional partners to implement creekshed-based planning, environmental analysis and coordinated programs to
protect the Huron River. Greatly diminish the quantities of pollutants, nutrients, and sediments reaching the Huron River. Eliminate sewage line overflows to
the River in storm events. Greatly reduce erosion of banks in each of the City�s tributary waterways. Greatly increase the number and effectiveness of storm
water storage facilities/flood capacity, throughout the City. Increase the opportunities for storm water to infiltrate soils. Work with neighboring River
communities to accomplish similar efforts. Solve the Allen�s Creek flooding problem.

2) Addtions regarding climatic change, diversity and invasives:
We have added to the Executive Summary under Native Plant and Animal Ecosystems

2) Plant landscapes to reflect the rich biodiversity of the native landscape to protect against disease, and periods of flood, drought or unusual periods of
prolonged high or low average temperatures.
4) Expand programs to control invasive species.

We have added to section V. General Description and Protection Measures primary goals:
8. Climate Change: Work to anticipate the impacts of a changing climate on the City�s important natural features, and take sensible action to mitigate those
effects. Increase the diversity and distribution of native plants that are adapted to the extremes of climate of the region. Continue membership in the
International Council for Local Environmental Initiatives and other regional planning agencies that are developing strategies to respond to drought, flood,
severe storms and other unusual climate.

Under Native Plants and Animals have added under Goals:
5. Reduce invasive species.
6. Increase the diversity and distribution of native plants that are adapted to the extremes of climate of the region.

And under Strategies:
5. Plant landscapes to reflect the rich biodiversity of the native landscape to protect against disease, and periods of flood, drought, severe storms or unusual
periods of prolonged high or low average temperatures.
6. Expand programs to control or reduce invasive species and coordinate programs with other public and private organizations.

Parma and Margie are getting copies to everyone.

Gwen

Janice Bobrin, Washtenaw County Drain Commissioner--copy of letter below (obtained from Tony Vanderworp, Washtenaw County).

April 4, 2003

Senator Liz Brater
District 18
510 Farnum Building
PO Box 30036
Lansing, MI 48909-7536

Representative Chris Kolb
District 53
S0987 House Office Building
P.O. Box 30014
Lansing, MI 48909-7514

Dear Senator Brater and Representative Kolb,

The Michigan Land Use Leadership Council has been given the opportunity to advise the Governor and the Legislature on a cooperative, common sense approach to land use in Michigan. I fully support the role of the Council, and I would like to thank Senator Brater and Representative Kolb for this opportunity to comment on this critical and timely issue. The focus of my remarks pertains to land use planning from a water resource protection perspective. Washtenaw County will be providing more comprehensive comments to the Council at a future date through our Department of Planning and Environment.

In identifying trends, causes, and consequences of unmanaged growth and the solutions to this staggering problem, there will be a number of challenges to address. Among these are urban revitalization, agricultural land preservation, transportation policy and intergovernmental coordination. At the very onset of this effort, I would like to emphasize that the future health and integrity of Michigan�s water resources are dependent on the land use decisions we make today.

Land use and water resource protection cannot be separated. The way in which the land within a watershed is developed and managed essentially defines the health of its waterways. For this reason, the case for integrated land use planning � for changing the way we currently do business � can be made most cogently from the water resources protection perspective.

Watershed management, by definition, requires coordination of land use planning, development standards, and resource protection strategies and standards across community and political boundaries. Traditional fragmented regulatory and management programs simply have not worked; waterways are complex systems that must be managed through comprehensive ecological approaches.

Unfortunately, under out current structure, land use decisions and water resource protection decisions are made independently by different units of government and agencies, and at different levels of government. In order to achieve watershed planning and management in Michigan, communities must have enhanced legal tools, expanded and more accessible technical information, and education about fundamental watershed management concepts. In addition, new working relationships will be required, not only across community boundaries, but also among state, regional and local agencies.

In this light, I would like to offer the following recommendations:

1. Legislative Enabling Authority for Watershed Planning and Management
Current enabling legislation for watershed organizations is relatively weak and limiting. Watershed plans are often prepared with grant funds, have no basis in law, and no funding mechanism for implementation. Legislation that provides both a process and a funding mechanism for watershed planning and plan implementation does not exist. This is a gap that must be filled if Michigan is to achieve long-term protection of high quality waterways and restoration of impaired systems.

House Bill 6131, introduced by Representative Kolb in the last legislative session, and originally proposed as part of a set of comprehensive amendments to Michigan�s Drain Code, would fill this gap in the state�s enabling legislation. The legislation includes requirements that all local governments in a defined watershed participate in development of plans and implementation strategies, and determination of allocation of costs. It further provides mechanisms for participation by all interest groups and the general public.

2. Economic Incentives for Watershed Planning and Management
In order to encourage local action for the creation of meaningful watershed organizations, a strong network of positive incentives and possibly sanctions should be enacted at the state and federal levels to promote and support watershed planning. Otherwise, citizens and local community leaders may be reluctant to pursue the creation of �another layer of government� with any significant authority.

I recommend that local governments� participation in a watershed management initiative be a prerequisite to awarding any state-controlled funding that has land use ramifications. Linking grant and low interest loan programs to participation in watershed planning would provide a strong incentive for local initiation of watershed plans and protection strategies, and participation in their implementation.

State administered financial assistance programs should ensure that aid is awarded consistent with local watershed plans. For example, state funding to assist local governments with the purchase of open-space recreational lands should be awarded based in part on the importance of the proposed site to its watershed. Priority should be given to sites that serve critical functions within a river system. Road improvements and community development funds should be directed away from areas where more intense development would be particularly deleterious (e.g. headwater and riparian areas). State-initiated projects and activities (construction of facilities, acquisition of lands, issuance of permits, etc.) also should be assessed from a watershed perspective. To achieve this watershed-based coordination of state programs and activities, an avenue that could be explored is a �State Watershed Coordination Act�, requiring that all state activities and award of funding be evaluated from watershed impact perspectives and be undertaken consistent with existing watershed plans.

3. Stormwater Management Authority
Currently, there is no mandate for stormwater management and runoff control in new development. Under the Land Division Act, the adequacy of stormwater management systems in proposed plats is reviewed by the county drain commissioner (or other designated authority) for consistency with county-adopted standards; however, no parallel requirements exist for other categories of development.

Locally administered stormwater management standards and review procedures should be developed and applied to all categories of land use. Such standards must go beyond flood control considerations to address both water quality and quantity management. This recommendation could be implemented by amendment to the Michigan Drain Code, Public Act 40 of 1956, or by stand-alone stormwater management legislation. Examples from other states are widely available.

4. Watershed Assessment and New Cost Sharing
Land use and development review procedures must be expanded in a way that fully accounts for the external costs of individual land use decision to an entire watershed. A process for the equitable distribution of the associated costs and benefits across watershed communities must be designed and implemented, so that further infrastructure improvement costs do not become the responsibility of the local governments and citizens long after the developer has left the scene.

Other necessary tools to ensure that costs and benefits are equitably allocated are mechanisms that will allow the cost of protecting critical areas in one community to be spread over other benefiting local governments. Approaches could include purchase of development rights by the watershed, and transfer of development rights across community boundaries within a watershed into areas where more intense development can be tolerated. These authorities should be included in any new enabling legislation for watershed organizations.

Recognizing that Michigan is a strong local home rule state, and local units of government will retain the right to make local planning decisions affecting their communities, specific authority to permit cross-jurisdictional watershed-based overlay zoning will enhance each community�s ability to protect critical water resources within the context of a broader watershed planning framework.

In conclusion, these enhanced legal tools, economic incentives and the prospect of an equitable distribution of the associated costs and benefits, are among a more comprehensive list of recommendations outlined in the report entitled Toward Integrated Land Use Planning: A Report to the Michigan Natural Resources Commission, dated August 1996. They provide a framework to ensure that the long-term integrity of

Michigan�s water resources is preserved. As stewards of twenty percent of the world�s fresh waters, this in an obligation we have not only for Michigan citizens, but to a much larger constituency.

I appreciate this opportunity to provide recommendations to ensure that future land use decision making in Michigan will more adequately protect and preserve the delicate resources that define the character of our state. I thank you again for the opportunity to comment.

Very truly yours,

Janis A. Bobrin
Washtenaw County Drain Commissioner

DRAFT
RESOLUTION TO USE CREEKSHEDS AS UNITS FOR APPROPRIATE LOCAL AND REGIONAL ENVIRONMENTAL ANALYSIS

Whereas:

- The City of Ann Arbor expresses, in multiple and enduring ways, an abiding interest in regional planning, environmental analysis, and intergovernmental coordination;
- Creeksheds are fundamental spatial units that fit together naturally to form river basins and larger watersheds that offer a natural geometric and geographic plan for appropriate regional planning, environmental analysis, and intergovernmental coordination;

Whereas:

- Local evidence is already present to suggest interest in this topic;
- Basin commissions throughout the world organize multinational interests along watershed and basin management principles;

Whereas:

- The City of Ann Arbor Planning Commission passed the resolution, "That the City Planning Commission will work to develop an overall Master Plan update schedule and investigate the concept of creekshed-based planning in FY2001-2002" (July 10, 2001);
- The Natural Features Ordinance Committee was charged by the City Council to create a Natural Features Master Plan that is nearing completion and addresses water resources;
- Recent changes in State law require the City to update its Master Plan on a five-year basis;

Resolved: That the City of Ann Arbor Environmental Coordinator:

- work with local and regional public and private partners to investigate, and to implement, creekshed-based environmental analysis, as it is appropriate to regional planning, broader environmental analysis, and intergovernmental coordination;
- document this work in a section of the annual State of the Environment report.

Resolution submitted, by Sandra L. Arlinghaus, for action to the Environmental Commission of the City of Ann Arbor.
June, 2003.

Subject:
Re: Creekshed resolution draft
Date: Wed, 18 Jun 2003 17:24:47 -0400
From: Sandra Arlinghaus <sarhaus@umich.edu>
Organization: The University of Michigan
To: Jesse Gordon <jgordon@umich.edu>
References: 1 , 2

Hi Jesse, thanks much for the input. Since this is coming from the environmental commission, I think I'll stick with "environmental". It comes up again on June 26th before the entire commission for voting.
Bye, Sandy.

Jesse Gordon wrote:

> Thanks for sending this material. My preference would be for the word
> "environmental" to be omiitted from the first bullet of the resolved
> section. I'd like to see the Planning Dept. replace its current division of
> the city into areas by a division into creeksheds, and your second whereas
> justifies that.

Other comments were received on an earlier draft and these were discussed at the previous environmental commission meeting. The item was left on the table for voting until the June 26 meeting to provide time to accumulate the comments above, particularly from the NFOC and from the WCDC.

Welcome!

Environmental Commission, Water Subcommittee

Constructive Feedback Form

Enter your e-mail address:

☑ Send a copy of this message to Sandy Arlinghaus.

Please discuss your interests and enter comments in the text area and fill out the checkboxes below. Your constructive feedback will help build a system tailored to our wishes and needs.

Send Message

MAP BANK:
Which of the following maps do you think might be of interest in making an interactive internet map?

City of Ann Arbor maps: parcel map	☐ Yes	☐ No
City of Ann Arbor maps: pavement, gutter to gutter	☐ Yes	☐ No
City of Ann Arbor maps: street centerline	☐ Yes	☐ No
City of Ann Arbor maps: hydro features including creek sheds. Also, broader watersheds available.	☐ Yes	☐ No
City of Ann Arbor maps: soils	☐ Yes	☐ No
City of Ann Arbor maps: rails	☐ Yes	☐ No
City of Ann Arbor maps: contours (5 foot interval; database incomplete)	☐ Yes	☐ No
Aerials of Ann Arbor possibly available	☐ Yes	☐ No
SEMCOG maps: regional Census tract map (regional, tracts, master plans, landuse, Michigan Geographic Framework	☐ Yes	☐ No
SEMCOG maps: regional Master Plan maps	☐ Yes	☐ No
SEMCOG maps: Land use maps	☐ Yes	☐ No
SEMCOG maps: Michigan Geographic Framework maps--includes hydro, roads, Minor Civil Divisions, and many features.	☐ Yes	☐ No
SEMCOG maps: Bus routes.	☐ Yes	☐ No
SEMCOG maps: Washtenaw County, race and poverty	☐ Yes	☐ No
SEMCOG maps: Washtenaw County. traffic crash maps.	☐ Yes	☐ No

On which of the following topics would you like to see more information? Pull down and select one, please.

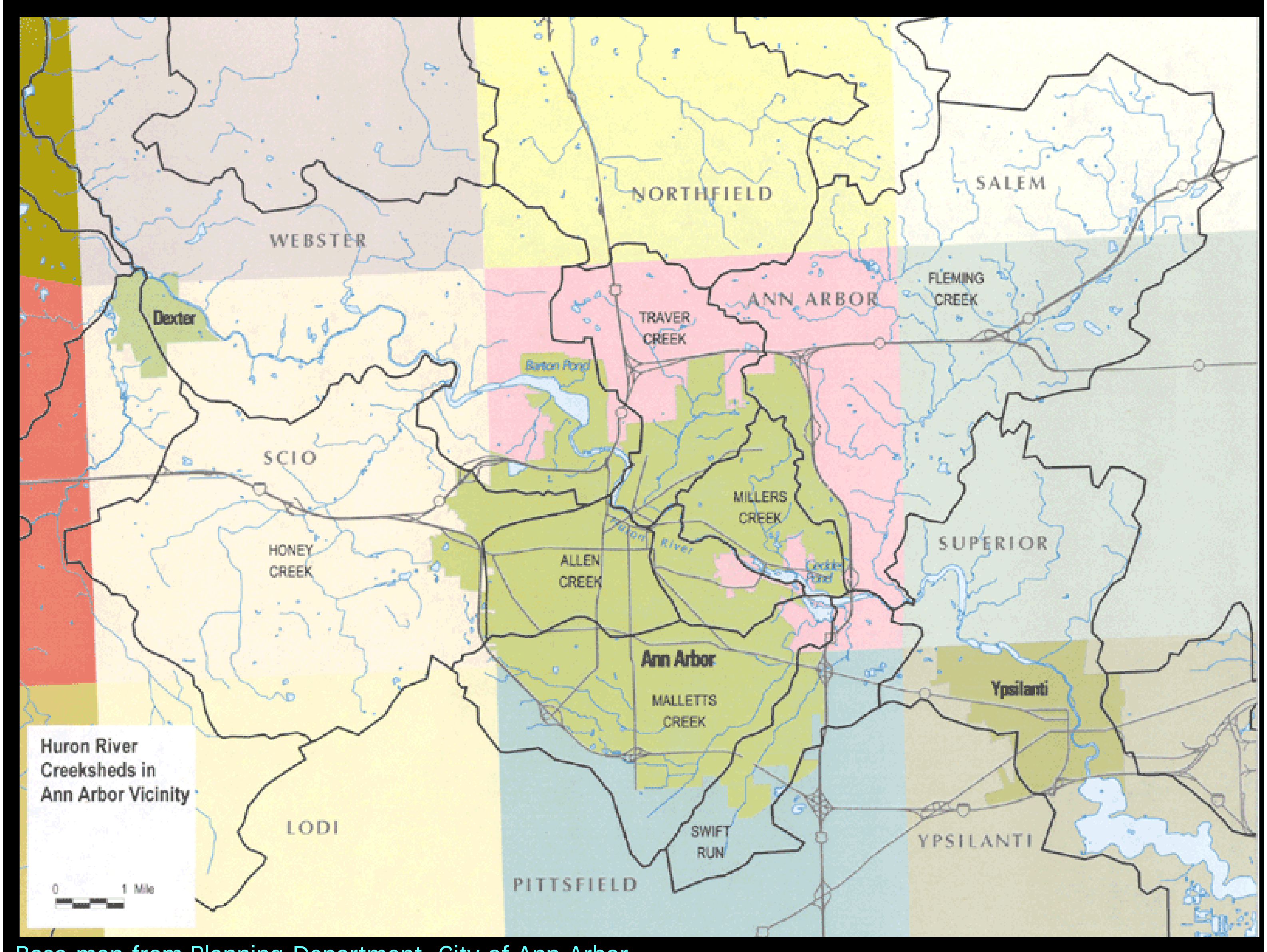
other subcommittees

Ann Arbor Creeksheds:
Detailed, Clickable Map

Click on links in the map to find information about creekshed groups, maps, and other related information.

Created by the City of Ann Arbor Environmental Commission, Water Subcommittee
on behalf of all of the citizens of Ann Arbor.

[Click here for Feedback Form.](#)
Start a Creekshed Resource Page.



Base map from Planning Department, City of Ann Arbor.

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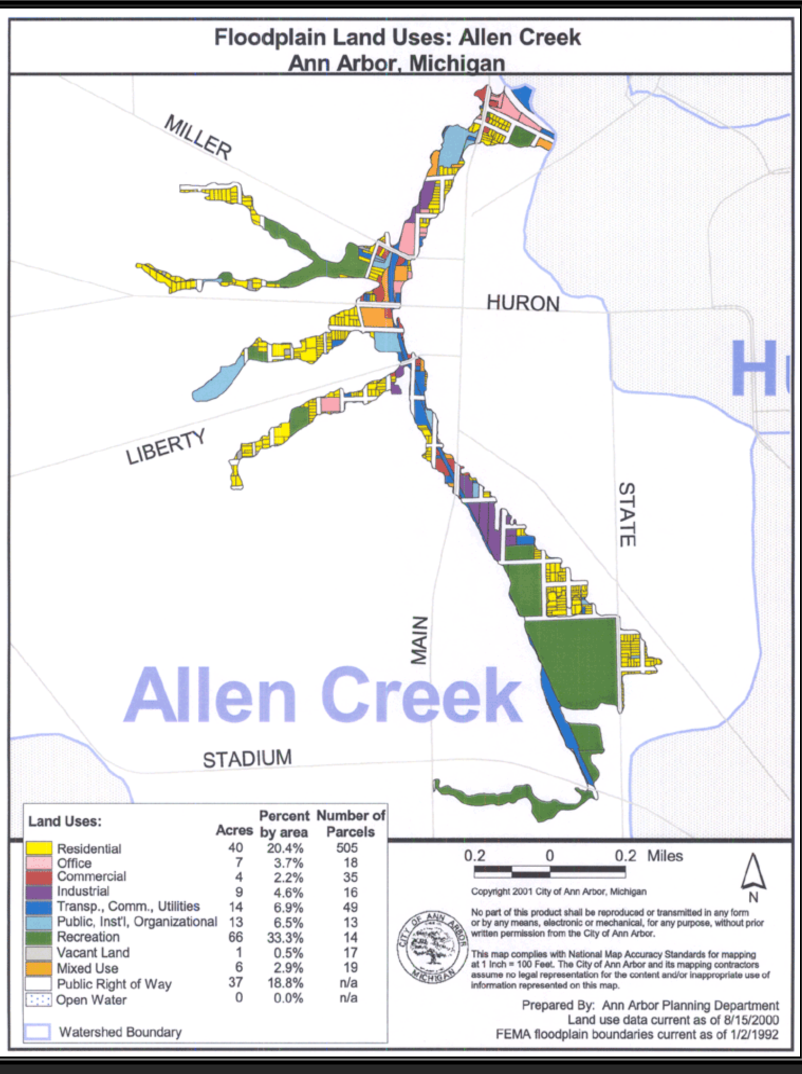
e-mail: Environmental Commission, water subcommittee webpage [contact](#).

Allen's Creekshed: Resource Page



Allen's Creek Watershed Group

- Allen's Creek Watershed Management Plan, May 30, 2001

City of Ann Arbor,
Planning Department Posters

Allen Creekshed, maps and aerials series.

1	2	3	4	5	6

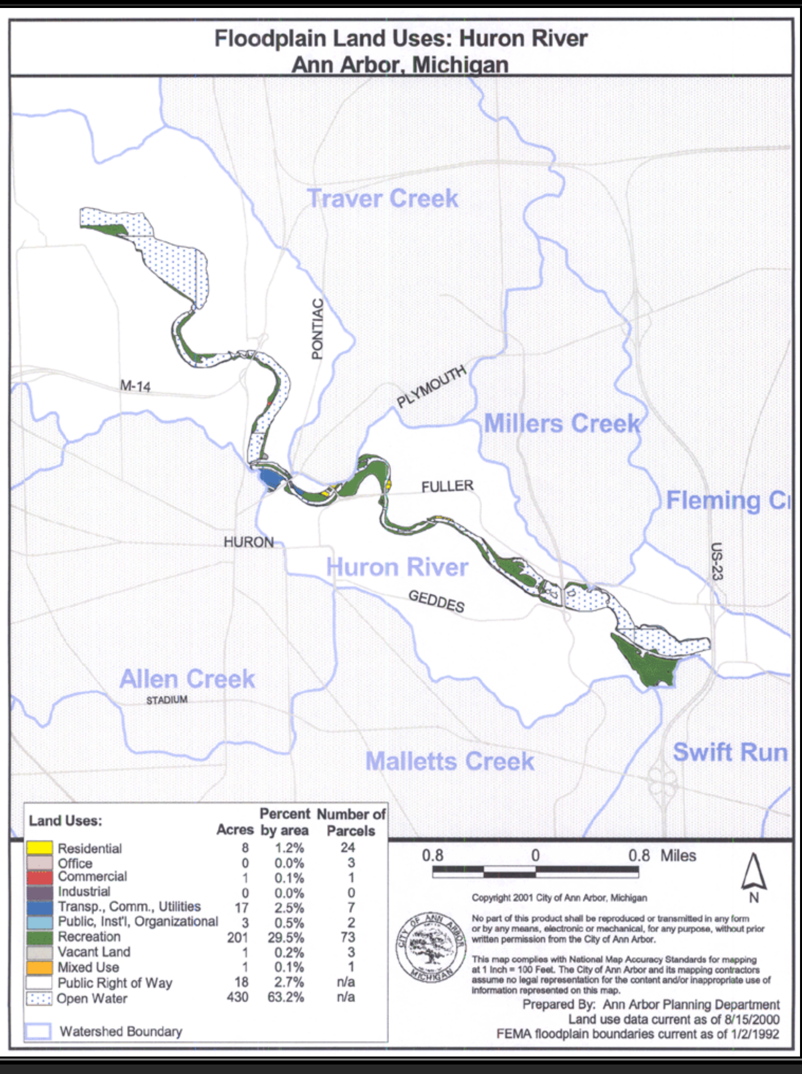
Related links

- Maps and Decisions: Allen's Creek Flood Plain, Opportunity or Disaster? S. L. Arlinghaus, *Solstice: An Electronic Journal of Geography* and Mathematics, Volume XII, Number 1, 2001.

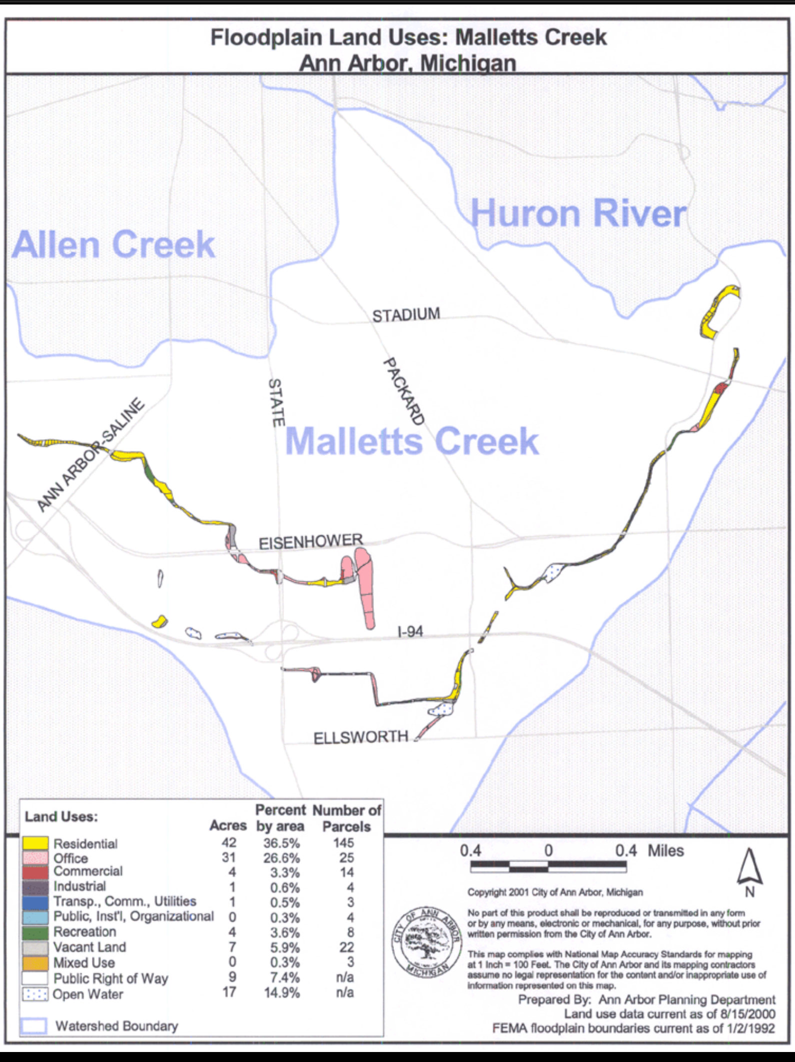
Fleming's Creekshed: Resource Page

Honey Creekshed: Resource Page

Huron River, Direct: Resource Page



Mallett's Creekshed: Resource Page



Documents from the Washtenaw County Drain Commissioner's Office, concerning the Mallett's Creek Sub-watershed

- Boundary of Sub-watershed.
- Detail of map; southwest portion of sub-watershed.
- Detail of map; entry of creek into Huron River.
- Text; page 32. Mallett's Creek: Background; Physical Assessment.
- Text, continuation of above. Biological Assessment; Summary.
- Mallett's Creek Physical Characteristics; Table 8 in Drain Commission document.
- Map of creek, showing where it runs in pipes.
- Legend for map to follow.
- Map showing most severly eroded banks adjacent to stream; table above gives text citation to numerals marking evidence of erosion or other damage to creek or banks. Generally, the darker the shading next to the creek, the more severe the problem.

Mallett's Creek Association:
Ann Arbor Citizens for the Rehabilitation of Mallett's Creek

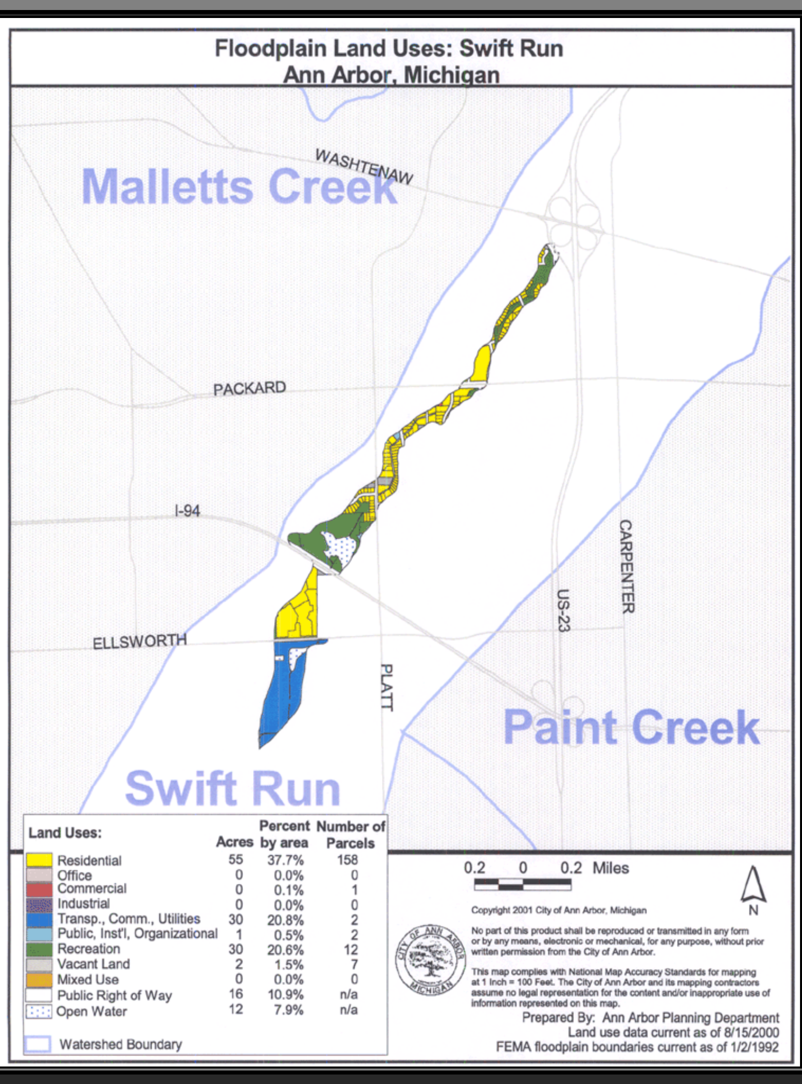
- Statement of Jesse Gordon to Ann Arbor City Planning Commission, July 15, 1996.

Master Plans

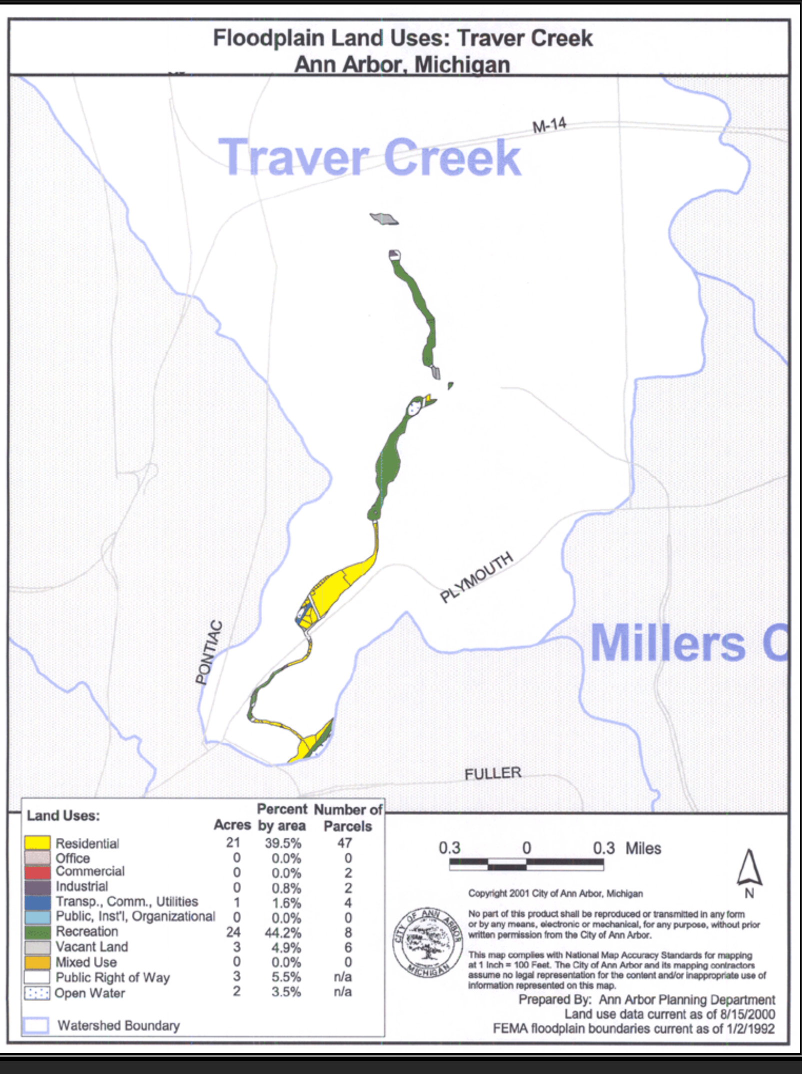
- North East Area Plan for the City of Ann Arbor, April 25, 1989. Entire text.
- North East Area Plan for the City of Ann Arbor, April 25, 1989. Entire set of figures.
- Huron Parkway Materials associated with original bond issue; actions of City Council, and so forth.
- Huron Parkway, Curb Cuts

Related Links

Swift Run Creekshed: Resource Page



Traver Creekshed: Resource Page



Related Links

A Neighborhood Information System in Ann Arbor, Michigan. S. L. Arlinghaus and Lloyd R. Phillips, *Solstice: An Electronic Journal of Geography and Mathematics*, Volume XI, Number 2, 2000.

What do you need?

- Elections
- Farmers Market
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- Trash & Recycling

City of Ann Arbor News

Labor Day Holiday to Delay Solid Waste Collection and Close Municipal Offices

August 26, 2014 - There will be no trash, recycling or compost collection services in the city of Ann Arbor on Labor Day, Monday, Sept. 1. The Monday pickups will occur on Tuesday, and the rest of the collections will occur one day later throughout the week. The normal Friday routes will be serviced on Saturday, Sept. 6. City of Ann... read more »

Renovations Scheduled for Ann Arbor Fire Station No. 3, Followed by Stations No. 4 and then No. 5

August 22, 2014 - Some Ann Arbor Fire Department stations will soon undergo renovations to their bathrooms and locker rooms. The project is included in the fiscal year 2015 adopted budget. Work at station No. 3 (2130 Jackson Ave.) is scheduled to begin... read more »

Main Street Closures & Stadium-area Parking Restrictions Resume for U-M 2014 Home Football Game Days

August 21, 2014 - Main Street closures will again be in place during the 2014 University of Michigan football season (click the map to open a PDF version). These closures will occur for all U-M home football games, beginning with... read more »

Programs Temporarily Relocated During Ann Arbor Senior Center Construction

August 15, 2014 - (*UPDATED Aug. 27, 2014) Ann Arbor Parks and Recreation has temporarily closed the Ann Arbor Senior Center, 1320 Baldwin Ave., due to an unscheduled construction project (*please see additional details at the end of this press release). The majority... read more »

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- HealthyStuff.org
- LocalMotionGreen
- Health Leaders

Communities
- Ann Arbor 350
- Environmental Education
- Partners for Transit
- Trash & Recycling

Our recycling affiliate

News & Updates

Taking action on climate change, near and far

"September is going to be a big month for climate," according to Monica Patel, policy specialist at the Ecology Center and coordinator of Ann Arbor 350. At the international level, government officials and corporate leaders from around the world are meeting at the United Nations in New York City on Sept. 23 for the Climate Summit 2014. **Read More »**

Pedaling from Grand Rapids to Chicago to benefit the Ecology Center

A team led by Ecology Center staff member Kate Harris will be pedaling from Grand Rapids to Chicago early next month, raising money every mile of the way. **Read More »**

Author Anna Lappé will headline annual fall event

Best-selling author Anna Lappé will be the featured speaker at the Ecology Center's annual fall event, Wednesday, November 12, at Zingerman's Cornman Farms in Dexter. **Read More »**

Gardeners Beware

What would your grocery store look like if bees were to go extinct? Cocoa, cucumbers, lemons, squash, almonds, grapes, tomatoes, strawberries, pears, cotton, and broccoli are a few of the products that would disappear from our shelves.The contribution made by bees to our global food production and the overall health of our ecosystem is overwhelming. **Read More »**

Starting Early: Getting Microplastics out of Products

The earlier you know, the more you can do, which is why the Ecology Center went to classrooms in Grosse Pointe recently to teach students about the life cycle of microplastics, their harmful environmental effects, and why they're still in use. **Read More »**

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Events

People's Climate March - NYC

Sep 20th 2014, 7:30pm - Sep 22nd 2014, 9:00am
This is an invitation to change everything. In September, world leaders are coming to New York City for a historic summit on climate change. With our future on the line and the whole world...

Calling all hospitals to celebrate Food Day with Us!

Oct 24th 2014
This October 24, Health Care Without Harm, and many of their partners like Ecology Center, will unite hundreds of health care facilities across the country to celebrate Food Day by serving meat...

See all events »

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339 E. Liberty St., Suite 300, Ann Arbor, MI 48104 USA • phone 734·761·3186 • fax 734·663·2414

Floodplain and Floodway Land Use Summaries

The following tables and maps detail the number of acres of each land use that fall within the floodplain and floodway, as well as how many parcels are affected. Many parcels are only partially within the floodplain or floodway.

Data sources: FEMA (Federal Emergency Management Agency) Flood Insurance Rate Map, revised January 2, 1992; City of Ann Arbor Land Use Inventory, current as of 8/15/2000.

Floodplain and Floodway land use summary tables:

Floodplain	By Watershed	Area in Acres
		Number of Parcels
	By Jurisdiction	Area in Acres
		Number of Parcels
	By Administration (Private, Public, UM)	Area in Acres
		Number of Parcels
Floodway	By Watershed	Area in Acres
		Number of Parcels
	By Jurisdiction	Area in Acres
		Number of Parcels
	By Administration (Private, Public, UM)	Area in Acres
		Number of Parcels

Floodplain land use maps:

Huron River
Allen Creek
Swift Run
Malletts Creek
Traver Creek

Overall summary of floodplain and floodway land uses within Ann Arbor:

		FLOODPLAIN			FLOODWAY		
Code	Land Use	Acres	Percent of Floodplain	Number of Parcels	Acres	Percent of floodway	Number of Parcels
100s	**Residential**	**167**	**14.0%**	**879**	**63**	**7.9%**	**386**
110	Single Family	65	5.4%	641	21	2.7%	261
120	Two Family	15	1.2%	119	7	0.8%	63
130	Multiple Family	83	7.0%	107	31	3.9%	53
200s	**Office**	**39**	**3.2%**	**46**	**13**	**1.7%**	**37**
300s	**Commercial**	**9**	**0.7%**	**53**	**5**	**0.6%**	**29**
400s	**Industrial**	**10**	**0.9%**	**22**	**6**	**0.8%**	**16**
500s	**Transp., Comm., Util.**	**63**	**5.3%**	**65**	**24**	**3.0%**	**38**
600s	**Public, Inst'l, Organiz.**	**17**	**1.4%**	**21**	**12**	**1.5%**	**16**
700s	**Recreation**	**325**	**27.2%**	**116**	**181**	**22.7%**	**89**
800	**Vacant Land**	**14**	**1.2%**	**55**	**6**	**0.8%**	**35**
900s	**Mixed Use**	**7**	**0.6%**	**23**	**4**	**0.5%**	**14**
	Public Right of Way	**83**	**6.9%**	**n/a**	**40**	**5.1%**	**n/a**
	Open Water	**461**	**38.6%**	**n/a**	**442**	**55.4%**	**n/a**
	TOTAL	1195	100.0%	1,409	797	100.0%	764

FLOODPLAIN LAND USE BY WATERSHED: Total Area in Acres

LAND USE		TOTAL*		BY WATERSHED: Huron River		Allen Creek		Swift Run		Traver Creek		Mallets Creek	
Code	Definition	Acres	% Total	Acres	% Total	Acres	% Total	Acres	% Total	Acres	% Total	Acres	% Total
1	Waterway	461	38.6%	430	63.2%	0	0.0%	12	7.9%	2	3.5%	17	14.9%
2	Public Right of Way	83	6.9%	18	2.7%	37	18.8%	16	10.9%	3	5.5%	9	7.4%
100s	Residential	167	14.0%	8	1.2%	40	20.4%	55	37.7%	21	39.6%	42	36.6%
110	Single Family	65	5.4%	2	0.3%	25	12.5%	23	15.5%	4	7.5%	11	9.7%
120	Two Family	15	1.2%	0	0.0%	11	5.4%	3	2.2%	1	1.2%	0	0.1%
130	Multiple Family	83	7.0%	6	0.9%	5	2.3%	29	19.9%	17	30.8%	27	23.3%
200s	Office	39	3.2%	0	0.0%	7	3.7%	0	0.0%	0	0.0%	31	26.6%
300s	Commercial	9	0.7%	1	0.1%	4	2.2%	0	0.1%	0	0.0%	4	3.3%
400s	Industrial	10	0.9%	0	0.0%	9	4.6%	0	0.0%	0	0.8%	1	0.6%
500s	Transportation/ Communications/ Utilities	63	5.3%	17	2.5%	14	6.9%	30	20.8%	1	1.6%	1	0.6%
600s	Public/ Quasi-Public/ Institutional/ Organizational	17	1.4%	3	0.5%	13	6.5%	1	0.5%	0	0.0%	0	0.3%
700s	Recreation	325	27.2%	201	29.5%	66	33.3%	30	20.6%	24	44.2%	4	3.6%
800	Vacant	14	1.2%	1	0.2%	1	0.5%	2	1.5%	3	4.9%	7	5.9%
900s	Mixed Use	7	0.6%	1	0.1%	6	2.9%	0	0.0%	0	0.0%	0	0.3%
	TOTAL	1,195	100.0%	681	100.0%	198	100.0%	145	100.0%	54	100.0%	117	100.0%

*Millers Creek is not included in the total because FEMA has not yet mapped its floodplain.

FLOODPLAIN LAND USE BY WATERSHED: Number of Parcels

LAND USE		TOTAL*		BY WATERSHED: Huron River		Allen Creek		Swift Run		Traver Creek		Mallets Creek	
Code	Definition	# parcels	% total	# parcels	% Total	# parcels	% Total	# parcels	% Total	# parcels	% Total	# parcels	% Total
100s	Residential	879	62.4%	24	13.0%	505	73.4%	158	82.3%	47	61.8%	145	54.5%
110	Single Family	641	45.5%	18	9.7%	345	50.1%	133	69.3%	30	39.5%	115	43.2%
120	Two Family	119	8.4%	0	0.0%	102	14.8%	9	4.7%	7	9.2%	1	0.4%
130	Multiple Family	107	7.6%	5	2.7%	52	7.6%	16	8.3%	10	13.2%	24	9.0%
200s	Office	46	3.3%	3	1.6%	18	2.6%	0	0.0%	0	0.0%	25	9.4%
300s	Commercial	53	3.8%	1	0.5%	35	5.1%	1	0.5%	2	2.6%	14	5.3%
400s	Industrial	22	1.6%	0	0.0%	16	2.3%	0	0.0%	2	2.6%	4	1.5%
500s	Transportation/ Communications/ Utilities	65	4.6%	7	3.8%	49	7.1%	2	1.0%	4	5.3%	3	1.1%
600s	Public/ Quasi-Public/ Institutional/ Organizational	21	1.5%	2	1.1%	13	1.9%	2	1.0%	0	0.0%	4	1.5%
700s	Recreation	116	8.2%	73	39.5%	14	2.0%	12	6.3%	8	10.5%	8	3.0%
800	Vacant	55	3.9%	3	1.6%	17	2.5%	7	3.6%	6	7.9%	22	8.3%
900s	Mixed Use	23	1.6%	1	0.5%	19	2.8%	0	0.0%	0	0.0%	3	1.1%
	TOTAL	1,409	100.0%	185	100.0%	688	100.0%	192	100.0%	76	100.0%	266	100.0%

*Millers Creek is not included in the total because FEMA has not yet mapped its floodplain.

FLOODPLAIN LAND USE BY JURISDICTION: Total Area in Acres

LAND USE		TOTAL*		BY JURISDICTION: City of Ann Arbor		Ann Arbor Twp		Pittsfield Twp		Scio Twp	
Code	Definition	Acres	% Total	Acres	% Total	Acres	% Total	Acres	% Total	Acres	% Total
100s	Residential	167	14.0%	166	29.2%	1	1.1%	0.2	40.6%	0	0.0%
110	Single Family	65	5.4%	64	11.2%	1	1.1%	0.2	40.6%	0	0.0%
120	Two Family	15	1.2%	15	2.6%	0	0.0%	0.0	0.0%	0	0.0%
130	Multiple Family	83	7.0%	83	14.6%	0	0.0%	0.0	0.0%	0	0.0%
200s	Office	39	3.2%	39	6.8%	0	0.0%	0.0	0.0%	0	0.0%
300s	Commercial	9	0.7%	9	1.5%	0	0.0%	0.0	0.0%	0	0.0%
400s	Industrial	10	0.9%	10	1.8%	0	0.4%	0.0	0.0%	0	0.0%
500s	Transportation/ Communications/ Utilities	63	5.3%	63	11.0%	0	0.1%	0.0	0.2%	0	0.0%
600s	Public/ Quasi-Public/ Institutional/ Organizational	17	1.4%	17	3.0%	0	0.0%	0.0	0.0%	0	0.0%
700s	Recreation	325	27.2%	246	43.3%	79	96.8%	0.0	0.0%	0	0.0%
800	Vacant	14	1.2%	13	2.2%	1	1.6%	0.2	59.2%	0	0.0%
900s	Mixed Use	7	0.6%	7	1.2%	0	0.0%	0.0	0.0%	0	0.0%
	TOTAL	1,195	100.0%	569	100.0%	82	100.0%	0.4	100.0%	0	100.0%

*Millers Creek is not included in the total because FEMA has not yet mapped its floodplain.

FLOODPLAIN LAND USE BY JURISDICTION: Total # of Parcels

LAND USE		TOTAL*		BY JURISDICTION: City of Ann Arbor		Ann Arbor Twp		Pittsfield Twp		Scio Twp	
Code	Definition	# parcels	% total	# parcels	% Total	# parcels	% Total	# parcels	% Total	# parcels	% Total
100s	Residential	879	62.4%	860	70.0%	18	35.3%	1	25.0%	0	0.0%
110	Single Family	641	45.5%	622	50.7%	18	35.3%	1	25.0%	0	0.0%
120	Two Family	119	8.4%	119	9.7%	0	0.0%	0	0.0%	0	0.0%
130	Multiple Family	107	7.6%	107	8.7%	0	0.0%	0	0.0%	0	0.0%
200s	Office	46	3.3%	46	3.7%	0	0.0%	0	0.0%	0	0.0%
300s	Commercial	53	3.8%	53	4.3%	0	0.0%	0	0.0%	0	0.0%
400s	Industrial	22	1.6%	21	1.7%	1	2.0%	0	0.0%	0	0.0%
500s	Transportation/ Communications/ Utilities	65	4.6%	62	5.0%	2	3.9%	1	25.0%	0	0.0%
600s	Public/ Quasi-Public/ Institutional/ Organizational	21	1.5%	21	1.7%	0	0.0%	0	0.0%	0	0.0%
700s	Recreation	116	8.2%	93	7.6%	23	45.1%	0	0.0%	0	0.0%
800	Vacant	55	3.9%	47	3.8%	6	11.8%	2	50.0%	0	0.0%
900s	Mixed Use	23	1.6%	23	1.9%	0	0.0%	0	0.0%	0	0.0%
	TOTAL	1,409	100.0%	1,228	100.0%	51	100.0%	4	100.0%	0	100.0%

*Millers Creek is not included in the total because FEMA has not yet mapped its floodplain.

PUBLIC, PRIVATE, & UM FLOODPLAIN LAND USE : Total Area in Acres

LAND USE		TOTAL*		BY ADMINISTRATION: Public		Private		UM	
Code	Definition	Acres	% Total	Acres	% Total	Acres	% Total	Acres	% Total
100s	Residential	167	14.0%	3	0.7%	165	57.8%	0	0.0%
110	Single Family	65	5.4%	0	0.0%	65	22.6%	0	0.0%
120	Two Family	15	1.2%	1	0.2%	14	4.9%	0	0.0%
130	Multiple Family	83	7.0%	2	0.4%	82	28.7%	0	0.0%
200s	Office	39	3.2%	0	0.0%	36	12.6%	3	4.5%
300s	Commercial	9	0.7%	0	0.0%	8	2.9%	0	0.0%
400s	Industrial	10	0.9%	0	0.0%	10	3.6%	0	0.0%
500s	Transportation/ Communications/ Utilities	63	5.3%	32	8.1%	29	10.3%	1	2.2%
600s	Public/ Quasi-Public/ Institutional/ Organizational	17	1.4%	11	2.7%	6	2.1%	0	0.6%
700s	Recreation	325	27.2%	256	65.0%	11	3.9%	58	92.6%
800	Vacant	14	1.2%	1	0.4%	13	4.5%	0	0.0%
900s	Mixed Use	7	0.6%	0	0.0%	7	2.4%	0	0.1%
	TOTAL	1,195	100.0%	395	100.0%	285	100.0%	62	100.0%

*Millers Creek is not included in the total because FEMA has not yet mapped its floodplain.

PUBLIC, PRIVATE, & UM FLOODPLAIN LAND USE : Total # Parcels

LAND USE		TOTAL*		BY ADMINISTRATION: Public		Private		UM	
Code	Definition	# parcels	% total	# parcels	% Total	# parcels	% Total	# parcels	% Total
100s	Residential	879	62.4%	6	3.6%	871	77.9%	2	6.3%
110	Single Family	641	45.5%	1	0.6%	640	57.2%	0	0.0%
120	Two Family	119	8.4%	2	1.2%	117	10.5%	0	0.0%
130	Multiple Family	107	7.6%	3	1.8%	104	9.3%	0	0.0%
200s	Office	46	3.3%	0	0.0%	37	3.3%	9	28.1%
300s	Commercial	53	3.8%	0	0.0%	52	4.7%	0	0.0%
400s	Industrial	22	1.6%	0	0.0%	22	2.0%	0	0.0%
500s	Transportation/ Communications/ Utilities	65	4.6%	13	7.7%	45	4.0%	7	21.9%
600s	Public/ Quasi-Public/ Institutional/ Organizational	21	1.5%	4	2.4%	15	1.3%	2	6.3%
700s	Recreation	116	8.2%	100	59.5%	5	0.4%	11	34.4%
800	Vacant	55	3.9%	6	3.6%	49	4.4%	0	0.0%
900s	Mixed Use	23	1.6%	0	0.0%	22	2.0%	1	3.1%
	TOTAL	1,409	100.0%	168	100.0%	1,118	100.0%	32	100.0%

*Millers Creek is not included in the total because FEMA has not yet mapped its floodplain.

FLOODWAY LAND USE BY WATERSHED: Total Area in Acres

LAND USE		TOTAL*		BY WATERSHED: Huron River		Allen Creek		Traver Creek		Mallets Creek	
Code	Definition	Acres	% Total	Acres	% Total	Acres	% Total	Acres	% Total	Acres	% Total
1	Waterway	442	55.4%	428	71.3%	0	0.0%	0	0.0%	14	18.6%
2	Public Right of Way	40	5.1%	13	2.2%	20	17.6%	1	7.7%	7	8.7%
100s	Residential	63	7.9%	7	1.2%	16	14.5%	8	73.9%	32	42.4%
110	Single Family	21	2.7%	2	0.3%	9	8.2%	1	9.9%	9	12.5%
120	Two Family	7	0.8%	0	0.0%	6	5.2%	1	5.9%	0	0.2%
130	Multiple Family	31	3.9%	5	0.9%	1	1.0%	6	58.1%	19	25.0%
200s	Office	13	1.7%	0	0.0%	4	3.5%	0	0.0%	9	12.6%
300s	Commercial	5	0.6%	1	0.1%	2	1.9%	0	0.2%	2	3.3%
400s	Industrial	6	0.8%	0	0.0%	5	4.7%	0	1.0%	1	0.9%
500s	Transportation/ Communications/ Utilities	24	3.0%	15	2.4%	9	8.0%	0	0.1%	1	0.8%
600s	Public/ Quasi-Public/ Institutional/ Organizational	12	1.5%	3	0.5%	9	7.8%	0	0.0%	0	0.4%
700s	Recreation	181	22.7%	132	22.0%	43	38.4%	2	15.9%	4	5.1%
800	Vacant	6	0.8%	0	0.1%	1	0.6%	0	1.2%	5	6.8%
900s	Mixed Use	4	0.5%	0	0.0%	4	3.2%	0	0.0%	0	0.4%
	TOTAL	797	100.0%	600	100.0%	112	100.0%	11	100.0%	75	100.0%

*Total does not include Millers Creek or Swift Run because FEMA has not yet mapped their floodways.

FLOODWAY LAND USE BY WATERSHED: Number of Parcels

LAND USE		TOTAL*		BY WATERSHED: Huron River		Allen Creek		Traver Creek		Mallets Creek	
Code	Definition	# parcels	% total	# parcels	% Total	# parcels	% Total	# parcels	% Total	# parcels	% Total
100s	Residential	386	50.5%	17	10.7%	217	66.2%	26	72.2%	126	52.7%
110	Single Family	261	34.2%	11	6.9%	144	43.9%	9	25.0%	97	40.6%
120	Two Family	63	8.2%	0	0.0%	55	16.8%	7	19.4%	1	0.4%
130	Multiple Family	53	6.9%	5	3.1%	15	4.6%	10	27.8%	23	9.6%
200s	Office	37	4.8%	1	0.6%	13	4.0%	0	0.0%	23	9.6%
300s	Commercial	29	3.8%	1	0.6%	15	4.6%	2	5.6%	11	4.6%
400s	Industrial	16	2.1%	0	0.0%	12	3.7%	1	2.8%	3	1.3%
500s	Transportation/ Communications/ Utilities	38	5.0%	6	3.8%	27	8.2%	2	5.6%	3	1.3%
600s	Public/ Quasi-Public/ Institutional/ Organizational	16	2.1%	2	1.3%	10	3.0%	0	0.0%	4	1.7%
700s	Recreation	89	11.6%	65	40.9%	13	4.0%	2	5.6%	8	3.3%
800	Vacant	35	4.6%	2	1.3%	9	2.7%	2	5.6%	22	9.2%
900s	Mixed Use	14	1.8%	1	0.6%	10	3.0%	0	0.0%	3	1.3%
	TOTAL	764	100.0%	159	100.0%	328	100.0%	36	100.0%	239	100.0%

*Total does not include Millers Creek or Swift Run because FEMA has not yet mapped their floodways.

Land use data current as of August 2000

FLOODWAY LAND USE BY JURISDICTION: Total Area in Acres

LAND USE		TOTAL*		BY JURISDICTION: City of Ann Arbor		Ann Arbor Twp		Pittsfield Twp		Scio Twp	
Code	Definition	Acres	% Total	Acres	% Total	Acres	% Total	Acres	% Total	Acres	% Total
100s	Residential	63	7.9%	62	21.4%	0	0.9%	0.2	40.7%	0	0.0%
110	Single Family	21	2.7%	21	7.1%	0	0.9%	0.2	40.7%	0	0.0%
120	Two Family	7	0.8%	7	2.3%	0	0.0%	0.0	0.0%	0	0.0%
130	Multiple Family	31	3.9%	31	10.7%	0	0.0%	0.0	0.0%	0	0.0%
200s	Office	13	1.7%	13	4.6%	0	0.0%	0.0	0.0%	0	0.0%
300s	Commercial	5	0.6%	5	1.7%	0	0.0%	0.0	0.0%	0	0.0%
400s	Industrial	6	0.8%	6	2.1%	0	0.0%	0.0	0.0%	0	0.0%
500s	Transportation/ Communications/ Utilities	24	3.0%	24	8.3%	0	0.0%	0.0	0.0%	0	0.0%
600s	Public/ Quasi-Public/ Institutional/ Organizational	12	1.5%	12	4.2%	0	0.0%	0.0	0.0%	0	0.0%
700s	Recreation	181	22.7%	159	54.4%	22	96.8%	0.0	0.0%	0	0.0%
800	Vacant	6	0.8%	6	1.9%	0	1.9%	0.2	59.3%	0	0.0%
900s	Mixed Use	4	0.5%	4	1.4%	0	0.0%	0.0	0.0%	0	0.0%
	TOTAL	797	100.0%	292	100.0%	23	100.0%	0.4	100.0%	0	100.0%

*Total does not include Millers Creek or Swift Run because FEMA has not yet mapped their floodways.

FLOODWAY LAND USE BY JURISDICTION: Total # of Parcels

LAND USE		TOTAL*		BY JURISDICTION: City of Ann Arbor		Ann Arbor Twp		Pittsfield Twp		Scio Twp	
Code	Definition	# parcels	% total	# parcels	% Total	# parcels	% Total	# parcels	% Total	# parcels	% Total
100s	Residential	386	50.5%	377	59.8%	8	26.7%	1	33.3%	0	0.0%
110	Single Family	261	34.2%	252	40.0%	8	26.7%	1	33.3%	0	0.0%
120	Two Family	63	8.2%	63	10.0%	0	0.0%	0	0.0%	0	0.0%
130	Multiple Family	53	6.9%	53	8.4%	0	0.0%	0	0.0%	0	0.0%
200s	Office	37	4.8%	37	5.9%	0	0.0%	0	0.0%	0	0.0%
300s	Commercial	29	3.8%	29	4.6%	0	0.0%	0	0.0%	0	0.0%
400s	Industrial	16	2.1%	16	2.5%	0	0.0%	0	0.0%	0	0.0%
500s	Transportation/ Communications/ Utilities	38	5.0%	38	6.0%	0	0.0%	0	0.0%	0	0.0%
600s	Public/ Quasi-Public/ Institutional/ Organizational	16	2.1%	16	2.5%	0	0.0%	0	0.0%	0	0.0%
700s	Recreation	89	11.6%	70	11.1%	19	63.3%	0	0.0%	0	0.0%
800	Vacant	35	4.6%	31	4.9%	2	6.7%	2	66.7%	0	0.0%
900s	Mixed Use	14	1.8%	14	2.2%	0	0.0%	0	0.0%	0	0.0%
	TOTAL	764	100.0%	630	100.0%	30	100.0%	3	100.0%	0	100.0%

*Total does not include Millers Creek or Swift Run because FEMA has not yet mapped their floodways.

Land use data current as of August 2000

PUBLIC, PRIVATE, & UM FLOODWAY LAND USE : Total Area in Acres

LAND USE		TOTAL*		BY ADMINISTRATION: Public		Private		UM	
Code	Definition	Acres	% Total	Acres	% Total	Acres	% Total	Acres	% Total
100s	Residential	63	7.9%	1	0.7%	62	48.9%	0	0.0%
110	Single Family	21	2.7%	0	0.1%	21	16.7%	0	0.0%
120	Two Family	7	0.8%	0	0.2%	6	5.0%	0	0.0%
130	Multiple Family	31	3.9%	1	0.4%	30	24.2%	0	0.0%
200s	Office	13	1.7%	0	0.0%	12	9.7%	1	2.7%
300s	Commercial	5	0.6%	0	0.0%	5	3.9%	0	0.0%
400s	Industrial	6	0.8%	0	0.0%	6	4.8%	0	0.0%
500s	Transportation/ Communications/ Utilities	24	3.0%	1	0.7%	22	17.6%	1	1.4%
600s	Public/ Quasi-Public/ Institutional/ Organizational	12	1.5%	7	3.5%	5	3.8%	0	0.9%
700s	Recreation	181	22.7%	140	70.5%	4	3.0%	37	94.9%
800	Vacant	6	0.8%	0	0.0%	6	5.0%	0	0.0%
900s	Mixed Use	4	0.5%	0	0.0%	4	3.2%	0	0.1%
	TOTAL	797	100.0%	198	100.0%	126	100.0%	39	100.0%

*Total does not include Millers Creek or Swift Run because FEMA has not yet mapped their floodways.

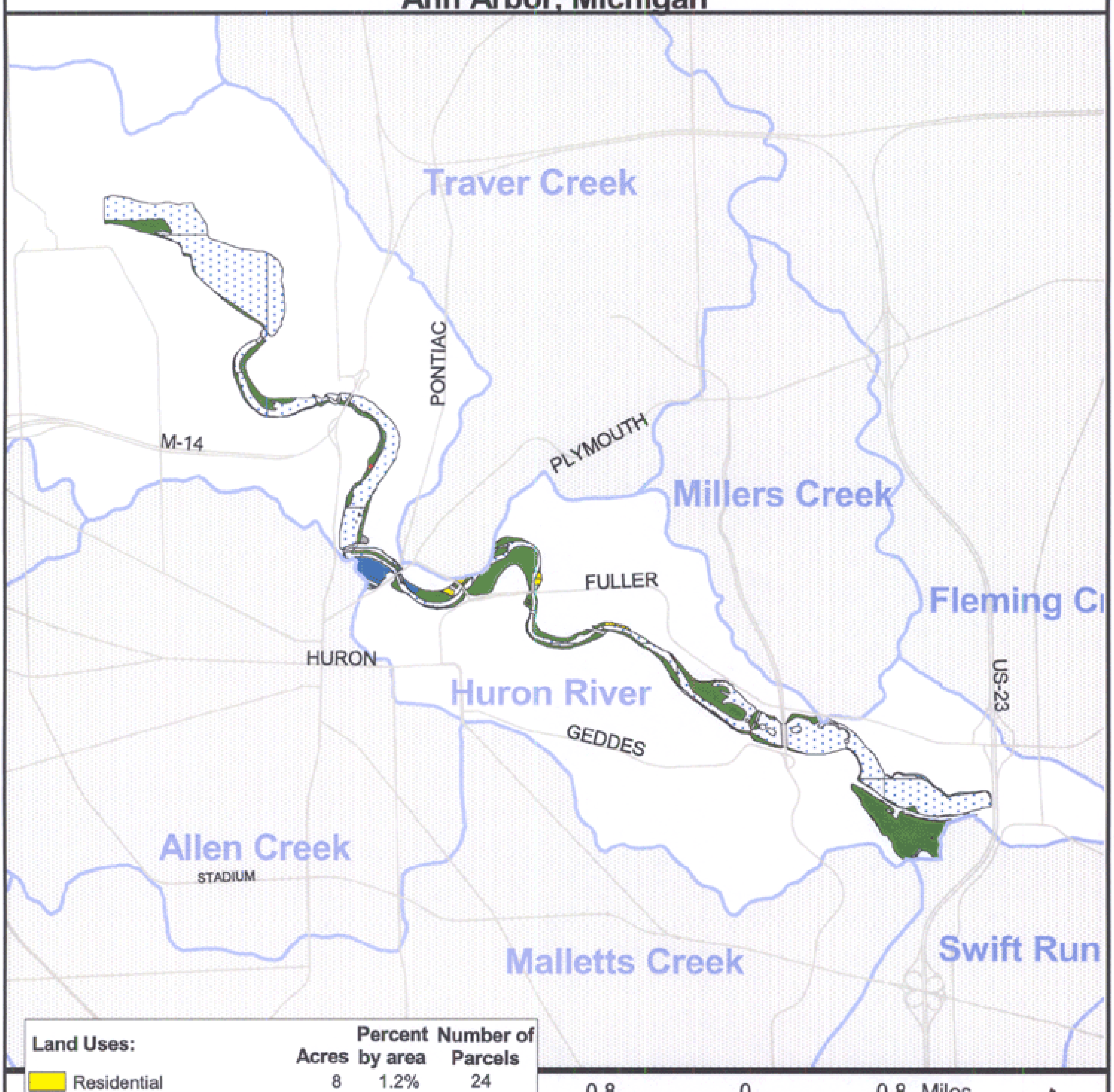
PUBLIC, PRIVATE, & UM FLOODWAY LAND USE : Total # Parcels

LAND USE		TOTAL*		BY ADMINISTRATION: Public		Private		UM	
Code	Definition	# parcels	% total	# parcels	% Total	# parcels	% Total	# parcels	% Total
100s	Residential	386	50.5%	4	3.1%	382	71.0%	0	0.0%
110	Single Family	261	34.2%	1	0.8%	260	48.3%	0	0.0%
120	Two Family	63	8.2%	1	0.8%	62	11.5%	0	0.0%
130	Multiple Family	53	6.9%	2	1.6%	51	9.5%	0	0.0%
200s	Office	37	4.8%	0	0.0%	29	5.4%	8	32.0%
300s	Commercial	29	3.8%	0	0.0%	28	5.2%	0	0.0%
400s	Industrial	16	2.1%	0	0.0%	16	3.0%	0	0.0%
500s	Transportation/ Communications/ Utilities	38	5.0%	9	7.0%	25	4.6%	4	16.0%
600s	Public/ Quasi-Public/ Institutional/ Organizational	16	2.1%	4	3.1%	10	1.9%	2	8.0%
700s	Recreation	89	11.6%	77	59.7%	2	0.4%	10	40.0%
800	Vacant	35	4.6%	2	1.6%	33	6.1%	0	0.0%
900s	Mixed Use	14	1.8%	0	0.0%	13	2.4%	1	4.0%
	TOTAL	764	100.0%	129	100.0%	538	100.0%	25	100.0%

*Total does not include Millers Creek or Swift Run because FEMA has not yet mapped their floodways.

Source: Planning Department, City of Ann Arbor.

Floodplain Land Uses: Huron River
Ann Arbor, Michigan



Land Uses:	Acres	Percent by area	Number of Parcels
Residential	8	1.2%	24
Office	0	0.0%	3
Commercial	1	0.1%	1
Industrial	0	0.0%	0
Transp., Comm., Utilities	17	2.5%	7
Public, Inst'l, Organizational	3	0.5%	2
Recreation	201	29.5%	73
Vacant Land	1	0.2%	3
Mixed Use	1	0.1%	1
Public Right of Way	18	2.7%	n/a
Open Water	430	63.2%	n/a

Watershed Boundary

0.8 0 0.8 Miles

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City of Ann Arbor, Michigan

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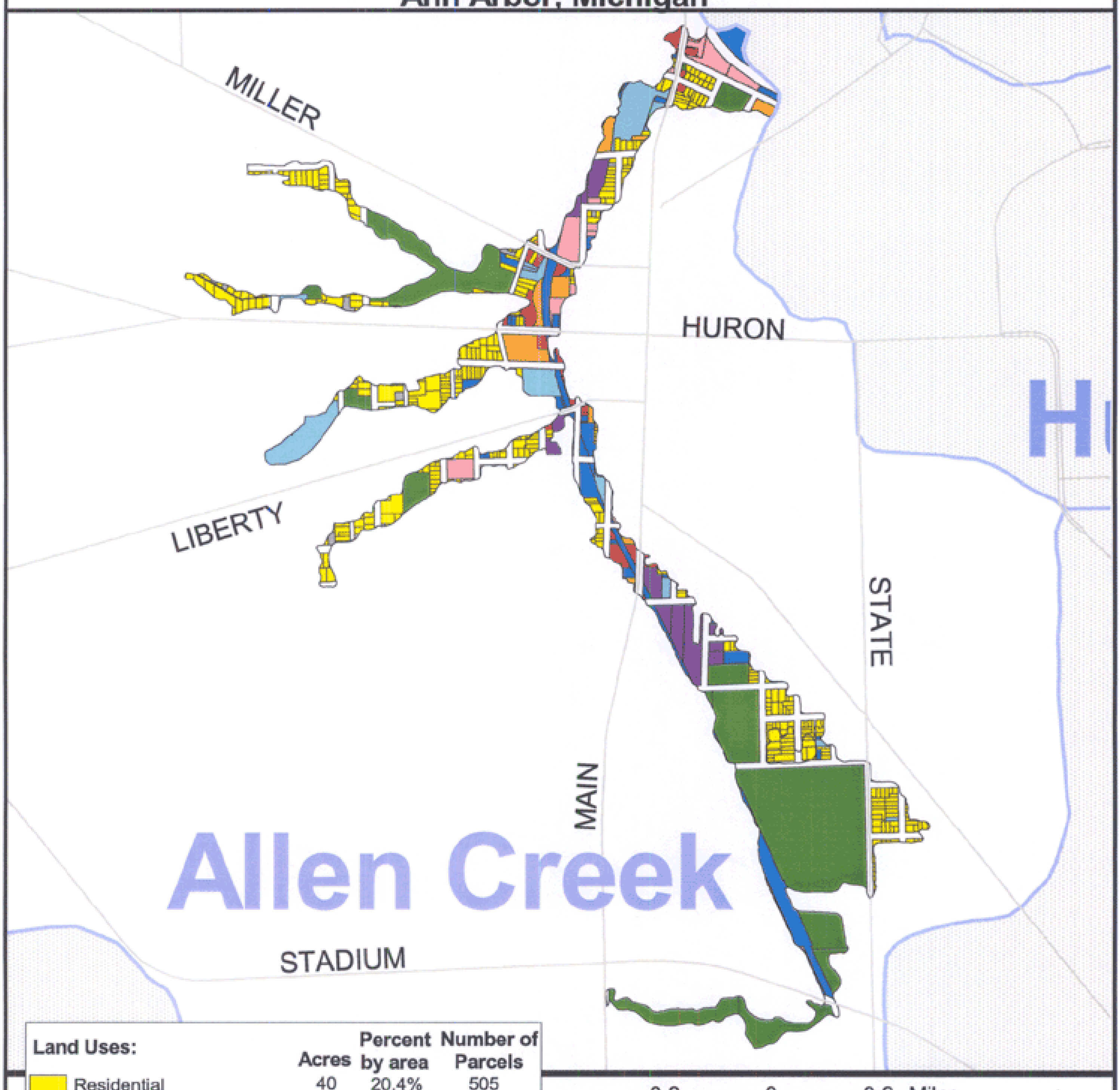
Prepared By: Ann Arbor Planning Department
Land use data current as of 8/15/2000
FEMA floodplain boundaries current as of 1/2/1992

Floodplain Land Uses: Allen Creek
Ann Arbor, Michigan



Land Uses:	Acres	Percent by area	Number of Parcels
Residential	40	20.4%	505
Office	7	3.7%	18
Commercial	4	2.2%	35
Industrial	9	4.6%	16
Transp., Comm., Utilities	14	6.9%	49
Public, Inst'l, Organizational	13	6.5%	13
Recreation	66	33.3%	14
Vacant Land	1	0.5%	17
Mixed Use	6	2.9%	19
Public Right of Way	37	18.8%	n/a
Open Water	0	0.0%	n/a

Watershed Boundary

0.2 0 0.2 Miles

N

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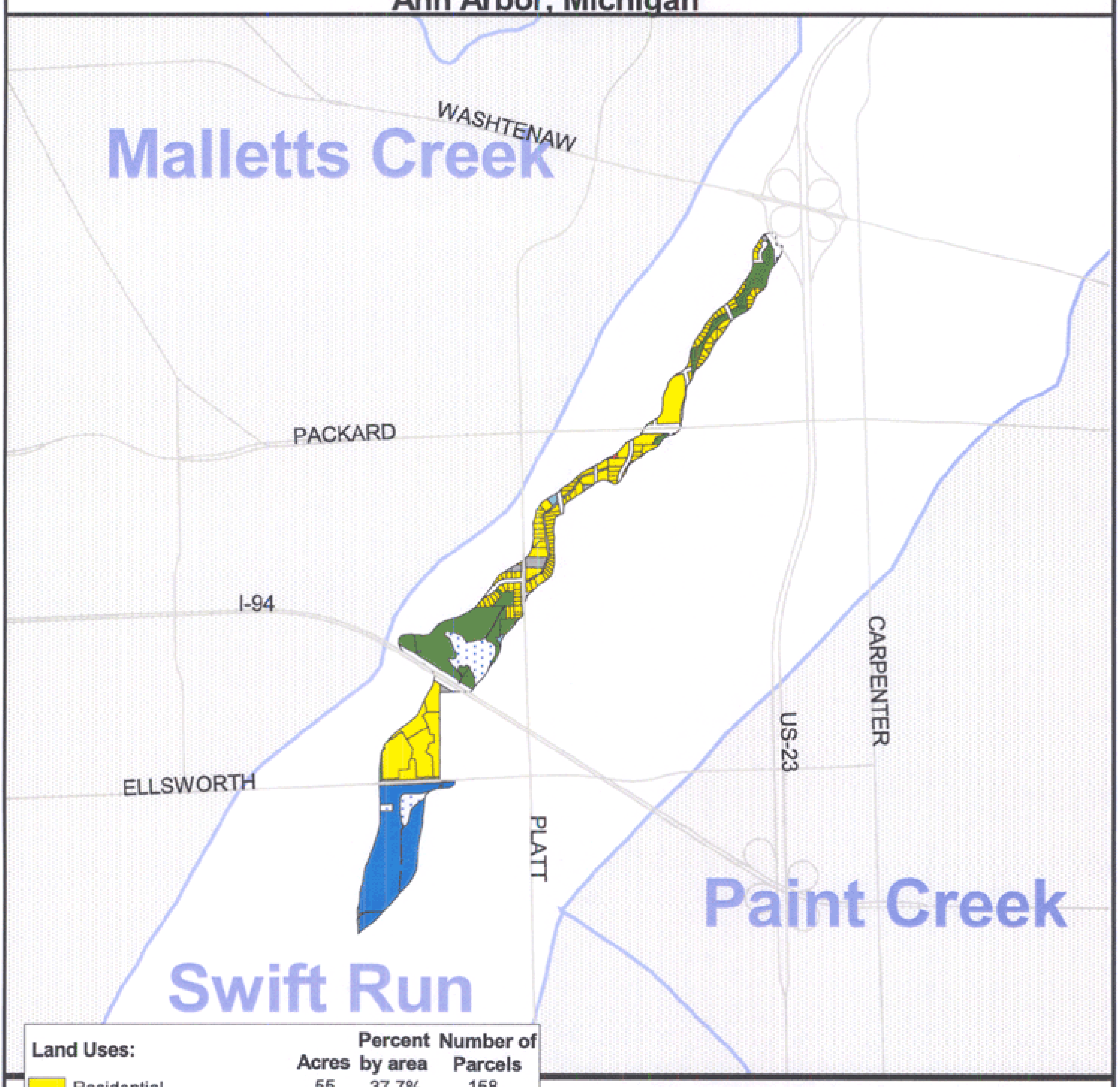
Prepared By: Ann Arbor Planning Department
Land use data current as of 8/15/2000
FEMA floodplain boundaries current as of 1/2/1992

Floodplain Land Uses: Swift Run
Ann Arbor, Michigan



Land Uses:	Acres	Percent by area	Number of Parcels
Residential	55	37.7%	158
Office	0	0.0%	0
Commercial	0	0.1%	1
Industrial	0	0.0%	0
Transp., Comm., Utilities	30	20.8%	2
Public, Inst'l, Organizational	1	0.5%	2
Recreation	30	20.6%	12
Vacant Land	2	1.5%	7
Mixed Use	0	0.0%	0
Public Right of Way	16	10.9%	n/a
Open Water	12	7.9%	n/a

Watershed Boundary

0.2 0 0.2 Miles

N

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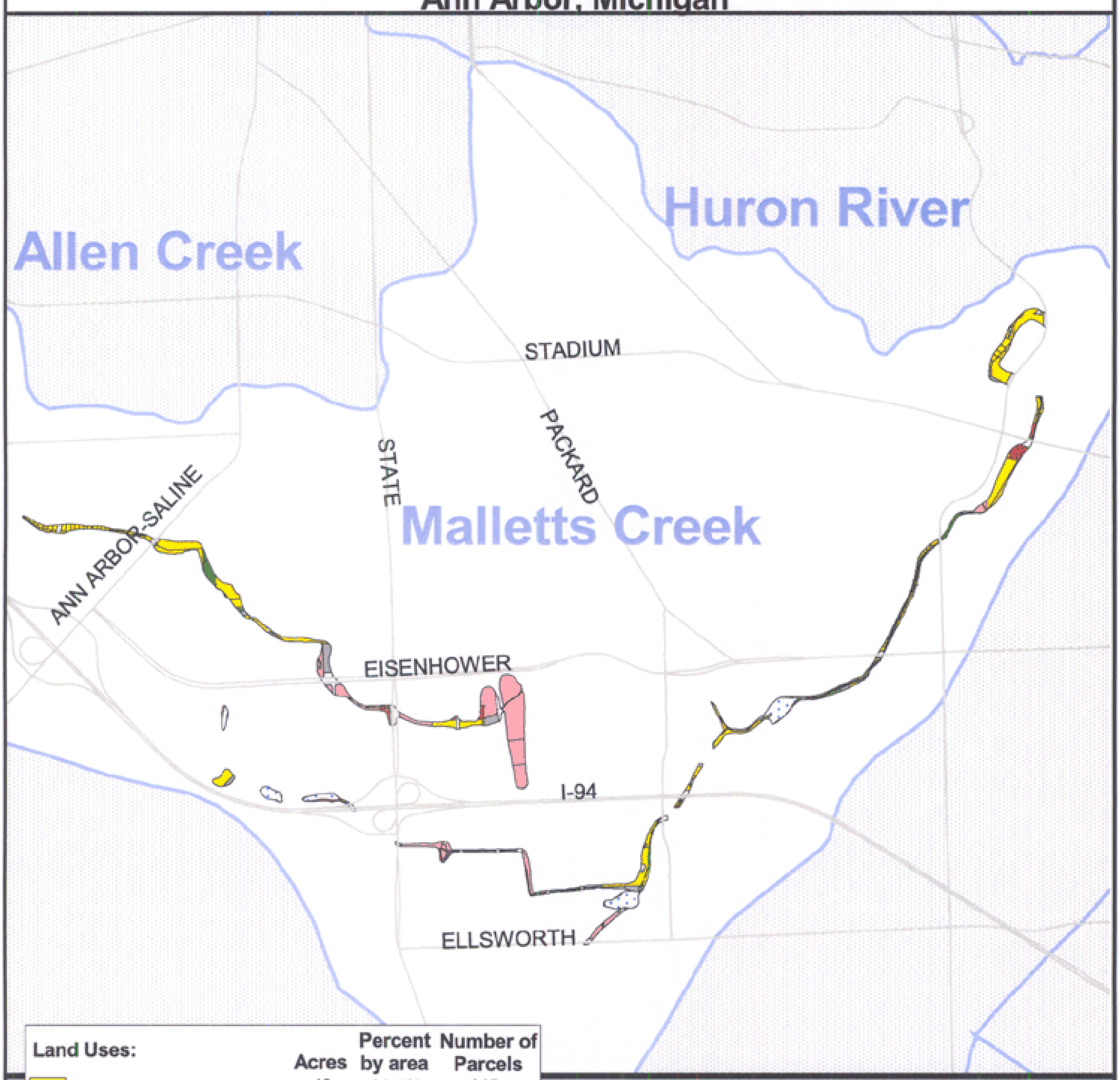
Prepared By: Ann Arbor Planning Department
Land use data current as of 8/15/2000
FEMA floodplain boundaries current as of 1/2/1992

Floodplain Land Uses: Malletts Creek
Ann Arbor, Michigan



Land Uses:	Acres	Percent by area	Number of Parcels
Residential	42	36.5%	145
Office	31	26.6%	25
Commercial	4	3.3%	14
Industrial	1	0.6%	4
Transp., Comm., Utilities	1	0.5%	3
Public, Inst'l, Organizational	0	0.3%	4
Recreation	4	3.6%	8
Vacant Land	7	5.9%	22
Mixed Use	0	0.3%	3
Public Right of Way	9	7.4%	n/a
Open Water	17	14.9%	n/a

Watershed Boundary

0.4 0 0.4 Miles

N

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City of Ann Arbor, Michigan

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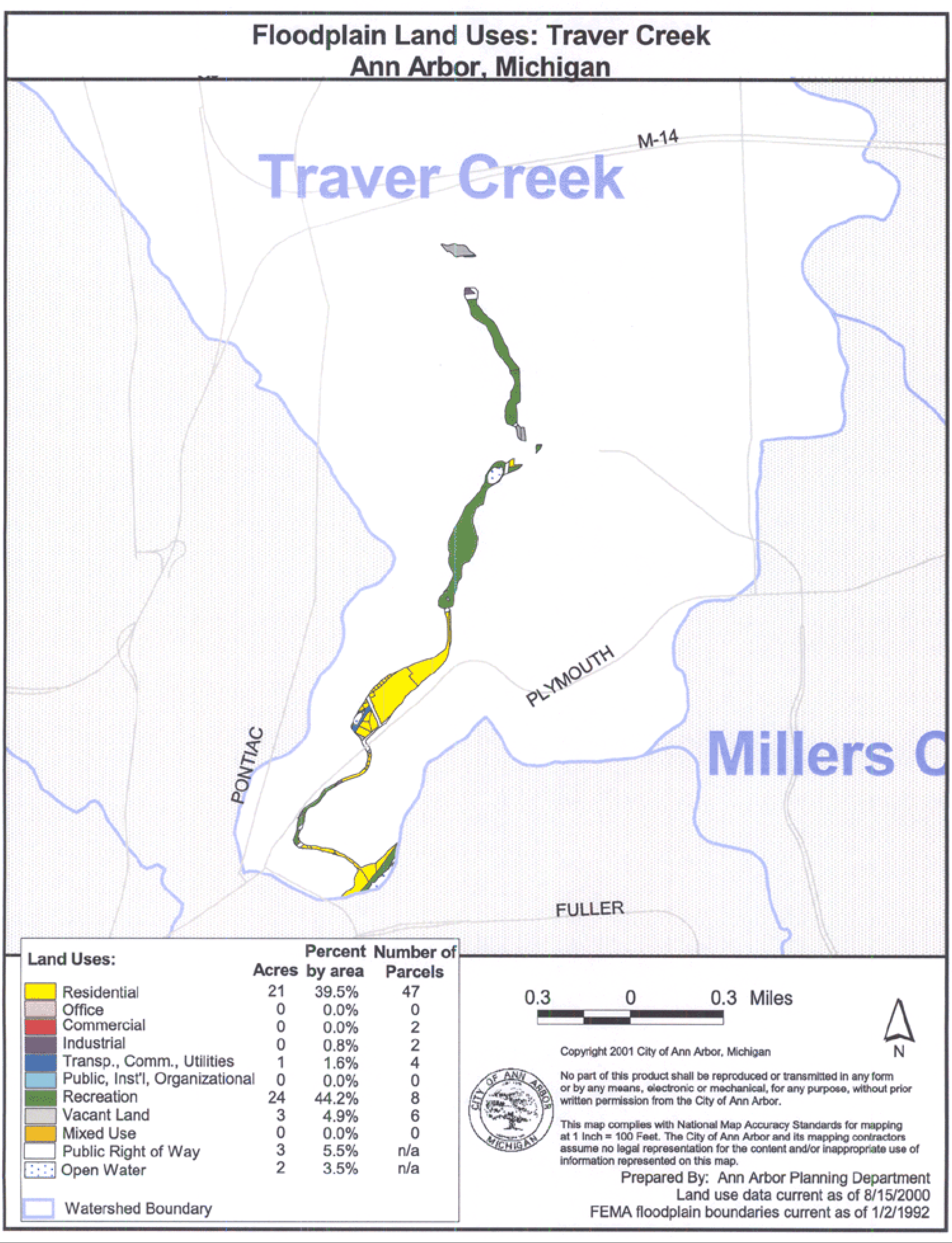
Prepared By: Ann Arbor Planning Department
Land use data current as of 8/15/2000
FEMA floodplain boundaries current as of 1/2/1992


Floodplain Land Uses: Traver Creek
Ann Arbor, Michigan
Traver Creek
M-14
PLYMOUTH
Millers C
PONTIAC
FULLER
Land Uses:
Acres
Percent by area
Number of Parcels
Residential 21 39.5% 47
Office 0 0.0% 0
Commercial 0 0.0% 2
Industrial 0 0.8% 2
Transp., Comm., Utilities 1 1.6% 4
Public, Inst'l, Organizational 0 0.0% 0
Recreation 24 44.2% 8
Vacant Land 3 4.9% 6
Mixed Use 0 0.0% 0
Public Right of Way 3 5.5% n/a
Open Water 2 3.5% n/a
Watershed Boundary
0.3 0 0.3 Miles
N
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CITY OF ANN ARBOR MICHIGAN
Prepared By: Ann Arbor Planning Department
Land use data current as of 8/15/2000
FEMA floodplain boundaries current as of 1/2/1992

re: 7a

1 May 2001

THE HURON RIVER WATERSHED COUNCIL

Ms. Karen Popek Hart
Planning Director
City of Ann Arbor
100 N. Fifth Avenue
P.O. Box 8647
Ann Arbor, MI 48107

Dear Karen:

On behalf of the Huron River Watershed Council, I am providing the following comments pertaining to the Master Plan that is being reviewed by the Planning Commission and Department. The Watershed Council is proposing that the City consider pursuing a Master Plan with planning units based on creeksheds, and is providing a list of potential benefits and issues related to this proposal.

Infrastructure viability	Much City infrastructure is organized by creeksheds already - namely sanitary sewers and stormwater drainage. Successful management of these systems is vital to the livability of the City and the financial health of the City. Creekshed planning recognizes the important connections among intra-watershed capital improvements, land use, land cover, and the successful operation of sewers and storm drains.
Downstream	Upstream developments and land management have strong impacts downstream. Planning within creekshed units enables the City of measure those impacts and better anticipate them.
Green Infrastructure	Creekshed planning promotes the development of a green infrastructure. A green infrastructure is essential for livable, sustainable, and attractive neighborhoods; it can consist of streams, stream corridor habitats, recreational greenways, and connections among parks. Planning and development of the green infrastructure within creeksheds is rational and most effective.
Awareness	Planning based on creeksheds greatly raises the awareness level about natural systems, their importance, their problems, and their possibilities. Natural systems such as streams and stream-based habitat are hidden very often by the human-built landscape. Creekshed planning will be enlightening for City staff, elected officials and citizens.
Master Plan subunits	The City already has subunits for the Master Plan. Changing to creekshed subunits will not change the basic premise, but, rather, will rearrange the subunits along natural boundaries.
Transition point in planning	The City is approaching a time when horizontal expansion within the freeway ring is maximized. Planning in the City will be further focused on issues such as in-fill development, downtown redevelopment, and historic preservation. Over-riding themes will be livability and sustainability. Creeksheds will provide natural units for this refocused planning. Reaching horizontal build-out will create a transition point - an opportunity to shift from development units (e.g., West Area, Northeast Area) to sustainability units (creeksheds).
Gradual change	The transition to creekshed-based planning can take place gradually. For example, instead of creating a new South Area Plan a few years from now, a Malletts Creekshed Plan can be undertaken.
Outside City limits	Ann Arbor planning needs to take neighboring environments into account. State planning enabling legislation explicitly cites the need to plan for some portion of land outside of formal City limits. Creeksheds are natural units that extend outside of the City. For example, the Traver Creekshed extends north of M-14 into Ann Arbor Township.
Huron River is vital	The Huron River is one of the crown jewels of Ann Arbor, and is one of the primary elements that help make this a unique and attractive place. Creekshed planning recognizes the importance of the river and its watershed to the City.
TMDLs	Under the total maximum daily load (TMDL) provisions of the Clean Water Act, we have a legal obligation to reduce phosphorus loading to the middle portion of the Huron River by 50%. The Ann Arbor urban area is in the heart of the middle Huron region. A huge reduction such as that will require changes throughout our creeksheds over a long period of time. Implementing, managing, and measuring those changes will be facilitated greatly by planning based on creeksheds.
$14M for one creek $?M for the others	Fourteen million dollars of stormwater drainage improvements are slated for Malletts Creekshed alone. The improvements are concentrated on the channel and corridor of the creek itself. The long-term benefit of the improvements can be assured by consistent maintenance of the new facilities and by permanent changes in stormwater management throughout the creekshed. Planning based on the creekshed can be vital to the success of the improvements. Meanwhile, most or all of the problems identified in Malletts Creek will be essential to making profound and needed improvements to all of the City's creeks.
Not everything fits	Some Master Plan elements should not necessarily be approached from a creekshed perspective. For example, the Central Area of the City - essentially a human-made, social, historical, and economic entity - might not be suitably planned in a creekshed context. On the other hand, most of downtown is an essential component of the creekshed of heavily-stressed Allens Creek.

Certainly this list is neither exhaustive nor definitive, and such a proposal likely will require time to consider its merits and time to transition into these planning units. The Watershed Council welcomes the opportunity to talk further with you and the Planning Department and Commission about this proposal.

Please feel free to contact me or Laura Rubin, Executive Director, at 769-5123.

Sincerely,

a former student →

Elizabeth Worzalla, Watershed Specialist
Middle Huron Initiative

Excellent copy to Envr. Comm — ASAP

State of Env. Commission asking if there were a written summary

MEMORANDUM

TO: City Planning Commission

FROM: Wendy Rampson, City Planner WCR

SUBJECT: **Ann Arbor Transportation Plan Update**

DATE: April 27, 2001

In October 1990, the Planning Commission adopted the Transportation Plan Update as an element of the City master plan. Four years later, the Planning Commission amended the Transportation Plan to include the Fuller/Geddes/Conrail Corridor Study. In the ten years since the Transportation Plan was adopted, the City of Ann Arbor, the Ann Arbor Transportation Authority (AATA) and the University of Michigan have worked together to implement the wide-reaching and innovative recommendations that came out of this plan.

Recognizing the importance of the ten-year milestone, AATA and Planning staff have been working on a brochure outlining the progress toward the goal of managing travel demand without widening roads. Attached is the draft of this brochure for your preview. I will highlight some of the more significant efforts at the business meeting.

We think you will find that the three implementing agencies have made important strides to providing a variety of transportation options for Ann Arbor residents, businesses and visitors. The range of actions taken also demonstrate how important a master plan can be in guiding the incremental decisions of many different actors in achieving a larger goal.

interesting!

As with any plan, the Transportation Plan will need to be updated to address the changing character of transportation for the area. For instance, the growth in jobs projected for the Ann Arbor area has greatly exceeded expectations, while the growth in households is substantially less than expected. This poses a particular challenge for travel demand in peak hours. The growth in surrounding townships, while anticipated, has taken different forms from that projected in 1990.

The Northeast Area Transportation Plan, soon to be underway, will allow us to test some of the newer analytical tools for transportation planning, including those that take into account land use changes and the use of transit and non-motorized modes. The FY 2002-2007 Capital Improvements Plan schedules the next citywide update of the Transportation Plan for FY 2003.

Env. Commission?

The draft brochure will be completed in the next few weeks, at which time staff will provide the final copy to the Commission. The brochure will be provided to elected and appointed officials and mailed to citizen participants in the 1990 Transportation Plan Update.

Attachment: Draft Transportation Plan Update Brochure

7b

Excellent copy to Envr. Comm — ASAP

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7b

MEMORANDUM

TO: City Planning Commission

FROM: Karen Popek Hart, Planning Director KPH

DATE: April 26, 2001

SUBJECT: **Collaborative Project with the Scio Township Planning Commission**

As a result of your joint meeting April 12, 2001, with the Scio Township Planning Commission, you identified a desire to form an intergovernmental task force to work on three issues that transcend community boundaries: transportation, land use, and open space. You also agreed that it was important to inform both the Township Board and City Council and to invite their support.

Below is a proposed motion for your consideration at the May 1, 2001, business meeting. It is a variation of the work of Commissioner Gibbs, tailored to the Ann Arbor City Council. Once you have adopted it, or a revised version, staff will transmit it both the City council and to the Scio Township Planning Commission, as well as a companion draft version, tailored to the Township Board, for their use. Staff recommends **approval**.

PROPOSED CITY PLANNING COMMISSION MOTION

Whereas, The Ann Arbor City Planning Commission met jointly with the Scio Township Planning Commission on April 12, 2001;

Whereas, Both commissions found that they share a strong desire to improve their community's livability, to increase the environmental sensitivity of their decisions, and to strengthen their economy; and

Whereas, Most [Many] planning issues do not recognize [transcend] the boundaries of any local government; [municipalities]

Resolved, That the Ann Arbor City Planning Commission commits to join the Scio Township Planning Commission in forming an intergovernmental task force, jointly led by the chairs of each commission, to prepare a concentrated, coordinated plan of transportation, land use, and open space issues affecting both communities and recommendations for addressing them;

Resolved, That the involvement of other entities involved in addressing these issues, including but not limited to the Ann Arbor Transportation Authority, the Ann Arbor-Ypsilanti Urban Area Transportation Study Committee, each community's Downtown Development Authority, and employers, business and environmental groups, and the public will be sought;

Resolved, That the support and participation of the Ann Arbor City Council and the Scio Township Board of Supervisors is invited and welcomed.

Project - transit service

help with sharing burdens - legal maps

7C

Mail suggesting links of possible interest to Solstice readers

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- **From Robert F. Austin: Interesting GIS page:** **http://www.geog.ubc.ca/courses/klink/g470/class00/gmenglan/frames.html**
- **From Ming-Hui Hsieh: software that allows us to split a picture, create a link for every mini-picture, and then put them back**

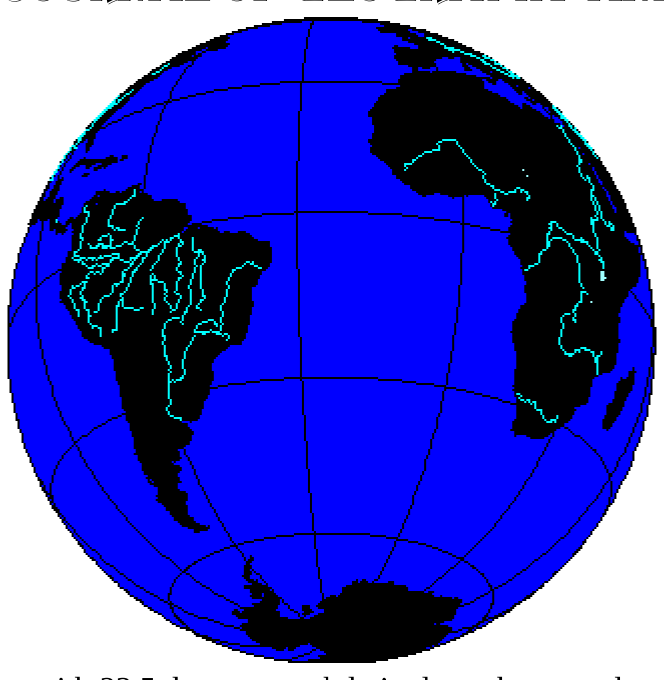
  together in a webpage. http://www.b-zone.de/software.htm
- **From Marc Schlossberg: Landsat images as art - http://astroboy.gsfc.nasa.gov/earthasart/**

Many thanks to Marc, Ming-Hui, and Bob for their thoughtfulness. Please feel free to communicate other links to Marc or Ming-Hui, or to IMaGe directly.

Educational Technology Experts:
Marc Schlossberg
Ming-Hui Hsieh

SOLSTICE:

AN ELECTRONIC JOURNAL OF GEOGRAPHY AND MATHEMATICS



Earth: with 23.5 degrees south latitude as the central parallel.

VOLUME XIV
NUMBER 2
DECEMBER, 2003

SOLSTICE: AN ELECTRONIC JOURNAL OF GEOGRAPHY AND MATHEMATICS

http://www.imagenet.org

Winter, 2003

VOLUME XIV, NUMBER 2

ANN ARBOR, MICHIGAN

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MISSION STATEMENT

The purpose of Solstice is to promote interaction between geography and mathematics. Articles in which elements of one discipline are used to shed light on the other are particularly sought. Also welcome are original contributions that are purely geographical or purely mathematical. These may be prefaced (by editor or author) with commentary suggesting directions that might lead toward the desired interactions. Individuals wishing to submit articles or other material should contact an editor, or send e-mail directly to sarhaus@umich.edu.

SOLSTICE ARCHIVES

Back issues of Solstice are available on the WebSite of the Institute of Mathematical Geography, http://www.imagenet.org and at various sites that can be found by searching under "Solstice" on the World Wide Web. Thanks to Bruce Long (Arizona State University, Department of Mathematics) for taking an early initiative in archiving Solstice using GOPHER.

PUBLICATION INFORMATION

The electronic files are issued yearly as copyrighted hardcopy in the Monograph Series of the Institute of Mathematical Geography. This material will appear in a Volume in that series, ISBN to be announced.

To cite the electronic copy, note the exact time of transmission from Ann Arbor, and cite all the transmission matter as facts of publication. Any copy that does not superimpose precisely upon the original as transmitted from Ann Arbor should be presumed to be an altered, bogus copy of *Solstice*. The oriental rug, with errors, serves as the model for creating this weaving of words and graphics.

Lewis and Clark, 200 Years: A Visual Tribute to an Exploration.
The Gates of the Rocky Mountains.

Sandra L. Arlinghaus, Robert J. Haug, and Ann E. Larimore
The University of Michigan

The historical texts of Meriwether Lewis, Captain United States Army, and William Clark, Captain United States Army, offer the mind's eye a stunning visual scene of explorers navigating a walled passage along the Missouri River, through the Rocky Mountains, just upstream from what is now Great Falls, Montana.

Journal Entry: July 19, 1805

Quotation from Lewis [DeVoto, pp. 159-160]:

this morning we set out early and proceeded on very well tho' the water appears to encrease in volocity as we advance. the current has been strong all day and obstructed with some rapids, tho' these are but little broken by rocks and are perfectly safe. the river deep and from 100 to 150 yds. wide. I walked along shore today and killed an Antelope. wh[en]ever we get a view of the lofty summits of the mountains the snow presents itself, altho' we are almost suffocated in this confined valley with heat. this evening we entered much the most remarkable clifts that we have yet seen. these clifts rise from the waters edge on either side perpendicularly to the hight of 1200 feet. every object here wears a dark and gloomy aspect. the towering and projecting rocks in many places seem ready to tumble on us. the river appears to have forced it's way through this immence body of solid rock for the distance of 5 3/4 Miles and where it makes it's exit below has thrown on either side vast collumns of rocks mountains high.

the river appears to have woarn a passage just the width of it's channel or 150 yds. it is deep from side to side nor is there in the 1st 3 Miles of this distance a spot except one of a few yards in extent on which a man could rest the soal of his foot. several fine springs burst out at the waters edge from the interstices of the rocks. it happens fortunately that altho' the current is strong it is not so much so but what it may be overcome with the oars for there is hear no possibility of using either the ord or Setting pole. it was late in the evening before I entered this place and was obliged to continue my rout untill sometime after dark before I found a place sufficiently large to encamp my small party; at length such an one occurred on the lard. side where we found plenty of lightwood and pich pine. this rock is a black grannite below and appears to be of a much lighter colour above and from the fragments I take it to be flint of a yellowish brown and light creem-coloured yellow. from the singular appearance of this place I called it *the gates of the rocky mountains*.

Quotation from Clark [DeVoto, pp. 160-161]:

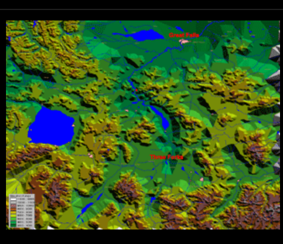
I proceeded on in an Indian Parth river verry Crooked passed over two mountains Saw Several Indians Camps which they have left this Spring. Saw trees Peeled & found poles &c. at 11 oC. I saw a gange of Elk, as we had no provision Concluded to kill Some. Killd. two and dined being obliged[d] to substitute dry buffalow dung in place of wood, this evening passed over a Cream Coloured flint which [has] roled down from the Clifts into the bottoms, the Clifts Contain flint a dark grey Stone & a redish brown intermixed and no one Clift is solid rock, all the rocks of everry description is in Small pi[e]ces, appears to have been broken by Some Convulsion my feet is verry much brused & cut walking over the flint & constantly stuck full [of] Prickley pear thorns, I puled out 17 by the light of the fire to night Musqutors verry troublesom.

Use of the historical and geographical record, coupled with current mapping capability, permits the creation of visual scenes that might have confronted Lewis and Clark at this unique site: The Gates of the Rocky Mountains. We offer these images as a modest tribute to their spectacular exploration. Note the differences that come from using different contour intervals (spacing between successive contours).

Gallery of Images

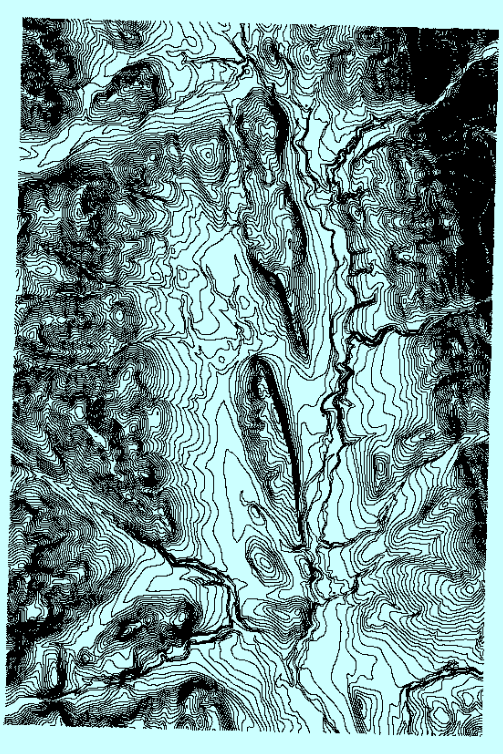
Digital Elevation Models offer one view of the terrain.

Digital Chart of the World. Contour interval of 1000 feet. The Gates of the Rocky Mountains are shown as a red dot.

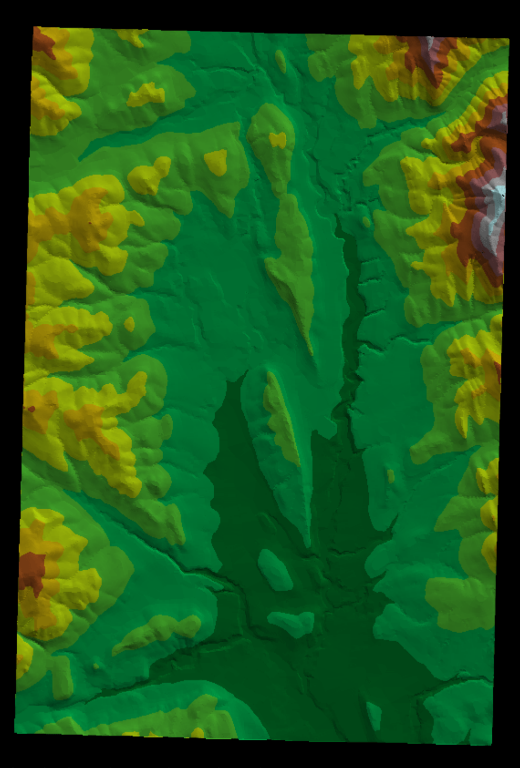


The Digital Chart of the World (from ESRI) offers contours at a 1000 foot contour interval. Creation of a Triangulated Irregular Network from these contours permits visualization of a chunky terrain and offers a general context in which to consider the region. (Click on the small map to see a larger map.)

USGS contours, Digital Elevation Model. Contour interval of 10 feet.

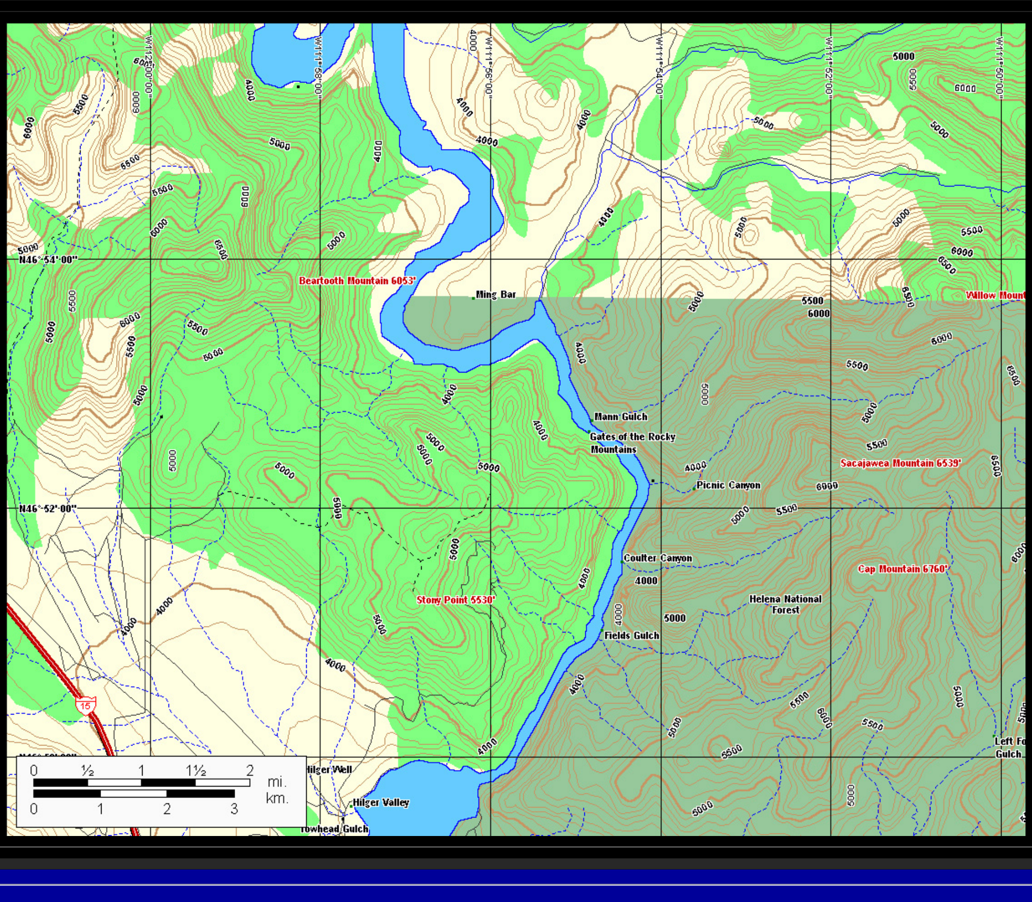


USGS contours show a much more detailed picture than does the Digital Chart of the World.

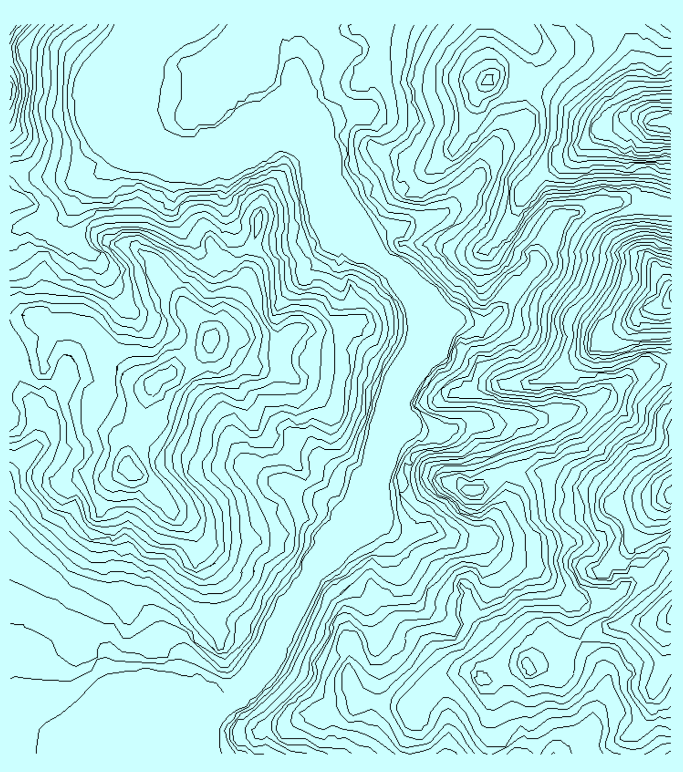


Triangulated Irregular Network created from the USGS DEM.

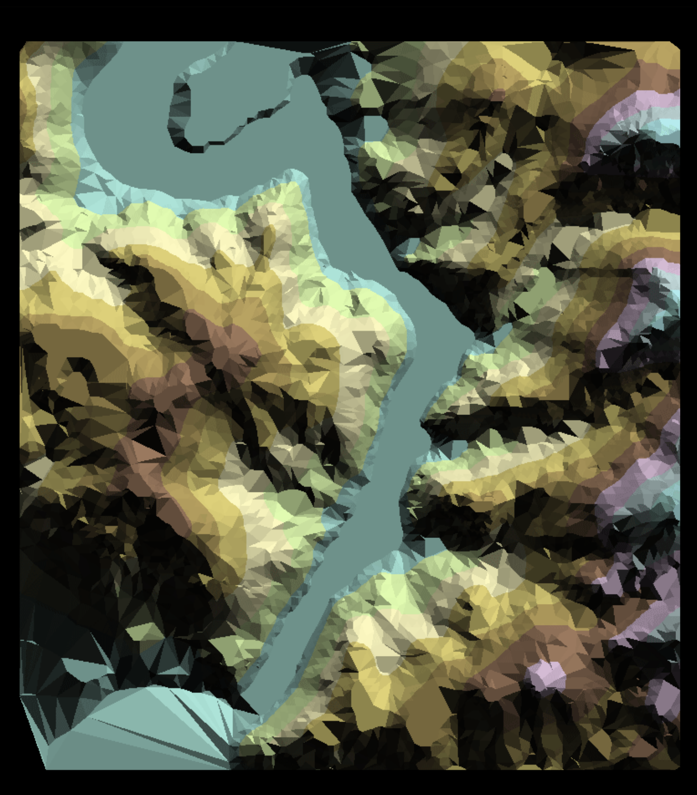
DeLorme Topographic Atlas on CD: contour interval of 100 feet.



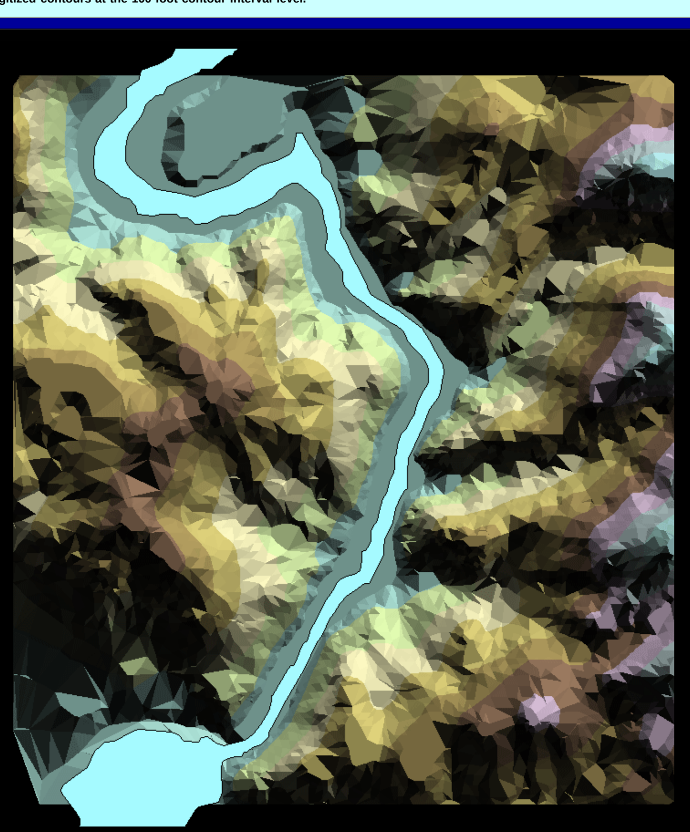
Scroll to the right to see the full display. The Gates of the Rocky Mountains are shown as a red dot.



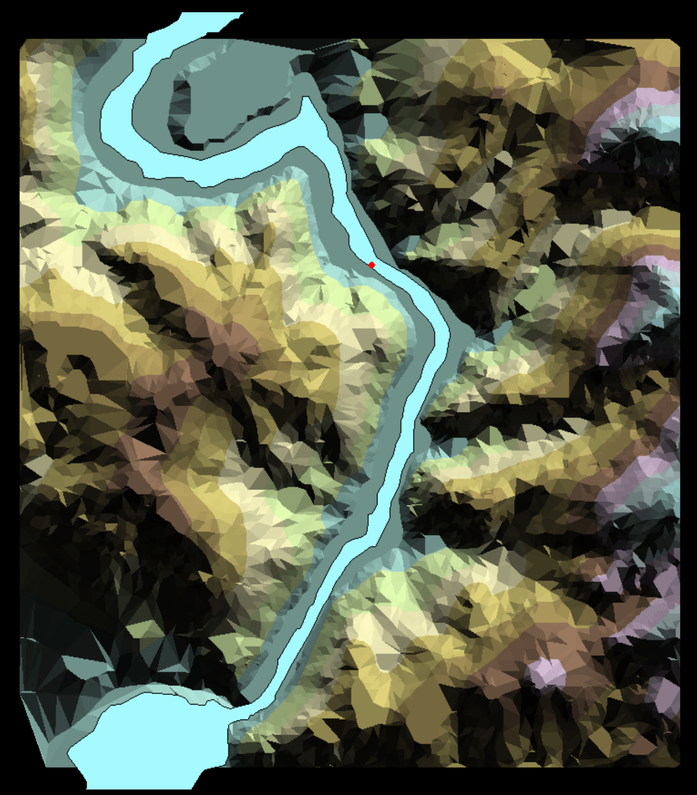
Digitized contours at the 100 foot contour interval level.



Triangulated Irregular Network made from digitized contours.



Missouri River superimposed in light cyan.



The Gates of the Rocky Mountains, red dot.

Each type of base topographic map has merits: the 1000 foot contour interval map is useful, especially when represented as a TIN, as a general context map. When the finest contour interval (10 feet) was used, the general context was not evident. The TIN derived from the contour base shows great detail. The 100 foot contour interval offers a balance between the two. That map, however, was not a digitized map that would work directly in a GIS (ArcView, ESRI). Thus, the contours were digitized from the 100 foot base map, a TIN created from that base, and then the TIN was put into ArcView 3D Analyst extension (ESRI) and saved as VRML 2.0, as a virtual reality of the scene. The much more highly detailed USGS file renders a fine virtual reality scene; however, the size of that file is over 177 MB and it causes many machines to crash. Thus, the more modest file of 3 MB created from the 100 foot contour interval map is included here. Readers should download (free) Cosmo Player from http://ca.com/cosmo/ in order to view the virtual reality files directly in their internet browser.

Click here to see an animation of contours with superimposed TIN; The Gates of the Rocky Mountains are shown as a red dot.

Click here to see the virtual reality scene of "The Gates of the Rocky Mountains" derived from the 100 foot contour interval.

What else might illuminate historical and geographical texts of the future, as an exploration in imaginative interactive communication and education?
One might envision

- creating routes and scenes, defined by the user, in support of text. (See, for example, the outstanding display created at the Department of Geography, University of Missouri in the attached link)
- taking virtual voyages in canoes up the Missouri River as a search (using a search function) of the landscape for animated local sentinels, all while music of the period is playing in the background.
- creating a virtual Mandan village, as a way for present day Americans to view one of the most important trading communities of the period.

Or, one might look ahead to see student or research scouts forging ahead into as yet unimagined connections between marvelous mapping advances and classical texts from the past as history comes alive!

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Dependence of Production of Paddy on the Total Annual Rainfall: A Different Approach*

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Abstract

Some statistical techniques have been employed to discern the dependence of paddy production on total annual rainfall. The study area is West Bengal, a state of India. The study is based upon the computation of Pearson Correlation Coefficient, Entropy, and testing for Poisson distribution.

Key words: West Bengal, Paddy production, Pearson Correlation Coefficient, Entropy, Poisson distribution

Introduction

This brief article aims at finding out a statistical relationship between the paddy production and total rainfall in West Bengal, a state in India. A positive correlation between these two features is well established. Most studies, however, are based on a traditional statistical approach. The present study deviates a bit from the earlier ones. The newness of this study is the application of the concept of entropy as explained by Chaudhuri and Chattopadhyay in *Solstice* (2003). One limitation of the traditional approaches is that they are based on the assumption that the yearly values of the aforesaid features in successive decision periods are serially independent.

This paper develops an approach to incorporating serial correlation (Wilks, 1991) into the decision making process. The underlying idea is to show that in the future both the production of paddy in the aforesaid state as well as probable maximum rainfall can be investigated through the theory of Markov Chain (Wilks, 1995) and that uncertainty in the production of paddy in the coming years can be discerned through the predicted value of maximum probable rainfall.

Experimentation setup

The experimentation set up consists of the following steps:

- Testing for the Markov status through lagged autocorrelations (Wilks, 1995)
- Finding out the interdependence between total yearly rainfall (R) and the production of paddy (P) through the Pearson Correlation Coefficient (Chattopadhyay, 2002)
- Checking for the Poisson distribution in the data series of ‘P’ considering it as a variable dependent on ‘R’ (Box and Jenkins, 1976)
- Calculating the entropies in the probability distribution of ‘P’ with different changes (%) in the value of ‘R’.

The study is based on data for the period 1995-2000 made available from *The Statesman*, a leading newspaper of India.

Testing for Markov Status

We have two time series, one for the values of ‘R’ and the other for the values of ‘P’.

For each variable, we consider the null hypothesis:

H0: The data are serially independent

This is to be tested against the alternative hypothesis

H1: The data are serially dependent.

Under the null hypothesis a Chi-square statistic is calculated for each parameter using the formula:

$$X^2 = [(\text{Observed value} - \text{Expected value})^2/\text{Expected value}]$$

If the observed value of the statistic is found to exceed the tabular value the null hypothesis is rejected, otherwise accepted .

In our study we have found that

For 'R' Chi-square= 10. 319

For 'P' Chi-square= 14.319

Both of the values are found to exceed the tabular value (Wilks, 1995) of Chi-square at 1% level of significance, leading us to reject the null hypothesis H0. It can therefore be concluded that on the basis of the body of evidence, we have nothing to believe that either 'R' or 'P' are serially independent. As the decision is true at 1% level of significance, we have enough reason to infer that in the long run, in 99% cases the data will remain to be serially dependent.

Next to see their Markov status:

Lag-k autocorrelation coefficient (ACC) is computed as

ACC=

(Covariance between k-lagged data pair)/{(sd for first (k-1)data values)(sd for last (k-1)data values)}

……………………………………………………….(1)

where, sd= Standard Deviation.

From the Markovian point of view, Lag-1 ACC, denoted as r1 is the measure of persistence. So if both of the series are found to have significant r1, we can go ahead to test the Markov status defined as

$$rk=(r1)^k \qquad \text{……………………………………………………………..(2)}$$

The Lagged ACCs in our study are presented in table-1.

Table-1

Parameter	Lag-1ACC	Lag-2ACC	Lag-3ACC	Lag-4ACC
R	0.4126	0.1703	0.0706	0.0291
P	0.5311	0.2310	0.1501	0.0811

The Lag-1 ACC being of significant value (compared to 1), and the four lagged ACCs being found to obey equation (2), it can be concluded that the series are generated by first-order-two-state Markov Chain (Wilks, 1995). Thus, serial dependendence with a specific pattern is established.

Pearson Correlation Coefficient

The values of ‘P’ and ‘R’ have been standardized by using the formula:

Standardized X=[(Actual X-Average of X)/sd of X]……………………………………………(3)

Their scatterplot with a trend line is shown in Fig.01.

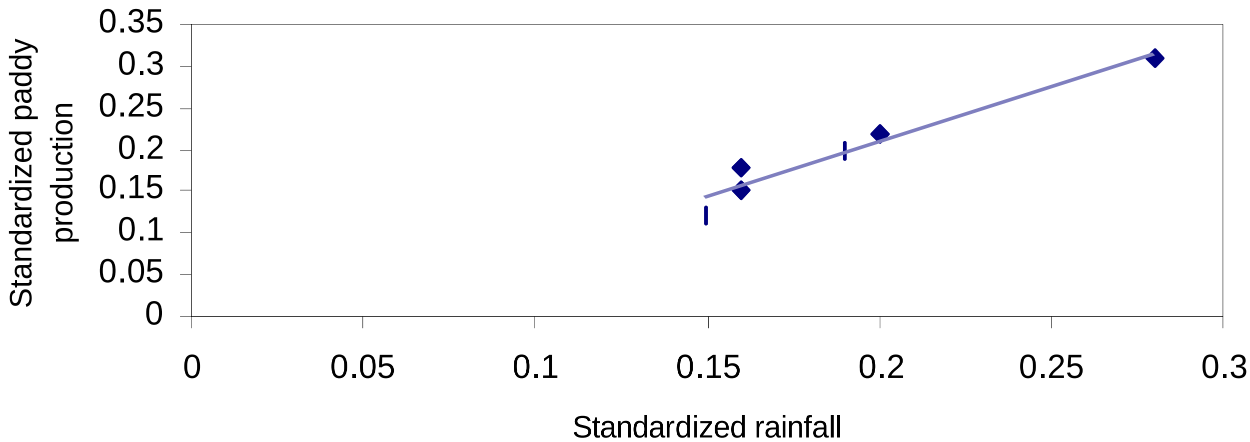
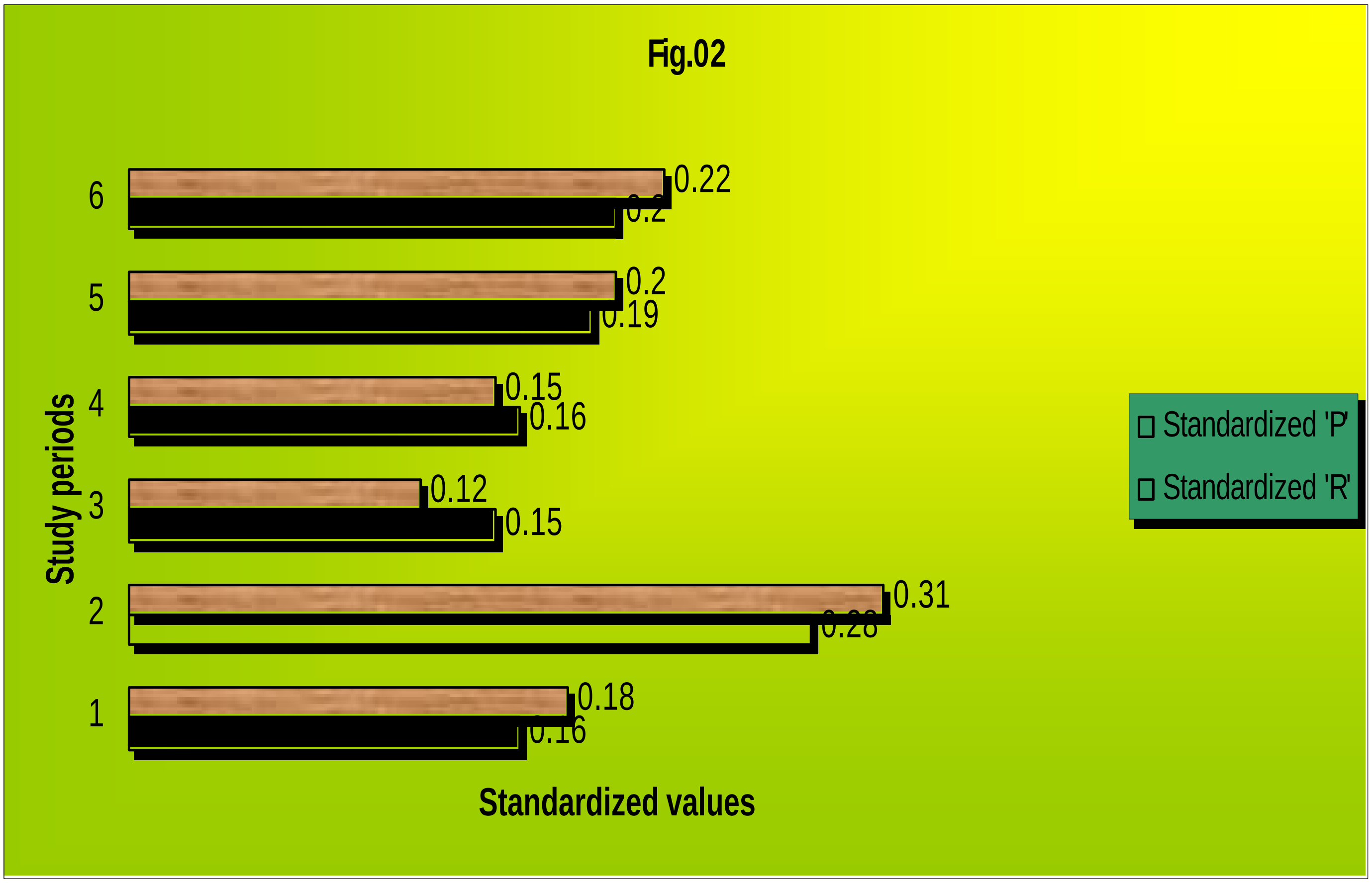


Fig.01-Scatter showing a linear relationship between rainfall and paddy production

The linear trend leads us to calculate a Pearson Correlation Coefficient between ‘R’ and ‘P’ which in this case is found to be 0.97, supporting quantitatively the linear relationship. The interrelationship has also been presented in figure-02.



Check for Poisson distribution

We now consider 'R' as an independent variable and 'P' as the variable dependent on it. Next, consider the null hypothesis:

H0: 'P' is not distributed as Poisson.

This is to be tested against,

H1: 'P' is distributed as Poisson.

Poisson distribution is presented as

$$f(x)=\exp(-\mu)(\mu^{x})/x! \quad ....(4)$$

Using H0 and (4), a Chi-square statistic is formed and the value at 1% level of significance and with 5 degrees of freedom. The value is found to be, 19.286. Comparing this value with the tabular value, it is found that 'P' is Poisson distributed. Thus 'P' has randomness with respect to 'R'.

Entropy calculation

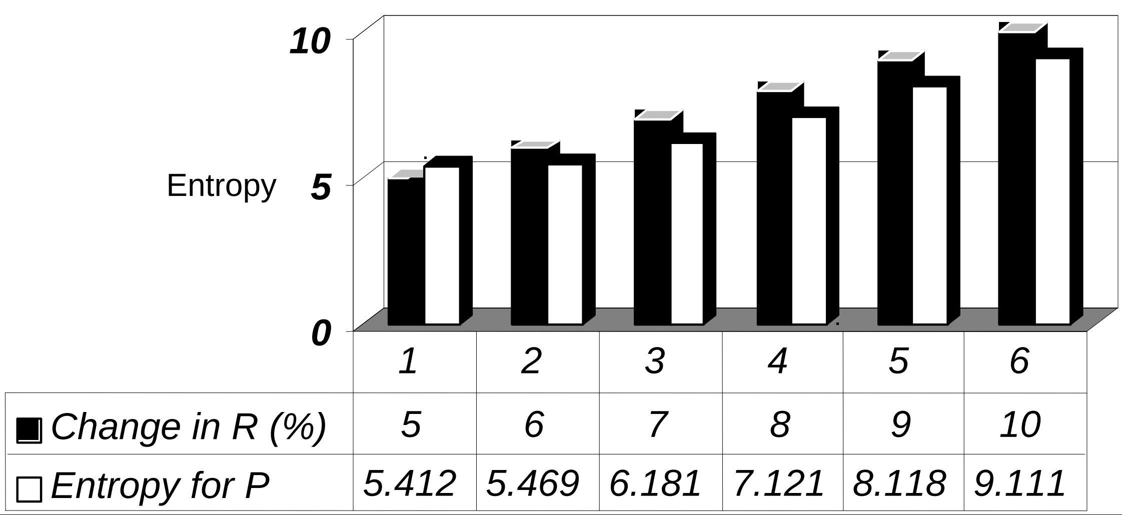
Maximum entropy probability distribution is calculated for 'P' with change (%) in 'R'. Results are presented in table-2.

Table-2

Change (%) in R	Entropy for P
5%	5.412
6%	5.469
7%	6.181
8%	7.121
9%	8.118
10%	9.111

The figure below (Fig. 03) shows that Paddy production is very much vulnerable to change in the value of total rainfall.

Fig.03-Relationship between change in R(%) and entropy for 'P'



Conclusion

It is no surprise that paddy production is dependent on total annual rainfall. The use of an entropy calculation shows the extent to which paddy production is vulnerable to change in the value of total rainfall. The degree to which randomness and uncertainty in production depend on rainfall is characterized by a Markov pattern.

*Acknowledgement:

The author wishes to thank Professor Sandra Arlinghaus for helping in various ways while preparing the manuscript

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Combating the complexity in spatial data: A neuronal approach

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The author wishes to express his indebtedness and regards to Prof. Sutapa Chaudhuri of Calcutta University, who sowed the seed of flexible computing approach in the author's mind.

Introduction

The datasets acquired from various climatological events are non-linear in nature. The non-linearity arises because climatological systems are superpositions of a set of deterministic, multivariate, and non-linear interactions over an enormous range of spatial scales. In order to understand this system, scientists must observe, summarize, make inference, and ultimately predict its behavior at each scale of variability (1). Thus, some flexible techniques are need. Ordinary statistical approaches are less flexible with respect to non-linearity; their application may not always give appropriate results (2). Statistical inference also requires some pre-processing of the data. When the question of prediction of some climatological data arises, the application of simple time-series analysis cannot give an appropriate forecast because of its limitation in handling a highly non-linear data structure. This observation is true for individual parameters as well as for the event itself. The cases, where grided data are employed, may give huge propagation error, if the traditional numerical methods for them are not mingled with some flexible techniques. The word "flexible" is used to mean that the technique should be able to modify itself in order to minimize the output error as much as possible. Various methods, such as, prepositional logic, probabilistic reasoning, neuronal nets can be tried as flexible techniques. In this article, Neuronal Residual Kriging (NRK) is proposed as a flexible technique to analyze spatial data. NRK can be employed to estimate a non-linear drift and to apply a geo-statistical, predictor (Kriging) to the residuals.

Methodology

The proposed method consists of the following steps:

1. **Data preparation:**

   NRK being a data driven approach, depends highly on quality and quantity of data. That is why the data are prepared by descriptive statistics.

   Attention is given to the data magnitude and variability.

2. **Designing network architecture:**

   A multilayer perception is proposed to be used with proper adjustment of the hidden layers and initial weights.

3. **Training of the data:**

   Method of back propagation is being proposed to be applied with a few essential modifications (if necessary) by some other soft computing techniques. The proposed modifications are:

   (a) Initial weights are selected with the help of genetic algorithm.

   (b) Conjugate gradients are used for the efficient local minimum search or error function.

   (c) Simulated annealing is used in order to escape form local minima.

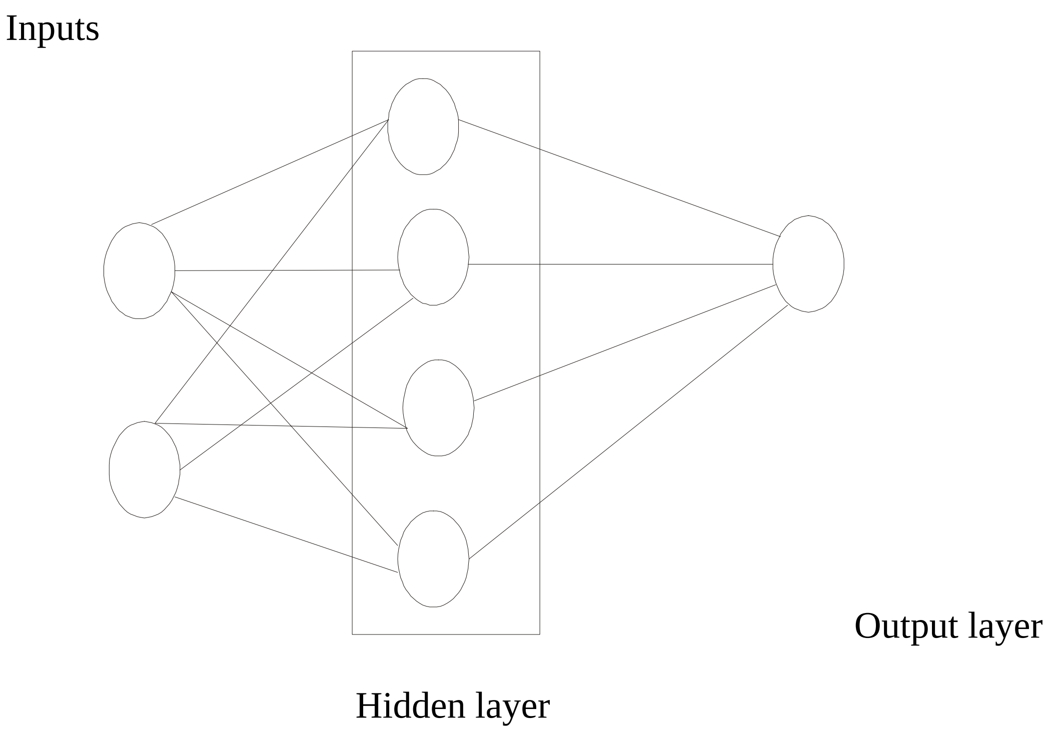
4. **Evaluating performance the network:**

   Different tools can be used for the evaluation, like cross validations accuracy test.

5. **Calculating the final NRK predictions at validation points and comparison**

with the true values are done as final validations.

The basic network architecture for the proposed method can be drawn schematically as:



→flow of information ←error propagation

Advantages of NRK

In NRK, several layers can be employed between input and output layers. Thus, like human neurons, the information can be processed very effectively in those hidden layers, where, through proper choice of activation function, the error in the output layer can be optimized.

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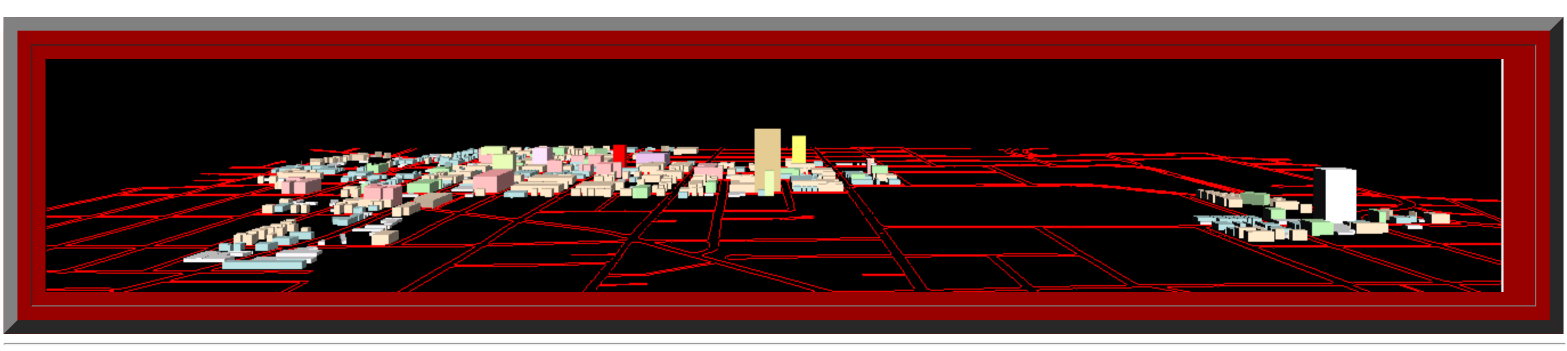

Ann Arbor, Michigan: Virtual Downtown Experiments, Part II

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member, Ordinance Revisions Committee (1995-2003), Master Planning Committee (2002-2003), and Environmental Commission (2001-2003), City of Ann Arbor.

For background information, please view this link to Part I: Ann Arbor, Michigan: Virtual Downtown Experiments

Material in this article is part of a forthcoming book by the author and William C. Arlinghaus entitled *Spatial Synthesis* (in press).

Thanks to:

- Merle Johnson of the City of Ann Arbor for permission to use City of Ann Arbor base maps and aerials in this article.
- Karen Hart, Planning Director, and Chandra Hurd, Planning Department, City of Ann Arbor, for files concerning building height in the downtown.
- Matthew Naud, Environmental Services Coordinator and Emergency Services Coordinator, City of Ann Arbor.
- Prof. Peter Beier, Director 3D Laboratory, Media Union, The University of Michigan and his staff members Lars Schumann and Brett Lyons.

Brief Background

Ann Arbor is a small city (of just over 100,000 population) in southeastern Michigan. It is home to the main campus of The University of Michigan, a state university with over 35,000 students on the Ann Arbor campus. The student population composes about 1/3 of the population of the city. Much of the rest of the population works at the university in some capacity or in research industry, businesses, government, or institutions that locate near the campus. Most cities in the US have shapes that are topologically equivalent to a circle, in terms of paying taxes to the city: land parcels that lie within the city boundaries pays taxes to the city. There are, of course, cities that contain enclaves within their boundaries that are not part of the city itself. In the case of Ann Arbor, however, and other small cities that contain large state universities, the city is more of an annulus (doughnut) in shape. A large hole, containing the university is cut out of the city: lands in this hole do not pay taxes to the city. Hence, a disproportionately large property tax burden is placed on owners of non university parcels within the city (although of course the presence of the university is vital to the well-being of the city in numerous ways). Ann Arbor is a college town.

Thus, there is a need to have mechanisms to create continuing economic development within the city. One way is to increase the stock of housing and space for commercial and other establishments in support of that housing. This path is all the more attractive in light of enduring interests in reducing "sprawl" and in preserving open space in the more rural surrounding lands. In a city with few remaining empty buildable lots, this approach seems to offer few alternatives, the most obvious of which is to increase the density of dwelling units within the city. When density increases are proposed in established residential neighborhoods there is often loud and long public objection from residents of those neighborhoods. There may also be serious environmental considerations, as well. Few residents, however, seem to object to increasing density in the downtown: many who already live in the downtown moved there with an acceptance of taller buildings. Residents of the city who do not live in the downtown often seem not to care about the idea of increasing density in the downtown. What people do seem to care about, however, is what an increase in downtown residential density may mean to the character, appearance, and feeling of the downtown: to its skyline and to the pedestrian experience. To some, an 18 story building is a visual blight on the skyline that provokes negative comment every time it is viewed; yet, others note that they have become accustomed to it and view it as an old, familiar friend. Building height can be a source of substantial dispute.

Inventory of the Vertical City

Prior to considering new tall buildings, it seems appropriate to create an inventory of existing buildings in the downtown area. (In Ann Arbor, the "downtown" generally refers to the "Downtown Development Authority" or DDA: a state-enabled authority that can capture increases in taxable value to pay for improvements within the defined boundaries.) To create this inventory, building footprints were digitized from high quality aerial flown in 2002. Heights were assigned to buildings based on information from the City of Ann Arbor Planning Department (only partially complete). When the building footprints are sorted out according to height it becomes possible to visualize how the taller buildings are arranged with respect to the shorter buildings. Figure 1 shows an animation of this pattern. In that animation the reader has an opportunity to study different layers of downtown space in relation to a plain backdrop and finally to an aerial of the city.

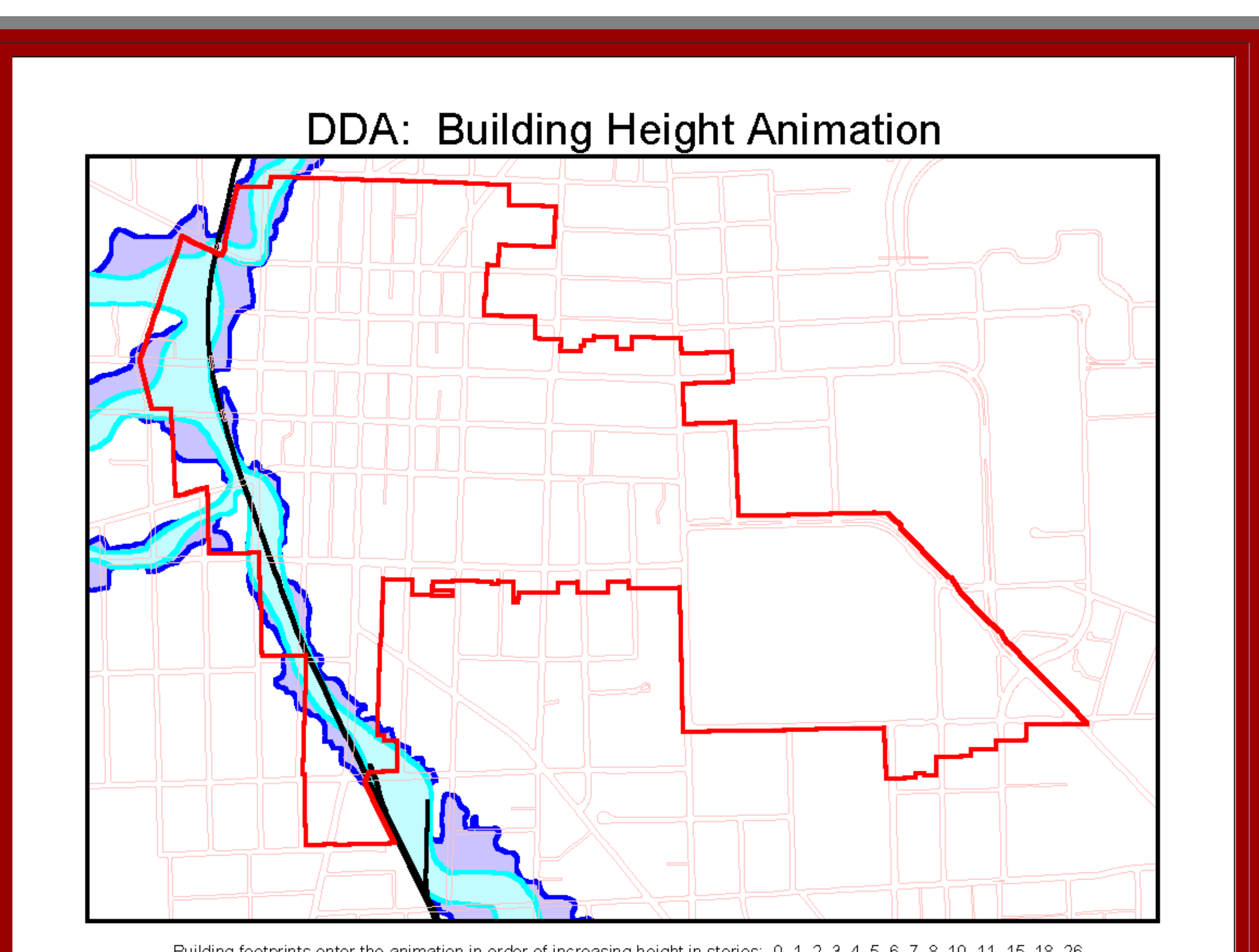


Figure 1. Animation of existing building height in downtown Ann Arbor, Michigan.

The evidence of Figure 1 suggests that buildings of 1, 2, and 3 stories are common in the downtown. Indeed, casual conversations with individuals from around town suggest that no one objects to buildings of any of these heights. One might wonder if that is because they somehow fit a sense of Ann Arbor well or if that is because they are prevalent and people become accustomed to them. In any event, one might imagine an ordinance which allows three stories "by right" on any downtown parcel. The question then becomes, how high elsewhere on prime parcels? For this question one might look to the spacing pattern of existing buildings taller than three stories. Tall buildings adjacent to other tall buildings can create wind tunnels and block wide channels of light. Tall buildings built lot line to lot line may present those as well as other unwelcome effects.

The Floor/Area Ratio as an Urban Planning Tool

The problem of where to locate tall buildings, with sensitivity to existing building types on adjacent and nearby lots, is a difficult one. In Ann Arbor, building height is currently limited by "floor area ratio" (FAR). The FAR is calculated as the ratio of floor area in a building divided by parcel area, times 100. If a given parcel has an FAR of 100 assigned to it, then a building footprint built lot line to lot line may have a height of 1 story. If a parcel has an FAR of 200 assigned to it, then a building footprint built lot line to lot line may have a height of 2 stories. Similarly, an FAR of 300, assigned to a parcel, yields a building of height 3 stories covering the entire parcel. Thus, on a parcel with an FAR of 300, one might, instead, build a building on half of the lot area but of height six stories, or on a third of the lot area but of height 9 stories. On the same parcel, a 30 story building could be built only if its footprint covered one tenth of the land area of the parcel.

The FAR provides a height limit based on the size of foundation needed to support a tall building. It also offers subtle encouragement for preserving some amount of open space and visual variation in the region to which it applies. The drawback is that a tall building may get built with no regard to the broader context of how that new building will fit in with existing buildings on the surrounding parcels. A possible side effect of using FAR (alone) to limit height is that it might encourage parcel amalgamation by large developers, thereby driving out desired local small business owners. [Note: in Ann Arbor, there are also "premiums" designed to encourage residential construction, and other uses viewed as "desirable" in the downtown; these allow an increase in FAR. They will not be covered in this discussion as they introduce no new theoretical issues--just complexity of detail.]

The Floor/Area Ratio, a Closer Look: The Hyperbola as an Urban Planning Tool

In a recent article Claudia Iturriaga and Anna Lubiw consider the problem of labeling maps. Because the current mapping environment is one that allows dynamic positioning of maps (zooming-in and panning), they consider the problem of non overlapping placement of text boxes to be one that is sufficient to solve with text boxes only at the perimeter of the map (with map content in the interior). They note that if the aspect ratio of the label (ratio of height to width) is permitted to vary, with label area held constant, then labels can be fit together in a variety of patterns that will permit a balanced display of map and text boxes. The requirement of constant label area ensures that a certain amount of text content is communicated; shape is permitted to vary. Thus, if the label is viewed as having a fixed lower left corner, then the upper right corner varies along the track of the first quadrant of a rectangular hyperbola with origin at the lower left corner. That is, if width is measured along the x-axis and height is measured along the y-axis, and the area of a label is fixed at K, then the equation describing the label is $xy = K$. This latter equation is precisely the equation of a rectangular hyperbola in the first and third quadrants intersecting the line $y = x$ at (K, K).

It is not a long conceptual leap to imagine the rectangular areas arranged around the perimeter of a rectangular map as being similar to the rectangular areas of building footprints arranged around a rectangular block of a downtown based on a gridded street system. The idea of a rectangle with an elastic aspect ratio tracing out the path of an hyperbola is similar to the idea of Floor Area Ratio (FAR) discussed above. From an abstract viewpoint, the FAR/100, or number of stories, times the parcel area serves as an envelope within which buildings may be built. For example, if a parcel has area 100,000 square feet and an FAR of 300, then 300,000 square feet of floor area may be built on the parcel: as a 3 story building lot line to lot line front, back, and sideways (green building in Figure 2); or, as a 6 story building with each floor having 50,000 square feet on half the parcel (yellow building in Figure 2); or as a 12 story building with each floor having 25,000 square feet on 25% of the parcel area (magenta building in Figure 2). What is constant is the value, K = (FAR/100)*(parcel area). If one graphs this function, with parcel area on the horizontal axis and FAR/100 on the vertical axis, the result is a rectangular hyperbola, $xy = 300{,}000$ (Figure 2). Different masses of building in relation to land area result depending on the height one chooses.

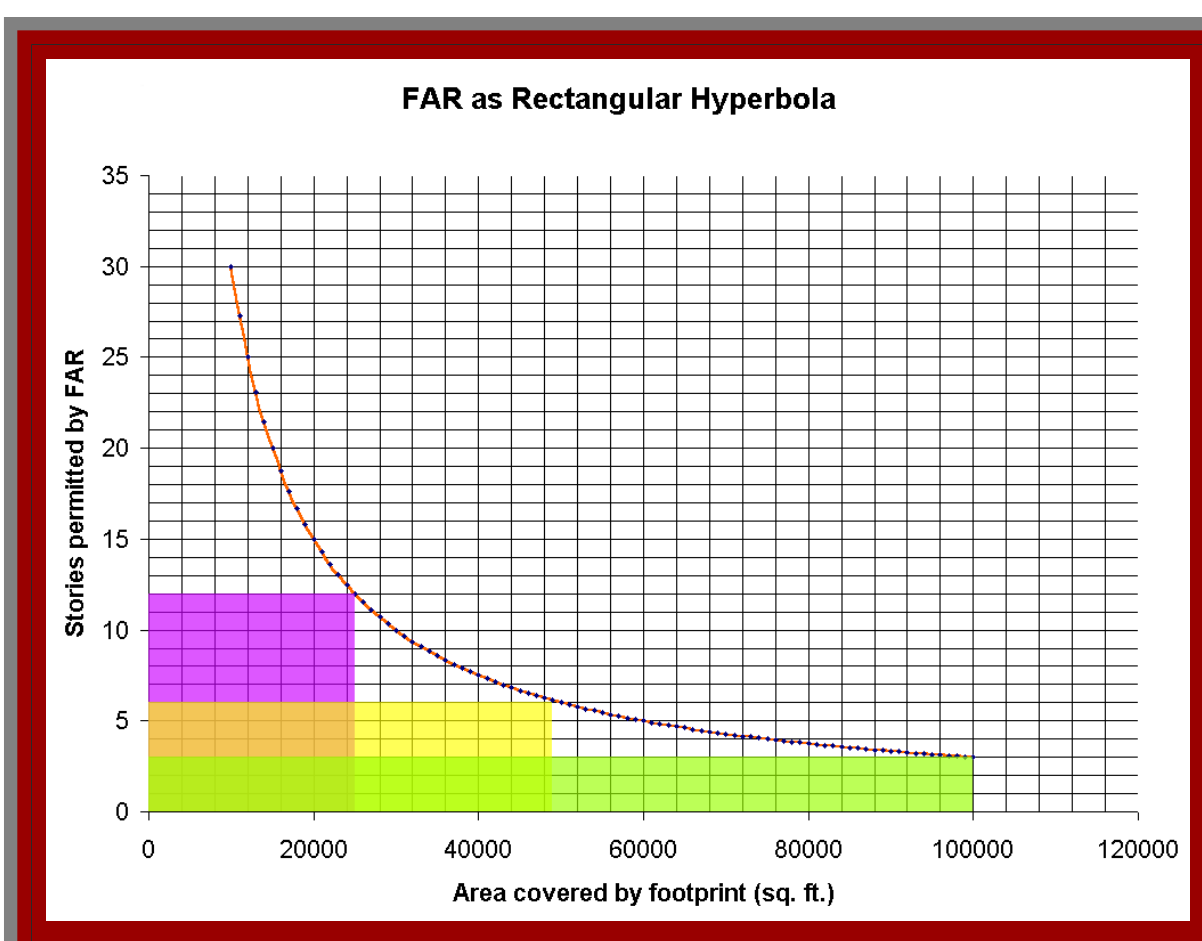


Figure 2. Rectangle with elastic aspect ratio and lower left corner fixed at the origin traces out part of one limb of a rectangular hyperbola $xy = 300{,}000$.

When one abstracts away from the grid suggested by Figure 2, and focuses instead on the hyperbola, it is possible to extend the analysis to the more global scene of the entire DDA and to the issue of building mass in relation to land area. Thus, consider that the x-axis units are now percent area in the downtown; then, the right-hand limit of the hyperbola is 100% of the land in the DDA. Under these assumptions, what the hyperbola of Figure 2 now says is that 100% of the DDA may be covered with 3 story buildings: that a 3 story building may be constructed, by right, anywhere within the DDA. It also says that 50% of the land area in the DDA may be covered with 6 story buildings, or that one quarter of the land area in the DDA may be covered with 12 story buildings, or that 10 percent of the land in the DDA may be covered with 30 story buildings. The use of the FAR to govern building height may play our at a regional (DDA) level as well as at a local level of the individual parcel. The hyperbola captures the FAR in a systematic manner and it does so at all scales, from local, to regional, to global. It does not reflect planning and geographic elements that the FAR does not capture such as (but not limited to) heights of neighboring buildings and other adjacency considerations, historic preservation issues, shadow or wind tunnel effects and other quality of life issues, or lateral or upper story setback concerns. Issues such as these require the human elements of judgment and common sense. The mathematical implementation can do much, but not all; it is a tool of humans, not a replacement for human thought (although numerous abstract connections remain to be probed: from cartography, to urban planning, to the Zipf rank-size rule and the lectures given by Michael Batty at The University of Michigan and Eastern Michigan University in the spring of 2003).

The principles set forth here, would enable one to consider the total mass of building square footage permitted according to FAR, independent of municipality and local concerns. Subtracting the actual built up area from that would give an estimate of the remaining mass that could be built, by right, according to code. Within that remainder, one might calculate how many more 3 story buildings could be built; how many more 6 story buildings; how many 12 story buildings (or whatever height in whatever units). Such a strategy can completely characterize the mass of building in relation to land area and may suggest a basis for the control of that mass, especially when one decides what future is desired and works back from that to create ordinances and code that will lead to that desired outcome (an approach similar to that take by others, as for example by people at ChicagoMetropolis2020). It offers, however, no guidance as to where tall buildings might be placed in relation to each other or in relation to existing structures, as to which parcels might contain tall buildings, as to wind, light, and sound issues, and as to a host of other qualitative issues. Other approaches might involve a guide to the spacing of buildings (forthcoming), buffers around existing buildings as zones of limited height, or legislated design standards. It is for creative needs such as these, to be superimposed on measures of sheer mass or quantity that can be captured generally as mathematical and geographical propositions, that cities require the service of professional planners and a host of municipal authorities and support personnel.

Beyond the Floor/Area Ratio: Virtual Reality as an Urban Planning Tool.

Virtual reality, the envisioning of alternative three-dimensional scenarios on a computer screen, offers to decision makers the capability to see how the massing of buildings and the general design of the urban landscape might look with various changes. In the case of Ann Arbor, that might mean envisioning the downtown with new tall buildings in a three-dimensional model that can be viewed at the pedestrian level: as a virtual landscape that can be navigated on the computer screen by City Council members as they sit with laptops in Council Chambers or by members of the public as they sit at home or in public libraries using computers with internet connections. Part I of this topic showed virtual reality of the downtown based on

- **VR 1:** parcels were extruded to form chunky buildings that filled entire parcels, lot lines to lot lines, with height assigned by FAR and zoning ordinance (C1A, 200% FAR; C1A/R, 300% FAR; C2A, 400% FAR; C2A/R, 300% FAR; C2B/R, 300% FAR).
- **VR 2:** parcels were extruded to form chunky buildings that filled entire parcels, lot lines to lot lines, with height assigned by records from the Planning Department of the City of Ann Arbor.

Additional work has yielded refinements on these files. Building footprints were digitized from an aerial of the downtown, flown for the City of Ann Arbor in 2002. Many of the footprints had heights from the records of the Planning Department. However, a number (over 300) did not. Buildings with no height were assigned the height based on FAR by zoning type (using information from the City of Ann Arbor Zoning Ordinance) calculated in association with the virtual reality in Part I, above.

The following sequence of interactive maps, made using the ImageMapper 3.3 extension to ArcView, shows the results, using maps and aerials in various combinations:

- **I-Map 1:** Click here for a link to an interactive map showing building footprints and height (on mouse-over) as well as building address and street names (on mouse-over). Parcel boundaries are shown on the underlying aerial and on the green Downtown Development Authority (DDA) area. The Allen Creek floodway (underground) and flood plain are shown, shaded, respectively in blue and turquoise. Click on a building or a street to see associated entries in the underlying database.
- **I-Map 2:** Click here for a link to an interactive aerial showing parcel boundaries, zoning, building height (on mouse-over), and street name. DDA outline, only, is shown in light yellow so the user may zoom in to get a closer view of the aerial within the DDA (up to 800% enlargement--can see cars clearly). The Allen Creek floodway (underground) and flood plain are shown, outlined, respectively in blue and light blue; again, because the shading is removed, the viewer may look at the content of the floodway/floodplain in greater detail than above. Click on a building or a street to see associated entries in the underlying database.
- **I-Map 3:** Click here for a link to an interactive aerial showing zoning boundaries in the downtown, zoning type (on mouse-over), building height (in the "zoneht" record of the database), and street name. Click on a building or a street to see associated entries in the underlying database.

This strategy necessarily produces error. Buildings that do not occupy a full parcel may well be taller than indicated here (as the FAR permits them to be). Others may be lower than what is allowed by FAR because they were not developed to the maximum permitted. Still others may be yet another height because they were part of a Planned Unit Development (PUD). (PUD designation is a custom zoning that permits projects to be built outside the standard zoning currently present for that parcel when there are good reasons to consider such action and when there is substantial public benefit, defined in City Code, for such action.) Finally, some parcels may not be developed for buildings: they may house parking lots or other non-building uses. Obviously, parcels that are empty, parcels housing parking lots, or parcels containing buildings of height less than permitted by FAR are targets for development or re-development. One block often targeted in this manner is the "Brown Block": the block of land bounded by Ashley, Huron, First, and Washington Streets (Figure 2). Vacant lands are easy to select from an aerial; what is not easy to see from an aerial is how new buildings might appear on them in relation to existing buildings. For that visualization, virtual reality is critical to gaining either a pedestrian's eye, or a bird's eye, view.

On November 9, 2003, City Council Member Jean Carlberg (and Mayor ProTempore, Planning Commissioner, and member of the Ordinance Revisions Committee), City Council Member Joan Lowenstein, City of Ann Arbor Planning Director Karen Hart, and former City Attorney (on two occasions) Jerold Lax, visited the GeoWall (with the author and others, a total of 14) at The University of Michigan's 3D Laboratory at the Media Union (Dr. Peter Beier, Director). At that time, they had the opportunity to view the files above at a scale that permitted them to feel as if they were walking among the buildings. Each was given the map displayed in Figure 3 and an earlier version of the commentary following the map. The red building on the map in Figure 3, at the southeast corner of Fifth and Huron Streets, is a location mentioned as a possible site for a new tall building by Ann Arbor Mayor John Hieftje (in personal communication with the author and elsewhere). The commentary following the map enumerates the steps taken to build a virtual structural base of the downtown to use as a model to consider density/height issues in the downtown.

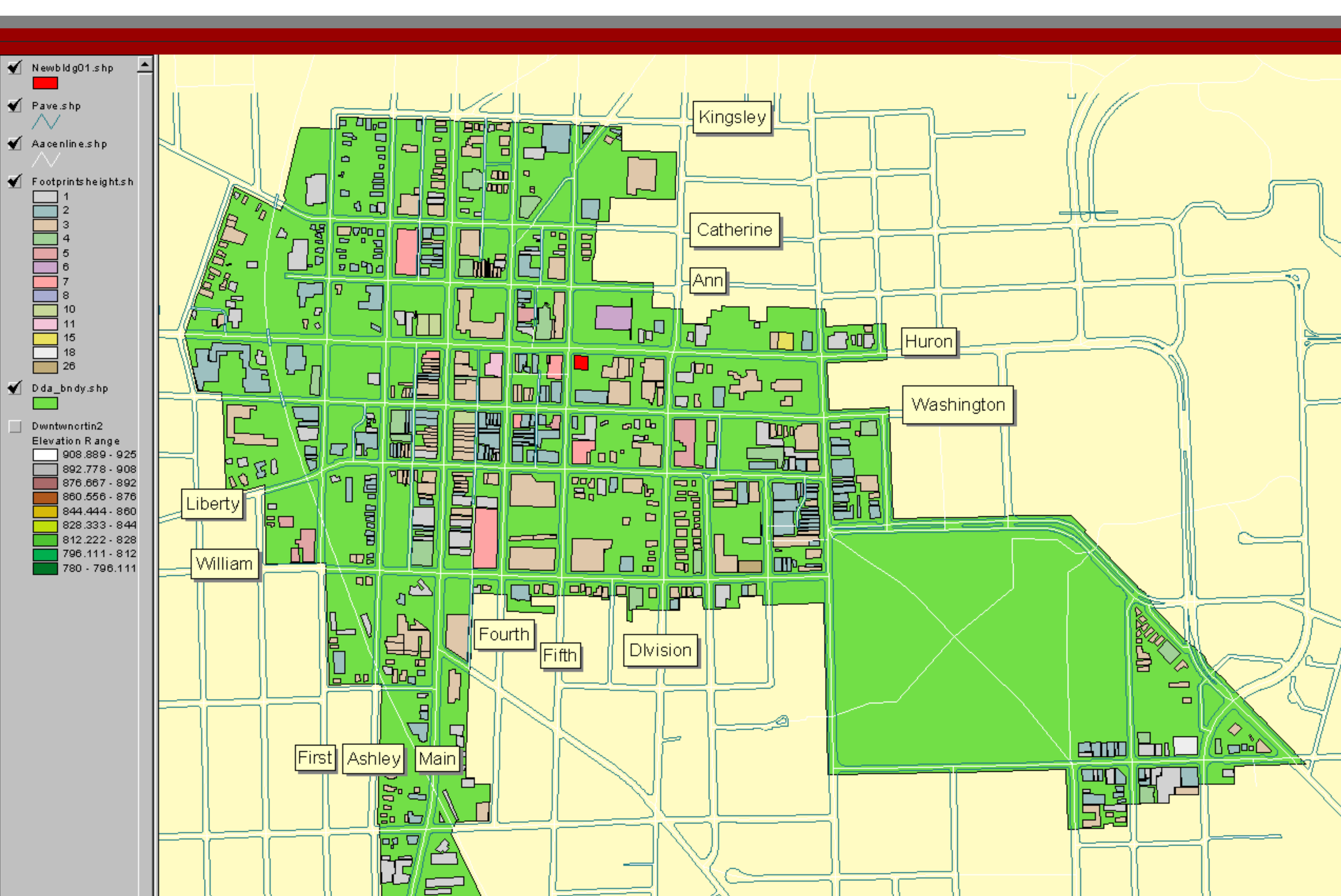


Figure 3. Map handed out to participants in the GeoWall display of November 9, 2003 at the Media Union of The University of Michigan.

Procedure used to date to create a structural building base of downtown (no detail):

- Building footprints were digitized using a city aerial (.tif file). They are represented in the map above as polygons filled with color according to building height (all buildings of the same height have the same color).
- Issues with height:
  - Over 300 polygons had a value of "0" height. For all but 32 of those polygons, the digitized building footprints were assigned values based on the FAR for the zoning category. Because the parcel outline generally exceeded the building footprint in area, this decision likely produces buildings that are shorter than what is permitted (although of course there may be actual buildings that have been constructed at less than what is permitted by right).
  - For the remaining 32 polygons, for which there was no data, a height of 3 stories was inserted (in later files, one was adjusted to 7 stories based on field evidence (Ashley Mews)).
  - Stories were assumed to be 12.5 feet in height.
- Contours, with a contour interval of 5 feet, were used to create a triangulated irregular network as a topographic base level from which to measure building height (rather than from a flat geometric base level).
  - **VR 3**: topographic base level in 3D
  - **VR 4**: topographic base level with buildings extruded from that level. This file may take a long time to load and it may be difficult to navigate because of the extended load time.
- Actual height Virtual Reality: digitized building footprints are superimposed on parcels in the downtown core zones.
  - These VR experiments depict the downtown using actual building heights, where known that are extruded from a topographic base. This base is a Triangulated Irregular Network (TIN) made from a City of Ann Arbor contour map with a contour interval of 5 feet. There are three sets of files for June 21:
    - **VR 5:** sun in the southeast (morning),
    - **VR 6:** in the south (noon),
    - **VR 7:** and in the southwest (afternoon).

    This was done in order to suggest variation in lighting conditions with season and with time of day. The lighting scheme is designed for hill shading and is therefore really only useful for suggesting shadow location as it does not account for light reflected from impervious surface.
  - Later experiments involved inserting building heights for the 300+ parcels of unknown height, as above. Links to
    - **VR 8:** a low sun scene (sun in the southwest) with the new building and
    - **VR 9:** a high sun scene (sun in the southwest) with the new building

    are included here. In these scenes parcels are extruded from topographic base level although it is not shown directly as a TIN in the scenes (in the interests of reducing file load time and map clutter).
- A new building was added in response to comments from Mayor John Hieftje and is shown as a red block in Figure 3 and also in the attached aerial..
- Earlier versions of files were shown to the Ordinance Revisions Committee of City of Ann Arbor Planning Commission.
- Karen Hart and Matthew Naud, both of the City of Ann Arbor, previewed earlier files in the immersion CAVE and on the GeoWall at the 3D Laboratory (Peter Beier, Director) of the Media Union of The University of Michigan.
  - Hart noted the utility of this tool for urban planning and mentioned one local project in particular; she agreed with the author that this tool might be useful in the context of a maximum height ordinance in the downtown;
  - Naud noted the utility of this tool for emergency management, including as a training tool for first responders. He expressed a desire to have building textures and other detail that would aid in building recognition introduced into scenes. Naud also suggested that knowing where hazardous materials were located would be useful to first responders. He followed up by suggesting a connection to others and helping to arrange, and participating in, meetings with them. These meetings have led to some proposals to fund emergency management activities linking various groups of individuals from the public and private sectors
  - Beier noted, on viewing the earliest files in the CAVE, that the buildings appeared to be too tall as one took a walk through the virtual downtown. Later, Lars Schumann (Programmer Analyst II and Lab Manager) and Brett Lyons (Programmer Analyst I), of the 3D Laboratory, Media Union, told the author that the .vrml files used in the CAVE and on the GeoWall have units in meters. Taejung Kwon (Ph.D. student, Taubman College of Architecture and Urban Planning and student in Engineering 477) noted (later yet) that one might calculate a z-factor to convert feet (used as the default unit in ArcView in City of Ann Arbor maps) to meters used in .vrml files. Other students in the group, Paul Oppenheim, Adrien Lazzaro, and Aaron Rosenblum agreed with Kwon.

Current activities:

- Research continues on building a "3D Atlas of Ann Arbor" designed to aid decision makers in a variety of contexts from Planning to Emergency Management. It will also serve as a pilot project for a number of more global 3D atlases.
- The author together with Matthew Naud and John D. Nystuen (Professor Emeritus, College of Architecture and Urban Planning, The University of Michigan) are serving as faculty advisors in Professor Peter Beier's Engineering 477 (College of Engineering, The University of Michigan)

course on virtual reality, Fall 2003. They are working with the team of four students mentioned above. The students have created a localized study for the "3D Atlas of Ann Arbor" at the intersection of Liberty and Main Streets. It will serve as a pilot study for other detailed 3D urban views.

Comments from the meeting from November 9, 2003 and subsequent follow-up:

- **Council Member Carlberg** noted that she might also wish to know more about where the shadows of new buildings might fall. Lighting changes are difficult to model in VR; however, with aerials that show existing building shadows, it is not hard to imagine where shadows of new buildings might fall. Thus, in the

  linked aerial

  one sees a red square on a parking lot corresponding to the location mentioned as a possible location for a tall building by Mayor Hieftje. The buildings around it cast shadows that extend almost across the street. A new building on the red square, of height greater than adjacent buildings would cast a shadow on both sides of the street. Shadow position is important when considering budgetary allocations from the city's street tree escrow. It is also important in creating a positive pedestrian experience in the downtown.
- **Council Member Lowenstein** commented to the author that the files above were, with navigation aids added, probably enough to be quite useful to City Council. Both she and Planning Director Hart noted their utility in considering issues involving height in the downtown as they relate to a recent city initiative to increase the residential population in the downtown. She also noted that the addition of callouts (notes) that show which buildings might contain hazardous materials, or similar information, might be helpful to firefighters and other emergency first responders. Two-dimensional interactive maps or aerials may well be sufficient for a hazardous materials inventory.
  - An I-Map based on an aerial might offer one approach. On the

    linked map

    the mouse-over callouts shows the building address for three locations. Click on a location to reveal elements of the database associated with each site. In seeing all buildings simultaneously one gets an immediate picture of adjacency patterns: for example, a fire in one building may need immediate containment on the eastern edge to prevent spread to an adjacent building on the east containing volatile material. Careful database construction is critical: the mapping, in this case, is easy in relation to the database construction.
  - A very simple approach might simply employ Adobe Photoshop (version 7.0 was used here) to work with a high quality aerial photograph of the City.

    In the

    attached aerial

    note files and voice files have been added to City Hall, to 219 S. Main, and to the central quadrangle (the "Diag") of The University of Michigan. Thus, emergency workers might have not only the benefit of reading notes attached to buildings that specify the locations of hazardous materials, but also the capability to hear voice transmissions of such locations when already in a tight spot. The drawback to this style of approach is that it requires the user to download the file and open it in Adobe Photoshop (or use some similar strategy to read the notes). If, however, the emergency management team already has Photoshop loaded on laptops, this is not much of a disadvantage. Indeed, it might be viewed as an advantage in file security given that it does not play directly on the Internet.
- **Planning Director Hart**, noted in addition, the importance of modeling upper story setbacks as a next step. She also suggested possible specific locations in the downtown where VR might be particularly helpful, including in the modeling of various aspects of long-standing plans for a renovation of governmental space. As convincing and as helpful as virtual reality can be, it is however, only virtual. When one walks away, it remains only in the mind. Another exciting technological tool that the group saw is the 3D "printer" that creates true 3D objects representing the experienced virtual reality. Hart also noted that she could see numerous uses for this tool. Indeed, sometimes the end desired suggests the process to get there, not only in master planning and other forms of planning, but also in the tools used in planning.

The display below presents the final experiments in this set (given to Ann Arbor City Council in December of 2003) as the first in a series of possible 3D mapping tools to aid in making a variety of difficult decisions: for Ann Arbor as well as more globally. It includes parcels extruded from building footprints, with the sun set in the south at a "low" setting, using an invisible topographic base created from a TIN made from a topographic map with a contour interval of 5 feet. Buildings have been adjusted using a *z*-factor of 0.3048. It also includes street labels that appear as one moves around at a local level as well as navigation aids (click in the lower left corner of Cosmo Player) of assigned camera viewpoints. These, coupled with using the "driving" capability of Cosmo Player, help in getting around the virtual downtown so that one does not get lost in the space of virtual Ann Arbor!

VR 10: this virtual model of downtown Ann Arbor shows views of the downtown

- from the south, along a corridor between Division and State streets
- from the south, looking north along the Main Street corridor
- from the east, looking west along the Huron Street corridor, at pedestrian level.

Use the list of viewpoints in the lower left-hand corner to be taken to these three different camera positions. Also, use the tools in Cosmo Player to structure your own route through the downtown at a bird's eye or human's eye level.

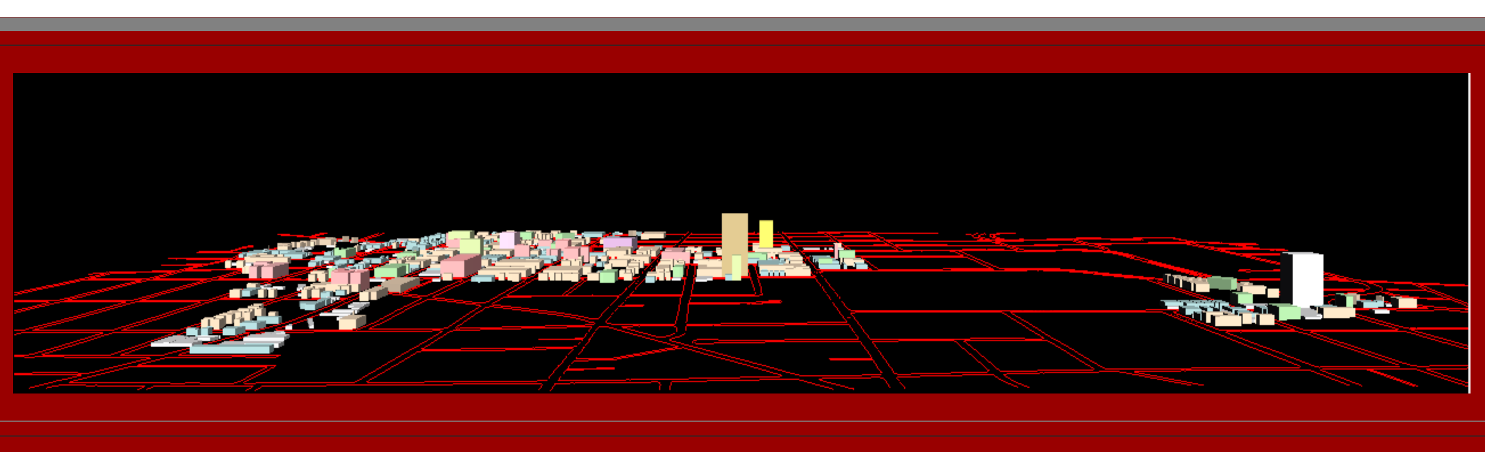
Labels on the streets will appear as one zooms in. Some graphic tasks that are easily accomplished in a GIS are not so easily accomplished in virtual reality. The lettering for these labels was made in a polygon layer of ArcView by tracing default lettering. Automatic labels that are easy to produce in a 2D map do not reproduce in the 3D version. Thus, as with the building footprints, digitizing letters will make them appear. In the process of digitizing letters such as "B" or "D," one might be reminded of converting a multiply connected domain to a simply connected domain and consequently the Jordan Curve Theorem from topology or the Cauchy-Goursat Theorem (or others) from the theory of functions of a complex variable. It is remarkable to see that strong interdisciplinary connections between geography and geometry arise even in the most mundane of mapping tasks.

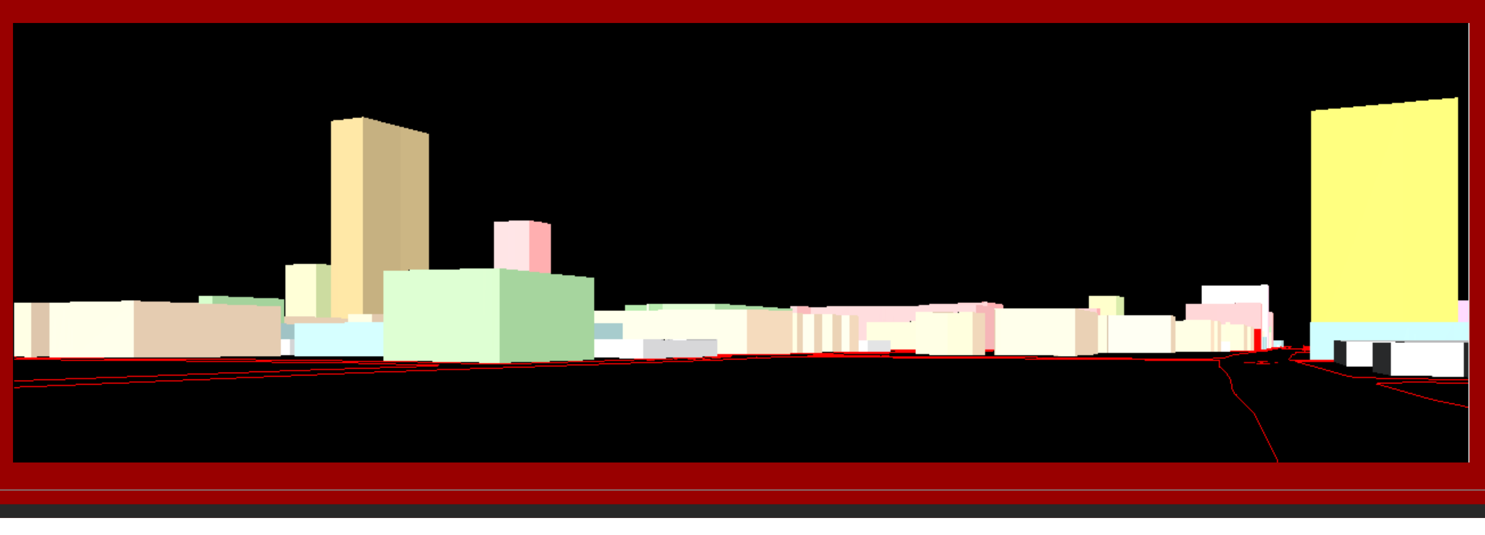
- **VR 11.1, 3 story building added at southeast corner of Huron and Fifth**
- **VR 11.2, 4 story building added at southeast corner of Huron and Fifth**
- **VR 11.3, 5 story building added at southeast corner of Huron and Fifth**
- **VR 11.4, 6 story building added at southeast corner of Huron and Fifth**
- **VR 11.5, 7 story building added at southeast corner of Huron and Fifth**
- **VR 11.6, 8 story building added at southeast corner of Huron and Fifth**
- **VR 11.7, 9 story building added at southeast corner of Huron and Fifth**
- **VR 11.8, 10 story building added at southeast corner of Huron and Fifth**
- **VR 11.9, 11 story building added at southeast corner of Huron and Fifth**
- **VR 11.10, 12 story building added at southeast corner of Huron and Fifth**

This set of files shows a sequence of views, all with the same two camera angles--the first is a view of the entire downtown and the second is a view looking west along Huron Street, from a vantage point to the east of State Street. Use the navigation system in the lower left-hand corner to see the views from these preset camera positions; they offer a standard source for comparison as one switches from model to model that the free-roaming form of navigation does not. The red building in each model is a virtual building built on the southeast corner of Huron and Fifth, across from City Hall. It is the empty spot selected by Mayor Hieftje on a number of occasions as one location to consider for building a tall building. The sequence of files shows the virtual building with different numbers of stories: 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12. The general view of the downtown suggests how the new building might or might not fit in the overall skyline view. The local view along Huron Street suggests what the pedestrian experience might be.

Figures 4a and 4b below show animated sequences of screen shots from the virtual reality files. Thus,

- **in Figure 4a, one can watch the bright red building "grow" from 3 to 12 stories, in 1 story increments, in the center of the DDA, across the street from City Hall, at the southeast corner of Huron and Fifth streets. A view such as this one suggest the impact the new building might have on the overall skyline. To get a good general picture, one might wish to have such animations from more than one vantage point and for change involving more than one building. This animation suggests a style of analysis at the global level of the entire downtown.**
- **in Figure 4b, one can watch the same building grow (as in Figure 4a, again in 1 story increments) but from a far more local viewpoint and from a level closer to a pedestrian's eye view. A sequence of such animations might be helpful in understanding the impact of new structures on the pedestrian experience.**





Next steps include:

- Field checking of building heights
- Modeling of upper story set backs

Possible future activities

- Thinning of file size based on scale.
- Produce a number of other files based on various lighting possibilities.
- Introduce cars along the streets, pedestrians on the sidewalks, and so forth.
- Model the weather (colleague John D. Nystuen suggested modeling a snow storm). Nystuen also suggested modeling the underground infrastructure.
- Consider how practical, day to day elements of decision making might be aided.
  - Might VR files serve to replace the model consideration in the PUD zoning?
  - If so, what sort of ordinance revision would be necessary and what legal ramifications might there be in such a consideration or in related ones?

    More generally, what are the legal questions involved in using VR as a planning and emergency management tool; do they differ from those associated with using 2D analysis for such purposes?

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*The author acknowledges productive meetings with and assistance from

- her colleagues on the City of Ann Arbor Planning Commission (Sandra Arlinghaus (Chair), Kevin McDonald (Vice-Chair), Scott Wade (Secretary), Braxton Blake, Jean Carlberg, Kristen Gibbs, Christopher Graham, William Hanson, and Steve Thorp);
- the Ordinance Revisions Committee of that Commission (Hanson, Chair; Carlberg, Arlinghaus, Blake);
- the City of Ann Arbor Planning Department staff (Karen Hart, Planning Director; Wendy Rampson, Coy Vaughn, Donna Johnson, Jeff Kahan, Chandra Hurd, Alexis Marcarello, Christopher Cheng, and Matthew Kowalski);
- Merle Johnson, City of Ann Arbor, Information Technology Services;
- Heather Edwards, Historic District Preservation Coordinator, City of Ann Arbor;
- Matthew Naud, Environmental Coordination Services Director and Emergency Management Director, City of Ann Arbor
- John D. Nystuen, Professor Emeritus, Taubman College of Architecture and Urban Planning, The University of Michigan
- Peter Beier, Professor of Engineering and Director, 3D Laboratory, Media Union, The University of Michigan.
- the Mayor of Ann Arbor, His Honor, John Hieftje

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Software used:

- ArcView GIS, v. 3.2, with Spatial Analyst Extension and 3D Analyst Extension. All from ESRI (Environmental Systems Research Institute, Redlands, CA). http://www.esri.com/
- ImageMapper 3.3, Alta 4, http://www.alta4.com/
- Microsoft Windows XP, http://www.microsoft.com/
- Cosmo Player, http://ca.com/cosmo/
- Adobe PhotoShop and Adobe ImageReady, versions 7.0.

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HOUSE OF REPRESENTATIVES
WASHINGTON, D.C. 20515

JOHN D. DINGELL
FIFTEENTH DISTRICT
MICHIGAN

July 15, 2003

Ms. Sandra Lach Arlinghaus
1964 Boulder Drive
Ann Arbor, Michigan 48104

Dear Ms. Arlinghaus:

I was recently informed that on your work mapping Ann Arbor's emergency sirens. With your computer mapping project, the city will be able to determine where to build their new sirens, notifying those currently out of earshot of an emergency.

Your effort is a sign of your dedication to the people of Ann Arbor and their safety. Thank you for going beyond the call of duty.

With every good wish,

Sincerely yours,

John D. Dingell
Member of Congress

Saturday, July 5, 2003.
Front page article by Tracy Davis, "A Pair of Emergency Sirens Added to Ann Arbor System," continued inside, with photos and map.
Excerpt from front page:

> Sandra Arlinghaus already spent time working with computer mapping and geographic information systems at work and in her position as chairwoman of the Ann Arbor Planning Commission, so when she heard the city was trying to figure out where to place new emergency alert sirens, she put her skills to work.
> The city's own GIS mappers and emergency directors had sent staff out to gauge how well sirens could be heard in various parts of town.
> But Arlinghaus took it a step further: She mapped the locations of Ann Arbor's existing 20 sirens, the approximate areas where they could be heard and how well. The resulting map showed overlaps and gaps that helped city emergency official determine where to place two new ones this week.

Thursday, July 19, 2003.
Opinion Column, "Cheers and Jeers," on the Editorial Page, A8.

> **Cheers**: Sandra Arlinghaus for going beyond her duties as Ann Arbor Planning Commission cha[i]rwoman by mapping on computer the location of Ann Arbor's 20 emergency sirens. Her work showed city official where the sirens could not be heard and helped them establish locations for two new sirens.