ENVIRONMENTAL STEWARDSHIP

Objective ES.1: Decrease consumption of energy and natural resources:

ES.1.a: Consumption of local vs. imported energy in Humboldt County Health and Human Services

Consumption of Local vs. Imported Energy Sources, 2003

Source	*Amount*	*MMBtu's*	*% imported*	*% local*
Gasoline	54,569,000 gal	6,275,435	100	0
Diesel	16,800,000 gal	2,184,000	100	0
Natural gas[14]	93,860,628 therms	9,386,063	89	11
Electricity	940 GWh	3,208,220	27	73
Biomass[15]	849,645 tons	5,182,919	0	100
Propane	4,210,900 gal	384,581	100	0

DATA SOURCE: Kammerer, 2005 and California Department of Conservation, 2003.

The majority of primary energy used in Humboldt County is imported, with the exception of biomass energy. Approximately 21.5% is from local renewable sources. Essentially all of the county's transportation fuels are imported. Although the majority of electricity is generated in the county, a large portion of it is generated using natural gas. The county imports about 90% of its natural gas; the rest is obtained locally from fields in the Eel River valley. The county has the capability of generating all of its own electricity. In fact, in 2001 during the California electricity crisis, Humboldt County was a net exporter of electricity. PG&E is currently soliciting offers to replace the aging 130 MW Humboldt Bay Power Plant. Replacement of this plant with local energy resources and perhaps a new, more efficient natural gas fired plant will be critical for the County to continue to meet its projected energy needs.

It is estimated that the total electricity generation from local renewable resources could provide as much as 1500 MW of generating capacity and over 6000 GWh per year of electrical energy (approximately 1100GWh are used annually). This includes power from the waves, wind, biomass, small hydroelectric and solar. This is over six times the county's current electricity consumption rate. However, there is a lot of uncertainty about how much of these resources can realistically be developed. For example, over 75% of the estimated renewable electricity resource would come from wave power, a technology that is in its early stages of development and therefore is quite uncertain. Even for well proven resources like wind, solar, and hydropower, there are many potential barriers that could impede

development, including high costs, regulatory hurdles, lack of financing, siting and transmission access issues, and lack of public support. Nonetheless, the potential of these local resources is large and offers significant economic development potential. Using local resources to meet local energy needs would keep energy dollars circulating in the local economy, and exporting local energy resources to surrounding communities could bring in a new source of income to the county.

DATA SOURCE: Humboldt County Energy Element Technical Report, Shatz Energy Research Center, Humboldt State University, October, 2005.

Why is this a community health indicator?

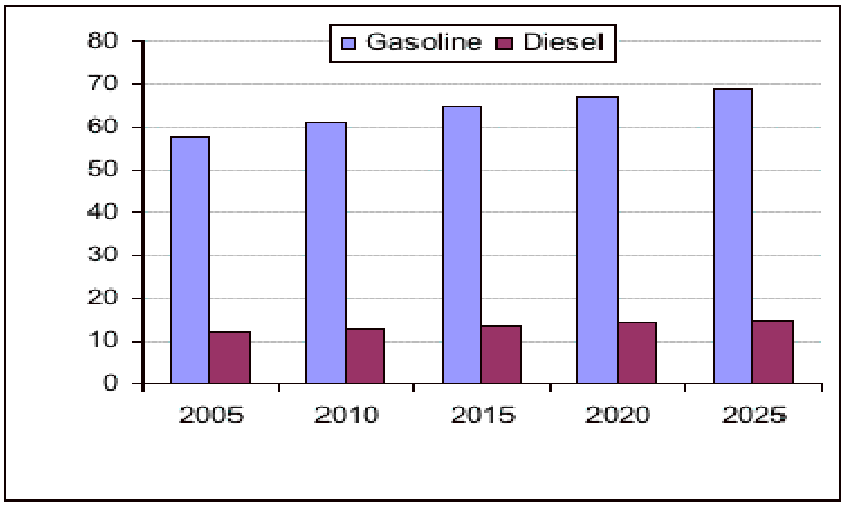
If long-term energy sustainability is achieved for the local community, the benefits will be significant. Benefits will likely include the ability to:

- Retain more energy dollars in the local economy;
- Ensure more reliable and secure energy supplies;
- Reduce the county's dependence on imported energy sources;
- Reduce the county's susceptibility to energy price shocks;
- Create jobs and diversify the economic base;
- More effectively incorporate the concerns of local citizens in energy decisions;
- Improve/maintain the quality of the environment;
- Address local and global environmental issues such as climate change; and
- Respond thoughtfully to energy projects that are proposed for the area.

ES.1.b: Proportion of electricity consumption renewably produced in Humboldt

ES1c. Motor vehicle fuel consumption in the county

Table I-11: Projected Growth in Fuel Consumption 2005-2025



Source*: Caltrans, California Motor Vehicle Stock, Travel and Fuel Forecast (MVSTAFF), November 2004*

Explanation and limitations: Gasoline and diesel consumption in Humboldt County in 2003 was about 71 million gallons. Between 1997 and 2003, consumption rose at 1.5% per year. The use of transportation fuels is closely linked to the number of vehicle miles traveled (VMT). Due to its rural nature, the county tallies more VMT than many more densely populated areas. Efforts to reduce VMT are critical to a secure energy future.

Both gasoline and diesel fuel consumption is expected to increase throughout the next 20 year period. Gasoline fuel consumption is expected to increase from 57.407 million gallons in 2005 to 68.915 million gallons in 2025, for a total compounded growth rate of 20 percent. Diesel fuel consumption is anticipated to increase from 11.928 million gallons in 2005 to 14.719 million gallons in 2025, for a total compounded growth rate of 23.4 percent.

Why is this a Community Health Indicator?
Climate change threatens health through more extreme weather events, increased air pollution, limitations on food production, increased water-borne and food-borne illnesses, and increased infectious disease vectors. For the major fossil fuels, the amounts of carbon dioxide produced for each billion Btu (British thermal units) of heat energy extracted are: 208,000 pounds for coal, 164,000 pounds for petroleum products, and 117,000 pounds for natural gas. Because natural gas is non-renewable and has relatively better environmental performance as a fuel, it will be important to conserve natural gas for the future.
The costs of fuel consumption affect the low income population disproportionately.

Objective ES.2: Restore, preserve and protect healthy natural habitats

ES.2.a Acres of public open space per 1,000 population

There are 7.5sq mi public open space/1000 persons in Humboldt County. Seventeen percent of land in Humboldt is publicly owned. Of the 2,287,000 acres, 262,000 are national forests and 15,000 are other public lands.
DATA SOURCE: NW California Resource Conservation and development Council Area Plan 2008-2013
Explanation and Limitations: The National Recreation and Parks' Association Guide publishes standards for cities regarding open space.
Why is this a Community Health Indicator?
Many residents of Humboldt County value the open space available here. Parks and natural open space areas promote physical activity and social interaction. Areas with natural vegetation also have direct effects on physical and mental health. One review of studies showed that access to places for physical activity combined with outreach and education can produce a 48% increase in the frequency of physical activity.[a] Exposure to greenery and the natural world has additional benefits to health. More generally, living in proximity to green space is associated with reduced self-reported health symptoms, better self-rated health, and higher scores on

general health questionnaires.[b] Trees and green space also improve the physical environment by removing air pollution from the air and mitigating the urban heat island effect produced by concrete and glass.[c]

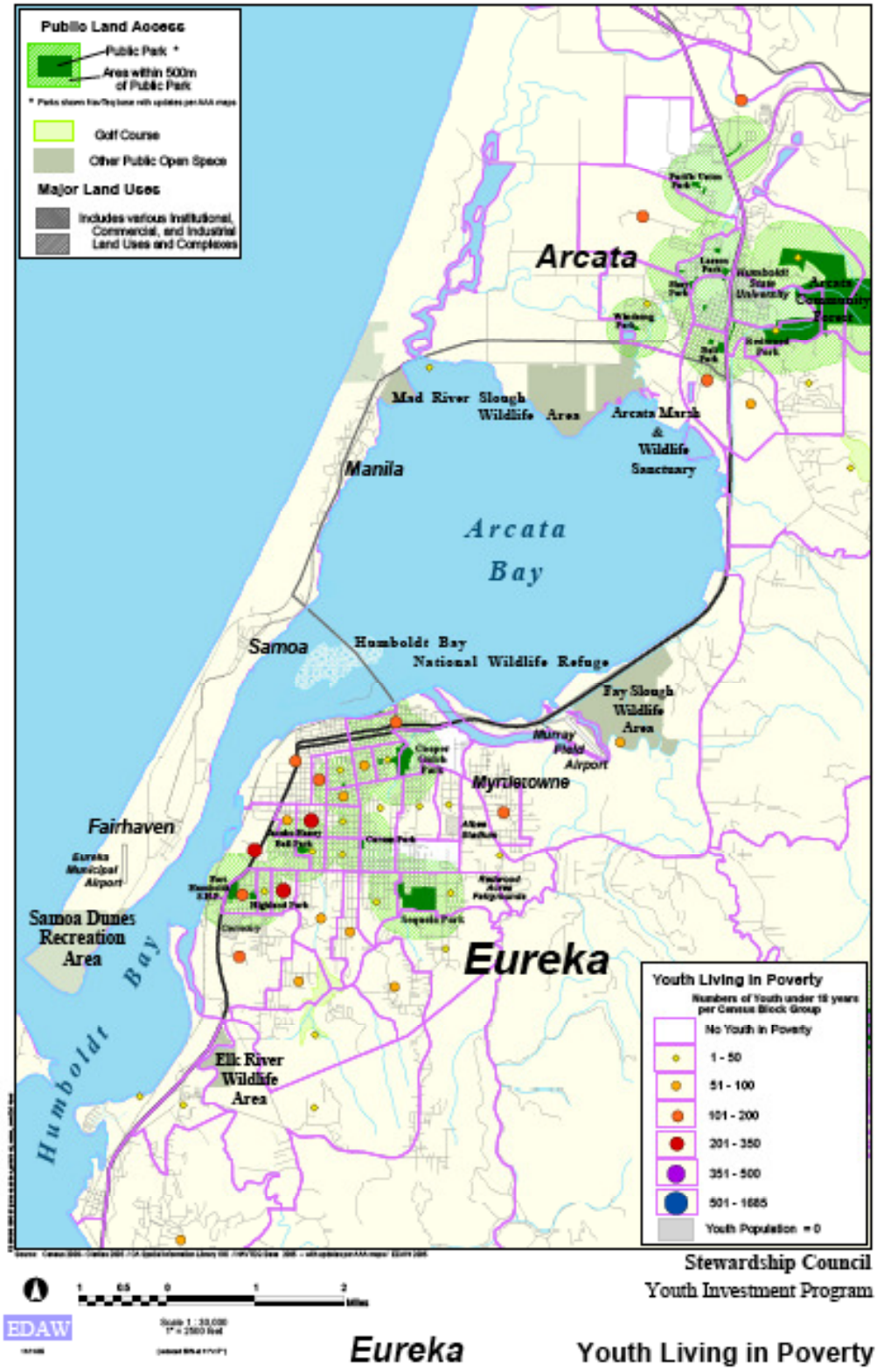
a. Kahn EB. The effectiveness of interventions to increase physical activity. Am J Prev Med. 2002;22(4):73-107.

b. Vries S, de Verheij RA, Groenewegen PP, Spreeuwenberg P. Natural environments - healthy environments? An exploratory analysis of the relationship between green space and health. Environment and Planning A. 2003;35(10):1717-1731.

c. Parks for People: Why America Needs more City Parks and Open Space. San Francisco: The Trust for Public Land, 2003.

Figure ES.2. A map overlaying parks with areas of poverty in Eureka and Arcata.[1]

[1] http://www.stewardshipcouncil.org/youth_investment/gis_maps/Loc-Eureka_youth-povdot_22x34.pdf.


Public Land Access
Public Park *
Area within 500m of Public Park
* Parks shown from Bing base with updates per AAA maps
Golf Course
Other Public Open Space
Major Land Uses
Includes various institutional, Commercial, and Industrial Land Uses and Complexes
Arcata
Mad River Slough Wildlife Area
Arcata Marsh & Wildlife Sanctuary
Manila
Arcata Bay
Samoa
Humboldt Bay National Wildlife Refuge
Fay Slough Wildlife Area
Murray Field Airport
Myrtletowne
Fairhaven
Eureka Municipal Airport
Samoa Dunes Recreation Area
Eureka
Humboldt Bay
Elk River Wildlife Area
Youth Living in Poverty
Numbers of Youth under 18 years per Census Block Group
No Youth in Poverty
1 - 50
51 - 100
101 - 200
201 - 350
351 - 500
501 - 1685
Youth Population = 0
Stewardship Council
Youth Investment Program
EDAW
Eureka
Youth Living in Poverty

Objective ES.3: Promote food access and sustainable urban and rural agriculture and timber production

ES.3.a Proportion of County land area retained for active farming uses

In 2002 there were 633,931 acres of farm land, accounting for 28% of Humboldt acreage. Cattle accounted for 17%, Milk Products for 36%, Nursery Products for 30% and miscellaneous crops for 17%.
As of August 2007 there were 17,879 acres certified as organic (15,479 prime farm land and 2400 acres range land).
The Williamson Act covers 8.68% of the acreage in the County.
DATA SOURCE: Northwest California Resource Conservation and Development Council Area Plan 2008-2013

Explanation and Limitations: The Williamson Act provides for lowered property taxes for lands maintained in agricultural and certain open space uses. The landowner enters into a contract with the county or city to restrict land uses to those compatible with agriculture, wildlife habitat, scenic corridors, recreational use, or open space. In return, the local authorities calculate the property tax assessment based on the actual use of the land instead of its potential value assuming full commercial development. To be eligible, the land must be designated by a city or county as agricultural preserve, scenic highway corridor, or wildlife habitat area; or it must be actively used for the three years immediately preceding the beginning of the contract as a salt pond, managed wetland, or recreational or open space area.

Each year the contract is automatically renewed for a new ten-year period, unless the landowner notifies the local government of a desire not to renew. In that case, the land use restrictions remain in effect until the remaining nine years of the contract have passed. There are also provisions for cancelling the contract if cancellation is consistent with the purposes of the Williamson Act or otherwise found to be in the public interest. A cancellation fee and deferred taxes, which under some circumstances can be waived, must be paid upon cancellation.

Why is this a community health indicator? Agriculture is an important part of the economic base of Humboldt County, including many small producers and self-employed. Productive farming land is part of what many local residents value about Humboldt County. Consumption of locally produced foods can reduce consumption of fossil fuels and reduce potential for global warming. Due to the rural nature and geographic location of the Area, transportation of agricultural and industrial products to larger marketing areas within and outside of California is difficult and expensive, since most goods must be shipped over a mountainous or coastal highway to reach a major market area. Getting the crop from seed to harvest takes only one-fifth of the total oil used for our food. Most is consumed transporting food from the point of production to the point of consumption. (Animal, Vegetable, Miracle , B Kingsolver, Harper Collins Publishers, 2007, p. 5.)

Importing food from other countries exposes the consumer to food produced under regulations concerning pesticides and production that may not be as vigorous as standards in this country.

Large commercial farming operations are the exception rather than the norm with smaller family farms making up the majority of agricultural operations in the Area. Livestock related operations, including the dairy industry and beef cattle operations, are the most significant agricultural contributors to the local economies within the region. Other significant agricultural operations are nursery crops that include lily bulbs and woody ornamentals, pasture and hay land crops, and to a lesser extent, vegetable row crops, orchards and vineyards. Small family farm operators are finding it difficult to stay competitive due to several limiting factors, not the least of which include higher operating and transportation costs to sell their products regionally or having to ship their products to larger market areas within or outside of California. Small farm operators are looking for ways to diversify their product lines and simplify marketing methods in order to offset their escalating operating costs. Direct farmer-to-consumer marketing methods have the greatest potential for growth and success within the RC&D Area.

Existing conditions

Amount and conversion of farmlands: In 2002 there were 633,931 acres of farm land, accounting for 28% of Humboldt acreage. Cattle accounted for 17%, Milk Products for 36%, Nursery Products for 30% and miscellaneous crops for 17%. As of August 2007 there were 17,879 acres certified as organic (15,479 prime farm land and 2400 acres range land)[2].

Humboldt 2025 General Plan Update Agricultural Resources and Policies report available at http://co.humboldt.ca.us/planning/gp/pdf/agrprt_2.pdf is a valuable resource for those interested in agricultural lands in the County. It contains a detailed breakdown of these lands by location and use as well as a detailed economic analysis. The report states that Humboldt ranked 36th in the state for gross value of agricultural production (excluding timber). The crops that produced the most value were: milk and diary products ($43 million), nursery stock (i.e., flowers and trees for sale to nurseries) ($34 million), livestock ($23 million), and field crops ($8 million). The report also includes information on farm size and agricultural land conversion. Based on the work of Smith and Giraud[3], it estimates that 60,500 acres of agricultural land was converted to other uses between 1985 and 2001. That land was used for subdivisions, was rezoned, or was used for other purposes. The figure below is a map from the report that shows the lands that were converted and for what purposes.[4]

[2] Northwest California Resource Conservation and Development Council Area Plan 2008-2013
[3] Michael Smith & Deborah Giraud; Traditional Land Use Planning Regulations and Agricultural Land Conversion, 2001.
[4] Humboldt 2025 General Plan Update Agricultural Resources and Policies report available at http://co.humboldt.ca.us/planning/gp/pdf/agrprt_2.pdf.

Figure ES.1. Conversion of agricultural lands in Humboldt County, 1985-2001.[5]

[5] Humboldt 2025 General Plan Update Agricultural Resources and Policies report available at http://co.humboldt.ca.us/planning/gp/pdf/agrprt_2.pdf.

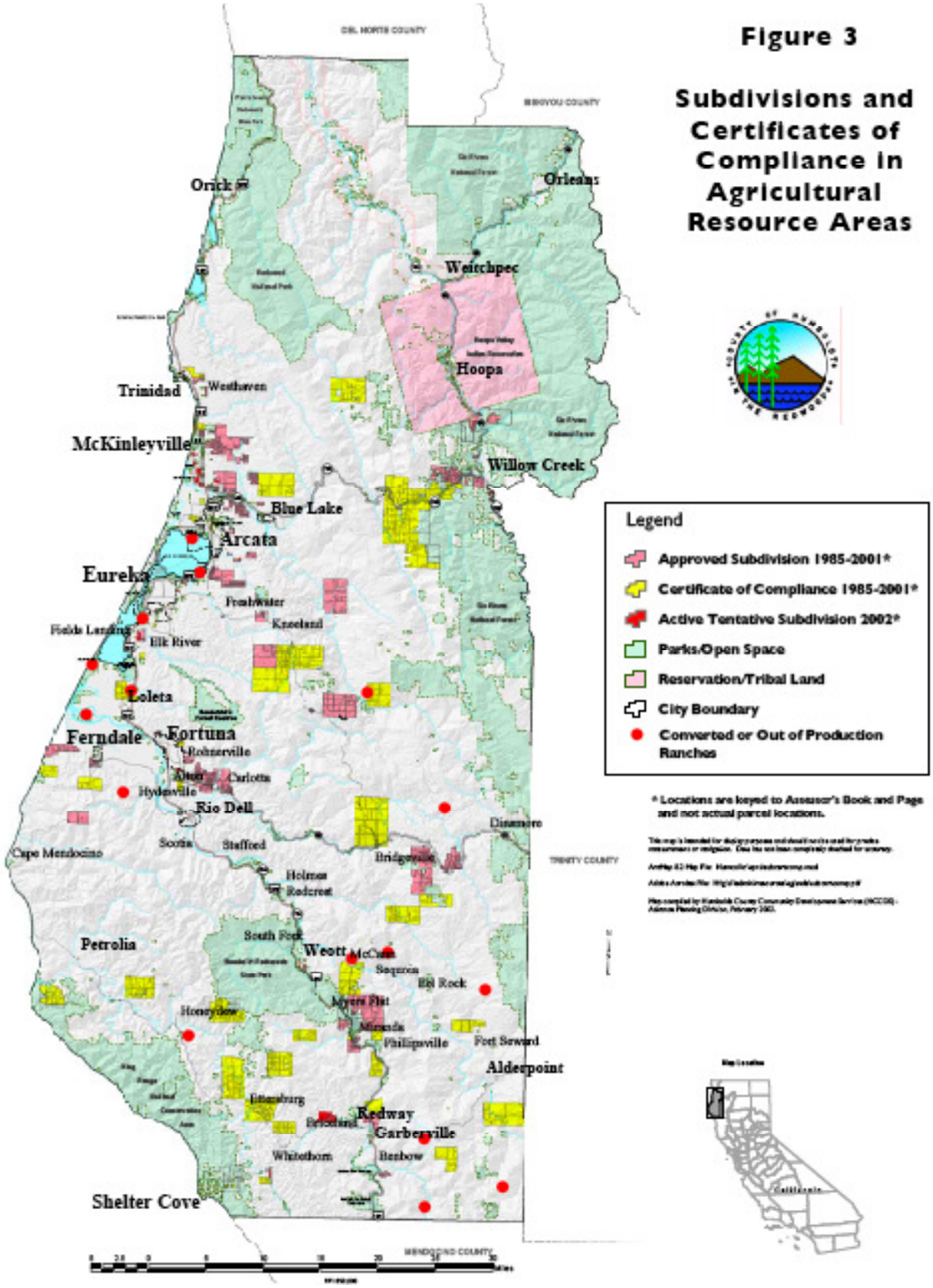


Figure 3
Subdivisions and Certificates of Compliance in Agricultural Resource Areas
Orick
Orleans
Weitchpec
Hoopa
Trimidad
Westhaven
McKinleyville
Willow Creek
Blue Lake
Arcata
Eureka
Freshwater
Kneeland
Fields Landing
Elk River
Loleta
Ferndale
Fortuna
Rohnerville
Carlotta
Hydesville
Rio Dell
Scotia
Stafford
Cape Mendocino
Dinsmore
Bridgeville
Holmes
Redcrest
Petrolia
South Fork
Weott
Sequoia
Elk Rock
Honeydew
Myers Flat
Miranda
Phillipsville
Fort Seward
Alderpoint
Redway
Garberville
Whitethorn
Benbow
Shelter Cove
Legend
Approved Subdivision 1985-2001*
Certificate of Compliance 1985-2001*
Active Tentative Subdivision 2002*
Parks/Open Space
Reservation/Tribal Land
City Boundary
Converted or Out of Production Ranches
* Locations are keyed to Assessor's Book and Page and not actual parcel locations.

Analysis

Assumptions

- Lands not currently designated as agriculture lands will be converted to that use.
- There will be a continued market for agricultural products.
- With escalating transportation costs and consciousness about global warming local consumer interest in local products will grow.

Logic

- Agricultural acreage has been declining in recent history.
- There is a recent increase in interest in purchase of locally produced foods.
- Getting crops from seed to harvest takes only one-fifth of the total oil used for our food. Most in consumed transporting food from the point of production to the point of consumption.
- Only certain areas in the County have soils suitable for farming; zoning should be preserved when possible.

ES.3.b Proportion of County land area retained for timber production

In 1996 Humboldt County had 1,487,000 acres forest lands(65% of total acreage): 262,000 were National Forests, 15,000 other public lands, 608,000 forest industry, 602,000 farmer and other private. (1)

In 1967 there were 1,850,000 acres of forested area, 81% of the total land. At that point, 1,700.000 cares were commercial, 47,000 productive reserved forest in State parks and 102,000 was unproductive forest land.

From 1948 to 1967 the redwood-type acreage on commercial forest land in Humboldt County decreased 30 Percent; Douglas-fir and Sitka spruce acreages combined increased 20 percent and hardwood-type and nonstocked acreages combined increased about 3 percent. (2)
DATA SOURCE: (1) Fire and Resource Assessment Program – California Dept of Forestry and Fire Protection

(2) Preliminary Timber Resource State for Humboldt County California, Daniel Oswald, SFS Resource Bulletin PNW-23, 1968

(3)

Why is this a community health indicator? Timberland preservation is important for long-term economic utilization and to actively enhance and increase county timber production capabilites. Further declines in timber production reduce the viability of the local forest industry, diminish economic productivity and result in job losses. Forestland fragmented into small parcels cannot economically sustain timber production as the primary use. Property improvements for residential purposes can increase the market value of the land so that it is cost prohibitive for use as commercially viable forest land. Residential uses can reduce the long-term productivity of adjacent timberlands when increased regulatory restrictions are imposed on

harvesting to moderate impacts to residential users. Timberlands may contain sensitive habitats of threatened and endangered species, sensitive watersheds or critical water supply areas.

ES.3.c Percent of food consumption of food produced within the County

Health-Based Rationale

Objective ES.4: Preserve clean air quality

ES.4.a Maintenance of compliance with federal and state air quality standards for toxics and criteria pollutants by jurisdiction INCOMPLETE

DATA SOURCE Rick Martin, Air Quality Management District

Pollutant sources are traffic, dust from unpaved roads, salt air and controlled burns.

Information on air releases is contained in the Aerometric Information Retrieval System (AIRS), a computer-based repository for information about air pollution in the United States. This information comes from source reports by various stationary sources of air pollution, such as electric power plants, steel mills, factories, and universities, and provides information about the air pollutants they produce. In AIRS, these sources are known as facilities, and the part of AIRS associated with data about sources is called the AIRS Facility Subsystem, or AFS. The information in AFS is used by states to prepare State Implementation Plans to track the compliance status of point sources with various regulatory programs, and to report air emissions estimates for pollutants regulated under the Clean Air Act. Source: US Environmental Protection Agency, Air Releases (AIRS/AFS). Accessed at: http://www.epa.gov/enviro/html/airs/index.html

As noted by the CA Air Resources Board, "Emissions Are Not the Same as Exposure:... Emissions alone do not fully represent where and what extent of exposures to air pollution or possible health risks may occur. Weather and wind can result in exposures that occur in different locations from where the emissions actually occurred, and can create new pollutants due to chemical reactions in the atmosphere. Also, a larger number for emissions of a particular chemical may not be as important as smaller amounts of more potent chemicals. While air pollutant emissions information can serve as an indicator of local air pollution, it is the exposure to emissions that influences health effects.

Exposure is the amount of pollution that someone actually breathes or otherwise ingests at different locations. Exposure varies with how far away the source is, how the emissions are released into the air and dispersed by the wind, and in what locations a person spends their time doing various activities. Exposure to air pollutants can also occur from indoor sources such as cooking, cleaning, and smoking...

The importance of the exposure to health risk also depends on the combination of multiple air pollutants, the relative toxicity of the pollutants, and many other factors.

ES.4.b Proportion of population living on unsurfaced roads INCOMPLETE

Data/Source: Tom Mattson, Director of Humboldt County Public Works Department, reports there are approximately 200 miles of unimproved roads in the County.
Explanation and Limitations: This figure is an approximation. Data is not available to calculate the proportion of population living on unsurfaced roads.
Why is this a community health indicator? According to Rick Martin, Director of the Northern California Air Quality Management District, dust is a significant contributor to air pollution in Humboldt County. High PM 10 or 2.5 measures reflect high amounts of particulate matter in the air, which can adversely affect people with chronic lung disease, asthma, young children and the elderly, increasing their need for medication, health care and hospitalizations.

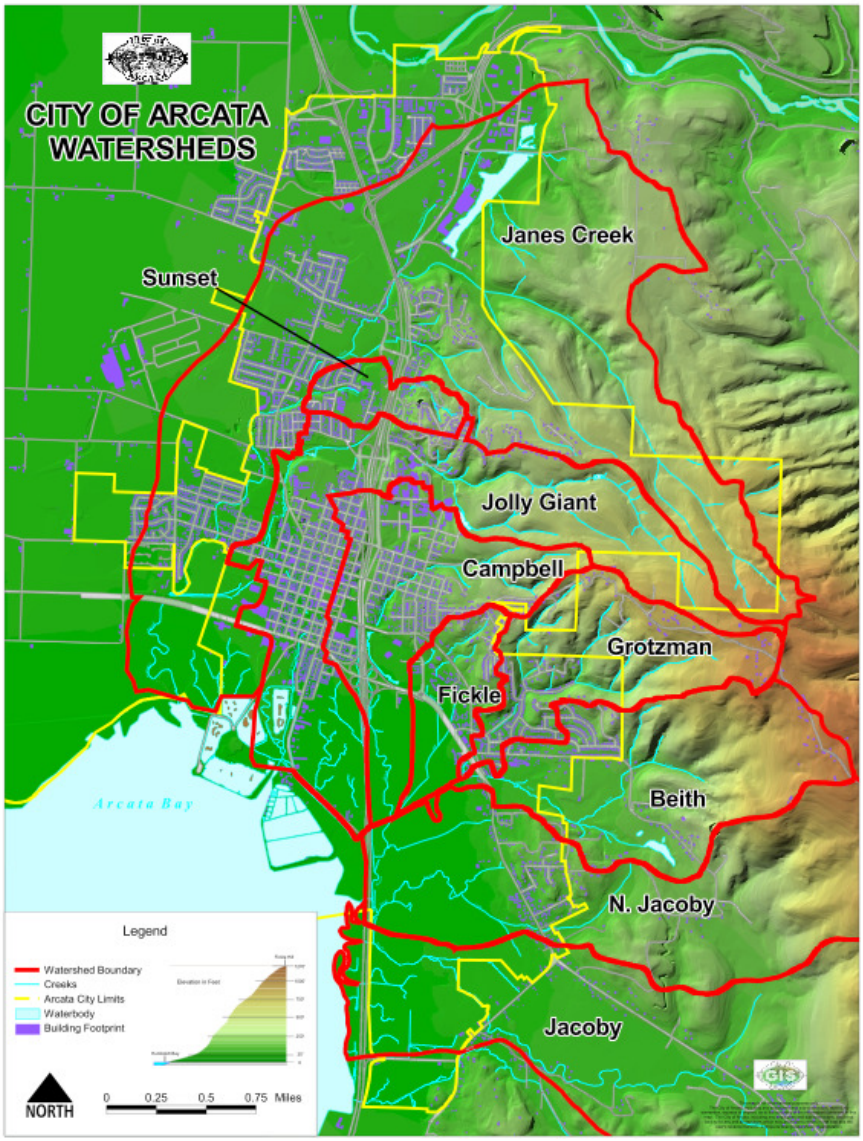
Objective ES.5: Preserve water quality

ES.5.a Total Impervious Area (TIA) 10% TIA is suggested for stability.

Campbell Creek Watershed: TIA 35%
Janes Creek Watershed: TIA 12%
Jolly Giant Creek Watershed: TIA 20%
Beith Creek Watershed: TIA 6%
Grotzman Creek Watershed: TIA 11%
Fickle Hill Creek Watershed: TIA 20%
Sunset Creek Watershed: TIA 32%

. A map showing the watersheds near Arcata.[6]

[6] DATA SOURCE: Mark Andre, Environmental Services, City of Arcata



DATA SOURCE: Mark Andre, Environmental Services, City of Arcata

Explanation and Limitations: Total impervious are is composed of rooftop and transport (e.g. roads and driveways) components. The roof top component is typically disconnected impervious area where runoff is captured by yards and given opportunity to infiltrate. Transport imperviousness is directly connected to drainage systems and often results in greater hydrologic impact than rooftop imperviousness.

As TIA increases, less precipitation infiltrates soil during a storm event, increasing the volume of surface runoff. Streams can flood. Soil retains less moisture to support plant life between rain storms, and there is a reduction of natural groundwater storage available for summer base flow.

Stream research generally indicates that certain zones of stream quality exist, most notably at about 10% impervious cover, where sensitive stream elements are lost from the system. ***A second threshold appears to exist at around 25 to 30% impervious*** cover, where most indicators of stream quality consistently shift to a poor condition (e.g., diminished aquatic diversity, water quality, and habitat scores). Table 1 reviews the key findings of recent research regarding the impacts of urbanization on aquatic systems.

Table 1. Review of Key Findings of Recent Research Examining the Relationship of Urbanization on Aquatic Systems

Watershed Indicator	*Key Finding*	*Reference*	*Year*	*Location*
Aquatic insects	Negative relationship between number of insect species and urbanization in 21 streams.	Benke, *et al.*	1981	Atlanta
Aquatic habitat	There is a decrease in the quantity of large woody debris (LWD) found in urban streams at around 10% impervious cover.	Booth, *et al.*	1996	Washington
Fish, habitat & channel stability	Channel stability and fish habitat quality declined rapidly after 10% impervious area.	Booth	1991	Seattle
Fish, habitat	As watershed population density increased, there was a negative impact on urban fish and habitat	Couch, *et al.*	1997	Atlanta
Aquatic insects and fish	A comparison of three stream types found urban streams had lowest diversity and richness	Crawford & Lenat	1989	North Carolina
Stream temperature	Stream temperature increased directly with subwatershed impervious cover.	Galli	1991	Maryland
Aquatic insects	A significant decline in various indicators of wetland aquatic macroinvertebrate community health was observed as impervious cover increased to levels of 8-9%.	Hicks & Larson	1997	Connecticut
Insects, fish, habitat water quality, riparian zone	Steepest decline of biological functioning after 6% imperviousness. There was a steady decline, with approx 50% of initial biotic integrity at 45% impervious area.	Horner, *et al.*	1996	Puget Sound Washington
Aquatic insects and fish	Unable to show improvements at 8 sites downstream of BMPs as compared to reference conditions.	Jones, *et al.*	1996	Northern Virginia
Aquatic insects	Urban streams had sharply lower insect diversity with human population above 4/acre. (About 10%)	Jones & Clark	1987	Northern Virginia
Aquatic insects & fish	Macroinvertebrate and fish diversity decline significantly beyond 10-12% impervious area.	Klein	1979	Maryland
Aquatic insects	Drop in insect taxa from 13 to 4 noted in urban streams.	Garie and McIntosh	1986	New Jersey
Fish spawning	Resident and anadromous fish eggs & larvae declined in 16 streams with > 10% impervious area.	Limburg & Schmidt	1990	New York

Fish	Shift from less tolerant coho salmon to more tolerant cutthroat trout pop.-between 10-15% impervious area at 9 sites.	Luchetti & Fuersteburg	1993	Seattle
Stream channel stability	Urban stream channels often enlarge their cross-sectional area by a factor of 2 to 5. Enlargement begins at relatively low levels of impervious cover.	MacRae	1996	British Columbia
Aquatic insects & stream habitat	No significant difference in biological and physical metrics for 8 BMP sites versus 31 sites without BMPs (with varying impervious area).	Maxted and Shaver	1996	Delaware
Insects, fish, habitat, water quality, riparian zone	Physical and biological stream indicators declined most rapidly during the initial phase of the urbanization process as the percentage of total impervious area exceeded the 5-10% range.	May, *et al.*	1997	Washington
Aquatic insects and fish	There was significant decline in the diversity of aquatic insects and fish at 10% impervious cover.	MWCOG	1992	Washington, DC
Aquatic insects	As watershed development levels increased, the macroinvertebrate community diversity decreased.	Richards, *et al.*	1993	Minnesota
Aquatic insects	Biotic integrity decreases with increasing urbanization in study involving 209 sites, with a sharp decline at 10% I. Riparian condition helps mitigate effects.	Steedmen	1988	Ontario
Wetland plants, amphibians	Mean annual water fluctuation inversely correlated to plant & amphibian density in urban wetlands. Declines noted beyond 10% impervious area.	Taylor	1993	Seattle
Wetland water quality	There is a significant increase in water level fluctuation, conductivity, fecal coliform bacteria, and total phosphorus in urban wetlands as impervious cover exceeds 3.5%.	Taylor, *et al.*	1995	Washington
Sediment loads	About 2/3 of sediment delivered into urban streams comes from channel erosion.	Trimble	1997	California
Water quality-pollutant conc.	Annual P, N, COD, & metal loads increased in direct proportion with increasing impervious area.	US EPA	1983	National
Fish	As watershed development increased to about 10%, fish communities simplified to more habitat and trophic generalists.	Weaver	1991	Virginia
Aquatic insects & fish	All 40 urban sites sampled had fair to very poor index of biotic integrity (IBI) scores, compared to undeveloped reference sites.	Yoder	1991	Ohio

http://www.stormwatercenter.net/monitoring%20and%20assessment/imp%20cover/impercovr%20model.htm

Taking all the research together, it is possible to construct a simple urban stream classification scheme based on impervious cover and stream quality. This simple classification system contains three stream categories, based on the percentage of impervious cover. **Figure 1** illustrates this simple, yet powerful

model that predicts the existing and future quality of streams based on the measurable change in impervious cover.

The model classifies streams into one of three categories: sensitive, impacted, and non-supporting. Each stream category can be expected to have unique characteristics as follows:

Sensitive Streams. These streams typically have a watershed impervious cover of zero to 10 percent. Consequently, sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however these streams are often expected to recover.

Impacted Streams. Streams in this category possess a watershed impervious cover ranging from 11 to 25 percent, and show clear signs of degradation due to watershed urbanization. The elevated storm flows begin to alter stream geometry. Both erosion and channel widening are clearly evident. Streams banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with most sensitive fish and aquatic insects disappearing from the stream.

Non-Supporting Streams. Once watershed impervious cover exceeds 25%, stream quality crosses a second threshold. Streams in this category essentially become conduits for conveying stormwater flows, and can no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, downcutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated and the substrate can no longer provide habitat for aquatic insects, or spawning areas for fish. Water quality is consistently rated as fair to poor, and water recreation is no longer possible due to the presence of high bacterial levels. Subwatersheds in the non-supporting category will generally display increases in nutrient loads to downstream receiving waters, even if effective urban BMPs are installed and maintained. The biological quality of non-supporting streams is generally considered poor, and is dominated by pollution tolerant insects and fish.

Although the impervious cover model is supported by research, its assumptions and limitations need to be clearly understood. There are some technical issues involved in its development which are discussed below:

Limitations of the Impervious Cover Model

1. Scale effect. The impervious cover model should generally only be applied to smaller urban streams from first to third order. This limitation reflects the fact that most of the research has been conducted at the catchment or subwatershed level (0.2 to 10 square mile area), and that the influence of impervious cover is strongest at these spatial scales. In larger watersheds and basins, other land uses, pollution sources and disturbances often dominate the quality and dynamics of streams and rivers.

2. Reference condition. The simple model predicts **potential** rather than **actual** stream quality. Thus, the reference condition for a sensitive stream is a high quality, non-impacted stream within a given ecoregion or sub-ecoregion. It can and should be expected that some individual stream reaches or segments will depart from the predictions of the impervious cover model. For example, physical and biological monitoring may find poor quality in a stream classified as sensitive, or good diversity in a non-supporting one. Rather than being a shortcoming, these "outliers" may help watershed managers better understand local watershed and stream dynamics. For example, an "outlier" stream may be a result of past human disturbance, such as grazing, channelization, acid mine drainage, agricultural drainage, poor forestry practices, or irrigation return flows.

3. Statistical variability. Individual impervious cover/stream quality indicator relationships tend to exhibit a considerable amount of scatter, although they do show a general trend downward as impervious cover increases. Thus, the impervious cover model is not intended to predict the precise score of an individual stream quality indicator for a given level of impervious cover. Instead, the model attempts to predict the average behavior of a group of stream indicators over a range of impervious cover. In addition, the impervious cover thresholds defined by the model are not sharp breakpoints, but instead reflect the expected transition of a composite of individual stream indicators.

4. Measuring and projecting impervious cover. Given the central importance of impervious cover to the model, it is very important that it be accurately measured and projected. Yet comparatively relatively little attention has been paid to standardizing techniques for measuring existing impervious cover, or forecasting future impervious cover. Some investigators define impervious cover as "effective impervious area" (i.e., impervious area not directly connected to a stream or drainage system) which may be lower than total impervious cover under certain suburban or exurban development patterns (Sutherland, 1995).

5. Regional adaptability. To date, much research used to develop the model has been performed in the mid-Atlantic and Puget Sound eco-regions. In particular, very little research has been conducted in western, midwestern, or mountainous streams. Further research is needed to determine if the impervious cover model applies in these ecoregions and terrains.

6. Defining thresholds for non-supporting streams. Most research has focused on the transition from sensitive streams to impacted ones. Much less is known about the nature of the transition from impacted streams to non-supporting ones. The impervious cover model projects the transition occurs around 25% impervious cover for small urban streams, but more sampling is needed to firmly establish this threshold.

7. Influence of BMPs in extending thresholds. Urban BMPs may be able to shift the impervious cover thresholds higher. The ability of the current generation of urban BMPs to shift these thresholds however, appears to be very modest according to several lines of evidence. First, a handful of the impervious cover/stream indicator research studies were conducted in localities that had some kind of requirements for urban best management practices; yet no significant improvement in stream quality was detected. Second, Maxted and Shaver (1996) and Jones, *et al.* (1996) could not detect an improvement in bioassessment scores in streams served by stormwater ponds.

8. Influence of riparian cover in extending thresholds. Conserving or restoring an intact and forested riparian zone along urban streams appears to extend the impervious cover threshold to a modest degree. For example, Steedman (1988) found that forested riparian stream zones in Ontario had higher habitat and diversity scores for the same degree of urbanization than streams that lacked an intact riparian zone. Horner, *et al.* (1996) also found evidence of a similar relationship. This is not surprising, given the integral role the riparian zone plays in the ecology and morphology of headwater streams. Indeed, the value of conserving and restoring riparian forests to protect stream ecosystems is increasingly being recognized as a critical management tool in rural and agricultural landscapes as well (CBP, 1995).

9. Potential for stream restoration. Streams classified by their potential for restoration (also known as restorable streams) offer opportunities for real improvement in water quality, stability, or biodiversity and hydrologic regimes through the use of stream restoration, urban retrofit and other restoration techniques.

10. Pervious areas. An implicit assumption of the impervious cover model is that pervious areas in the urban landscape do not matter much, and have little direct influence on stream quality. Yet urban pervious areas are highly disturbed, and possess few of the qualities associated with similar pervious cover types situated in non-urban areas. For example, it has recently been estimated that high input turf can comprise up to half the total pervious area in suburban areas (Schueler, 1995a). These lawns receive high inputs of fertilizers, pesticides and irrigation, and their surface soils are highly compacted.

Although strong links between high input turf and stream quality have yet to be convincingly demonstrated, watershed planners should not neglect the management of pervious areas. Pervious areas also provide opportunities to capture and store runoff generated from impervious areas. Examples include directing rooftop runoff over yards, the use of swales and filter strips, and grading impervious areas to pockets of pervious area. When pervious and impervious areas are integrated closely together, it is possible to sharply reduce the "effective" impervious area in the landscape (Southerland, 1995).

While there are some limitations to the application of the urban stream impervious cover model, impervious cover still provides us with one of the best tools for evaluating the health of a subwatershed. Impervious cover serves not only as an indicator of urban stream quality but also as a valuable management tool in reducing the cumulative impacts of development within subwatersheds.

Why is this a community health indicator? Urban and suburban development cause profound changes to natural watershed conditions by altering the terrain, modifying the vegetation and soil characteristics, and introducing pavement, building, drainage and flood control infrastructure. Increasing TIA increases the risk for flooding. Water may contain high concentrations of heavy metals, organic pollutants, fecal coliform bacteria, nutrients and total suspended solids. Aquatic life can be harmed. Some contaminants are human carcinogens or cause significant infections in people. Increased sediment affects salmonid and other fish population. The affects the supply of locally available food, and has added economic and cultural significance for Native Americans. Clustering development in less sensitive areas can reduce the impact of TIA on watersheds.

ES.5.b Bacterial contamination and turbidity

In Humboldt County there are 21 community Public Water System (PWS) with greater than 200 service connections. There are 25 PWS with fewer than 200 service connections.

The number of coliform failures (total coliform or e. coli) for PWS with greater than 200 service connections over last 3 years is approximately 1. The number of coliform failures (total coliform or e. coli) for PWS with fewer than 200 service connections over last 3 years is approximately 10. (In addition, there were approximately 13 failures to monitor for coliform in systems with fewer than 200 service connections over the last 3 years.)

The number of community PWS with greater than 200 service connections using surface water is approximately 6. The number of community PWS with fewer than 200 service connections using surface water is approximately 12.

The number of turbidity failures for PWS with greater than 200 service connections over last 3 years is approximately 3. The number of turbidity failures for PWS with fewer than 200 service connections over last 3 years is approximately 72.

DATA SOURCE: Craig M. Bunas, P. E., Associate Sanitary Engineer, DRINKING WATER FIELD OPERATIONS BRANCH. California Department of Public Health

Explanation and limitations: Larger public community water systems are located in more densely populated communities. Smaller PWS are in less densely populated areas.

Remote habitations may have private water systems. Data is not available for private water systems.

Why is this a Community Health Indicator? Coliform bacterial contamination of water supplies can cause significant human illness, notably diarrheal illness. Infants, young children and the elderly are particularly prone to serious complications of such illnesses, which can include death. As far as water quality is concerned, it is significantly safer to live in more densely populated areas served by larger PWS.

ES.5.c percent of households using municipal water systems

Health-Based Rationale

Water resources and water quality have been greatly affected by development. Watersheds (regions of land within which water flows down into rivers, lakes, or ocean; drainage basins) have been developed, stormwater runoff has increased, and pollution levels in water has increased. Among other environmental effects, the increase in impervious areas (most notably, roads and parking lots) leads to loss of groundwater recharge (the process by which ground water is replenished), which can reduce both residential and municipal water supplies and to increased flooding. Stormwater is often polluted by pesticides and fertilizers from homes and farms, and from oil, lead, heavy metals, and other pollutants from industry and transportation. In some parts of the California, pesticides in drinking water because of industrial agriculture is so great that by the age of 10, children have been exposed to the maximum allowable "life doses".[7] Water can also contain fecal coliform bacteria. This water can make its way into our drinking water supply, into the water used for recreation, and into the water in which we fish. Additionally, excess nutrients in water resources due to sewage and fertilizer runoff and other sources is harmful due to the resulting increase in plant growth (e.g., algae) and due to oxygen depletion, which can harm fish.

Water quality in many rivers, lakes and estuaries in the country is degraded and water can no longer be used for drinking, swimming or fishing. The EPA's 1996 National Water Quality Inventory estimates that about 40% of the bodies of water they surveyed were too polluted for such uses.[8] 59% of the North Coast Region is affected by sediment impairment.[9]

Access to clean drinking water is vital for health. Coliform bacterial contamination of water supplies can cause significant human illness, notably diarrheal illness. Infants, young children and the elderly are particularly prone to serious complications of such illnesses, which can include death. Other water contaminants can also cause disease.

As far as water quality is concerned, it is significantly safer to live in more densely populated areas served by larger PWS, as the data below shows.

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[7] Heavner B. 1999. Toxics on Tap: Pesticides in California Drinking Water Sources California Public Interest Research Group. Available at http://www.environmentcalifornia.org/reports/environmental-health/environmental-health-reports/toxics-on-tap-pesticides-in-california-drinking-water-sources. Accessed on January 21, 2008.
[8] U.S. Environmental Protection Agency. "National Water Quality Inventory: 1996 Report to Congress." 1996.
[9] Winzler & Kelly Consulting Engineers. Nov 2007. Draft Water Resources Technical Report. http://co.humboldt.ca.us/planning/gp/PrelimHearingDraft/Group7b/Water_Resource_Tech_Rpt_11_21_07.pdf.

Existing conditions

Public Water Systems: In Humboldt County there are 21 community Public Water System (PWS) with greater than 200 service connections. There are 25 PWS with fewer than 200 service connections. The lager PWSs tend to be used in more urban areas with denser populations.

Failures of the PWSs: The number of coliform failures (total coliform or e. coli) for PWS with greater than 200 service connections over last 3 years is approximately 1. The number of coliform failures (total coliform or e. coli) for PWS with fewer than 200 service connections over last 3 years is approximately 10. (In addition, there were approximately 13 failures to monitor for coliform in systems with fewer than 200 service connections over the last 3 years.) The number of community PWS with greater than 200 service connections using surface water is approximately 6. The number of community PWS with fewer than 200 service connections using surface water is approximately 12.

The number of turbidity failures (turbidity measures the amount of suspended matter/impurity in water) for PWS with greater than 200 service connections over last 3 years is approximately 3. The number of turbidity failures for PWS with fewer than 200 service connections over last 3 years is approximately 72. [10]

Data is not available for private water systems such as streams or wells, but water from wells in the County are often poor in quality and quantity.[11]

Water supply: There are currently shortages of water for domestic use in some areas of the County and these areas and the County as a whole require infrastructure development, including fixing leaks and improving storage capacity, to improve the situation and to avoid future health related issues. $180 million is needed currently to bring the sewer and water systems in the County into compliance with standards.[12]

Analysis

Assumptions

- Urban infill areas have access to Public Water Systems with greater than 200 service connections.
- Non-urban growth will occur in areas without access to a PWS with greater than 200 service connections. These include PWS with fewer connections and other water sources like streams and ponds.
- Existing municipal water supplies with infrastructure improvements can handle increased growth of urban areas.

[10] Craig M. Bunas, P. E., Associate Sanitary Engineer, Drinking Water Field Operations Branch. California Department of Public Health

[11] Winzler & Kelly Consulting Engineers. Nov 2007. Draft Water Resources Technical Report. http://co.humboldt.ca.us/planning/gp/PrelimHearingDraft/Group7b/Water_Resource_Tech_Rpt_11_21_07.pdf.

[12] Winzler & Kelly Consulting Engineers. Nov 2007. Draft Water Resources Technical Report. http://co.humboldt.ca.us/planning/gp/PrelimHearingDraft/Group7b/Water_Resource_Tech_Rpt_11_21_07.pdf.

Logic

- Homes built in existing urban areas would have access to municipal water supply; those built in non-urban areas would not.

Quantitative Analysis

Without data on the numbers of people served by different types of water systems and without data on the number of illnesses caused by water-borne contaminants over a given time period in the County, the changes in the number of people with access to public water systems or the changes in the number of people that become ill as a result of water-borne contaminants can not be quantified.

Qualitative Analysis

Water quality was a concern that was brought up in every focus group and appears to be a serious concern for residents of the County. Clean water was recognized for its contribution to food (fish), recreation, culture, and mental health (views of nature). Water diversion and conservation were raised as issues. Erosion was a concern as were stormwater runoff (impermeable surfaces) and runoff from agricultural lands. Having an emergency water supply was raised. Wastewater management was raised a number of times. Overall, water conservation was of high importance to participants.