Land&People

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Conservation by Computer

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30 Years in Florida

THE TRUST *for* PUBLIC LAND

CONSERVING LAND FOR PEOPLE

Conservation by Computer

In King County, Washington, and across the nation, computerized analysis—or "greenprinting"—is helping agencies and conservationists decide what land should be protected.

by Sandra Tassel

Green Valley Road weaves through the dark, productive bottomland of southeast King County, Washington. Roadside signs advertise brown eggs and homemade berry jams, remnants of a time when this part of the county was entirely agricultural. Other signs remind the traveler that the region is changing, with burgeoning Seattle only 45 minutes to the north. Giant real estate signs promise rural peace amid the placid Holsteins. Arched wrought-iron gates mark where a one-time farm has become a luxury residence for a commuter or telecommuter. Where the road crosses the Green River, every bridge holds another kind of sign, this one depicting a graceful salmon above the words "This stream is in your care."

Lisa Parsons has taken that message to heart. Parsons is founder and executive director of the Middle Green Coalition—composed of recreation groups, governments, and conservation nonprofits, including the Trust for Public Land, working to protect a wild, 12-mile stretch of the Green River and to guarantee that, as the region changes, the lands needed to protect the health of the river and its salmon are conserved.

While King County has been a national leader in conservation, it faces a daunting challenge in prioritizing conservation expenditures.

By way of example, Parsons takes me to a parcel of privately owned land where Icy Creek springs from a hillside quilt of leaves, moss, and ferns. Surrounded by native cedar, Douglas fir, maple, and hemlock, this clear, frigid rivulet delivers a consistent and pure supply of water to the Green River, especially important in the dry summer months. Where the creek meets the river, a state salmon hatchery also relies on the cool, clean water to fill its pond, brimming with restless, two-inch-

long salmon smolts. On the day we visited, returning salmon—nearly as long as the creek was wide—finned in the current among slick boulders. This land, says Parsons, could be developed with 28 homes.

"This place is home to bear, cougars, ospreys, eagles, pileated woodpeckers, and these incredible salmon that come all the way up the Green River through pollution and sludge to reach this stream," Parsons marvels. "It just makes sense to save land like this before it gets developed."

To Parsons and many other residents, it seems self-evident that lands such as those surrounding Icy Creek should be protected, if only for their importance to water quality and fisheries. But while King County has been a national leader in conservation, it faces a daunting challenge in prioritizing conservation expenditures.

Now an innovative GIS computer modeling approach developed by TPL and its partners is helping King County decide what lands need to be protected and why. GIS stands for Geographic Information Systems: computer-based tools for gathering and analyzing information about land and its uses. The Icy Creek watershed is one of many places that may benefit from this groundbreaking technology.

King County covers 2,130 square miles—an area the size of Delaware—from the Cascade Mountains in the east, through thick evergreen forests cut by rushing snowmelt rivers, to the densely populated shelf of coastal land that is home to Seattle and many of the county's 1.8 million residents. The county is home to five threatened or endangered species of fish that depend on clean land and water. But this is far from the only conservation need. Farms and forests are being threatened by inappropriate development. Land needs to be conserved to mitigate flooding, and a growing population is demanding more parks and trails for recreation.

PHOTO BY NATALIE B. FOBES

Covering an area the size of Delaware, urbanizing King County (previous page) is home to five threatened and endangered species of fish, such as the sockeye salmon, left. Right: Conservationist Lisa Parsons at Icy Creek.

Global positioning system (GIS) receivers are only one of the high-tech tools now used by conservationists.

How do you decide which land is most important to protect and which should be protected first with limited conservation funds? This is the problem facing the county's Water and Land Resources Division (WLRD), which must apportion limited (and shrinking) conservation dollars to five separate programs: parks and trails, ecological open space, flood control, agricultural protection, and forestry. Agency staff and elected officials have long sought an objective way to ensure that every dollar invested in purchasing, restoring, and managing land provided maximum benefit, says Mark Isaacson, assistant director of WRLD. "In the past, it was very hard to pull together our team and figure out how to divvy up a limited pot of funding," Isaacson notes. "Everyone had their priorities with good justification. Sometimes we even had several programs competing for the same money."

Fast Facts: BENEFITS OF A TPL GREENPRINT

- Identifies lands whose protection could meet multiple conservation priorities, including recreation, watershed protection, habitat preservation, and flood control.
- Offers an objective way to evaluate land for protection, helping diverse community members reach common ground on conservation priorities.
- Compares existing parks with current population and projected growth to reveal current and future park needs.
- "Living" computer models can be updated easily as data changes.
- Makes the case for conservation funding by providing a scientific, credible basis for evaluating lands to be conserved.
- Key step in a suite of conservation services that leads to conservation funding options and transactions to protect priority properties.

MAPPING CONSERVATION

TPL calls its computer mapping service for conservation "greenprinting." In turn, greenprinting is part of TPL's larger effort to help regions and communities develop a proactive conservation strategy in the face of growth. In response to local concerns, TPL has developed greenprints for cities, towns, counties, and watersheds across the country. Other county- and ecosystem-wide greenprints now under way include those for the Quinault Nation of Native Americans on Washington's Olympic Peninsula; around Biscayne Bay in Florida; in the ecosystem of Cherry Creek near Denver, Colorado; and in northwest Connecticut's Litchfield County.

The King County Greenprint is among TPL's most ambitious to date. It includes data on every parcel of land in the county—more than a half million parcels in all. The county had heard about TPL's greenprinting work and asked TPL to create a greenprint for the county. Partners in the project also included the Seattle-based firm of Jones & Jones Architects and Landscape Architects and Environmental Systems Research Institute (ESRI), the primary producer of GIS

GIS FOR CONSERVATION

Jack Dangermond, president and founder of Environmental Systems Research Institute (ESRI)—the major developer of GIS software and a TPL partner—describes GIS as the "language of geography." TPL has been assisted in its GIS work by significant support from ESRI, in the form of software, support, and advice.

At its simplest GIS is computer analysis of geographic data, often displayed in the form of a map. Information related to a place is fed into a computer. This might be basic or specialized geographic information, such as elevation, rainfall, zoning, and the location of rivers and lakes; where parks and trails are located; transportation features, such as roads and railroads; or the known habitat of endangered species. Or it might be demographic information about population, projected population growth, and zoning.

"The beauty of using GIS for analysis and modeling is that you can visualize patterns and connections," explains Breece Robertson, TPL's national GIS director. "While a two-dimensional map can show that two sections of a trail don't connect, GIS analysis can reveal the obstacles to making them connect: for example, seasonal runoff or major roads. GIS can also compare alternate scenarios to help envision the most practical solutions to conservation problems."

Although GIS has been in use for decades, its practical utility for TPL and other conservation groups has been constrained by a two major factors. For many years, complicated GIS analysis could be done only on relatively expensive com-

Breece Robertson, director of TPL GIS services.

JANE BERNARD

puters, and differences in software standards made it complicated to combine information from different sources. The emergence of powerful personal computers and the development by ESRI of advanced software tools and widely accepted data standards have put complicated GIS analysis within reach of scientists and conservationists.

Today, conservationists and environmental scientists can model complicated GIS scenarios without the help of professional computer programmers. According to ESRI's Bill Miller: "It is changing the world to have this capability in the hands of people who know the planet."

TPL's president, Will Rogers, sees GIS as a natural extension of the organization's work. "Our efforts have always been responsive to community needs and priorities," Rogers says. "GIS mapping has become an increasingly important visioning and communication tool, allowing us to capture community or regional conservation needs and visually communicate them to a wide audience. We could not have done this without ESRI's help. Jack Dangermond, Bill Miller, and many others at ESRI have demonstrated a real commitment to conservation."
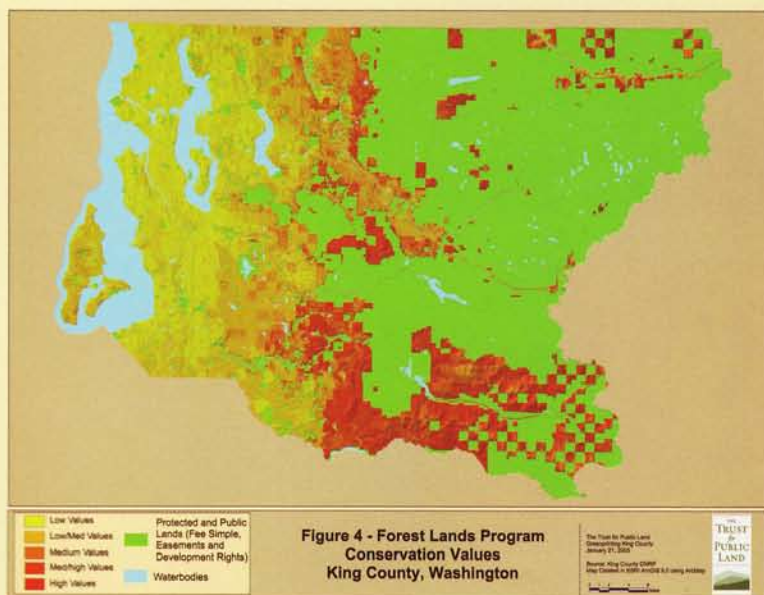

One of the maps generated during King County's greenprinting effort, showing prioritized values for forestland acquisition.

How Greenprinting Works

| ① **Data Entered for Selected Criteria**	② **Displayed as GIS Models**	③ **Weighted by Community Goals***

WATER QUALITY

- proximity to streams, wetlands, water bodies
- locations of nonpoint source pollution
- EPA-regulated streams
- aquifer recharge areas
- impervious areas

20%

PARK EQUITY

- service and accessibility of each existing park
- percentage of children under 18
- population density
- percentage of minorities
- percentage of low-income families

60%
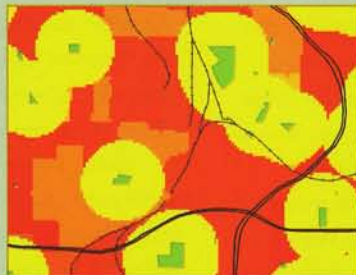
CONDUCIVENESS TO TRAIL CONNECTIONS

- landscape slope
- presence of roads, rivers, and other obstructions
- vacant parcels
- existing rights-of-way and easements
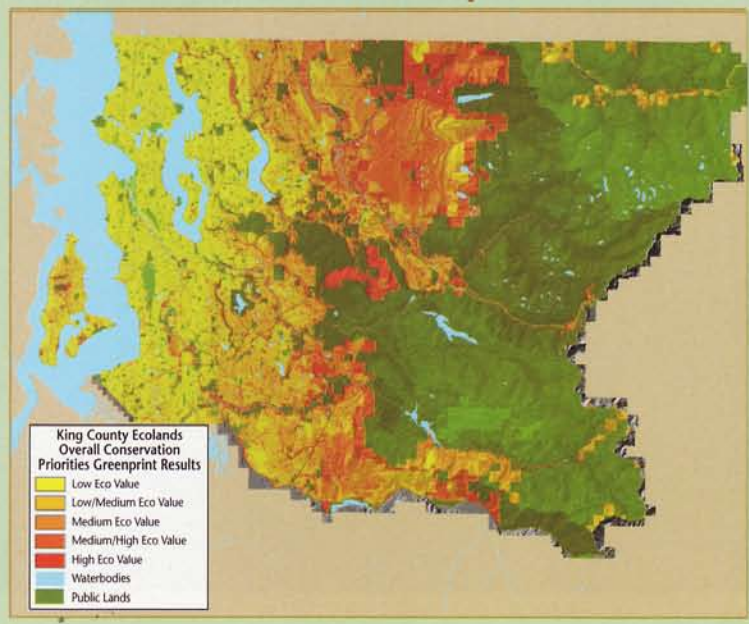
5%

WILDLIFE CONSERVATION

- known migration corridors
- habitat areas important to reproduction
- sensitive habitats
- known locations of protected species
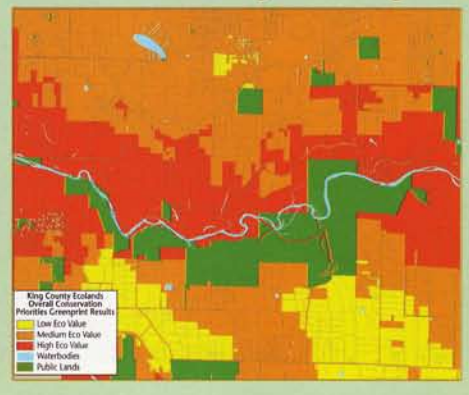- areas with unique vegetation and soils needed by species

15%
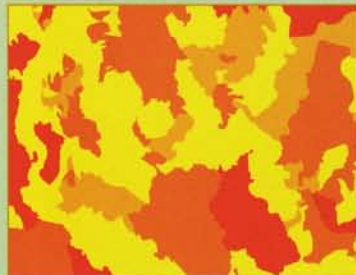
* Weighting can be changed to display alternate scenarios.

To Create Overview Maps, Parcel Priority Rankings, and Reports

Overview Map

King County Ecolands
Overall Conservation
Priorities Greenprint Results
- Low Eco Value
- Low/Medium Eco Value
- Medium Eco Value
- Medium/High Eco Value
- High Eco Value
- Waterbodies
- Public Lands

Parcel Priority Ranking

King County Ecolands
Overall Conservation
Priorities Greenprint Results
- Low Eco Value
- Medium Eco Value
- High Eco Value
- Waterbodies
- Public Lands

Sample Greenprint Report

ANALYSIS LAYER	IDENTIFIED BY MODEL		ALREADY PROTECTED		UNPROTECTED PRIORITY		UNPROTECTED & VACANT	
	# of Parcels	# of Acres	# of Parcels	# of Acres	# of Parcels	# of Acres	# of Parcels	# of Acres
Ecological Lands								
Conservation Priority								
5 (highest)	6,757	163,562	2,520	129,241	4,237	34,321	1,693	22,992
4	11,181	317,945	2,427	253,039	8,754	64,906	2,767	37,870
3	5,028	269,207	1,312	250,043	3,716	19,164	1,040	13,249
2	18,715	200,120	955	75,936	17,760	124,184	4,714	90,154
1	93,901	260,721	1,466	13,377	92,435	247,344	17,020	92,307
0 (lowest)	452,774	252,761	243	2,394	452,531	250,367	31,297	28,356
Farm Lands								
5	389	11,528	290	9,380	99	2,148	38	727
4	773	10,131	115	1,739	658	8,392	257	3,455
3	1,585	10,722	123	2,194	1,462	8,528	369	2,927
2	2,932	18,402	97	1,326	2,835	17,077	807	5,490
1	42,324	56,195	498	4,674	41,826	51,521	4,895	13,363
0	540,353	1,357,341	7,800	704,721	532,553	652,620	52,165	258,967
Flood Hazard Reduction								
5	13,230	178,228	2,483	118,210	10,747	60,018	3,159	26,487
4	10,520	278,726	2,487	221,528	8,033	57,198	2,343	5,630
3	3,946	115,968	647	63,275	3,299	52,693	978	7,018
2	6,181	321,188	1,622	290,635	4,559	30,553	1,184	24,872
1	100,709	301,639	1,460	27,045	99,249	274,594	17,263	142,755
0	453,754	266,905	216	3,290	453,538	263,615	33,600	48,160
Forest Lands								
5	2,102	247,983	674	153,968	1,428	94,015	1,098	89,692
4	2,550	232,349	1,075	181,854	1,475	50,495	915	44,407
3	5,185	199,533	951	139,318	4,234	60,215	1,543	48,540
2	24,407	275,727	1,549	202,886	22,858	72,841	5,340	28,634
1	151,618	261,475	3,188	37,424	148,430	224,051	25,232	55,006
0	402,478	245,586	1,478	8,533	401,000	237,053	24,399	18,642

The Green River flows through the forests and farms of southern King County.

> "The project encompasses not just biological data and mapping. It combines natural systems, demographics, and social and economic considerations such as park equity and development threats."
>
> Roger Hoesterey
> Director of TPL's Northwest and
> Rocky Mountain Region

software and developers of the software used in the project. "This was a tremendous partnership effort," says Breece Robertson, TPL's director of GIS, whose team also included consultants from Foresite Consulting and Earth Analytic, Inc.

To create the greenprint, Robertson and her team gathered information on topography, geology, plant and animal biology, and hydrology, along with data about population growth, zoning, and road networks, and fed it all into a greenprint model. Demographic data was added to analyze where parks were needed most. The computer was programmed to prioritize 42 different criteria that define the resources of greatest concern to the county.

After a yearlong effort all this information has now been converted into visual workflows that can be viewed as maps, revealing which parcels are most important for each of the county's programs. The results also inform DWLR which specific places would achieve the highest number of conservation objectives through protection.

MAPPING CITY PARK ACCESS

One of the most important applications of TPL's GIS modeling technique is to map where parks and open space are most needed in American cities. As part of its Parks for People initiative, TPL compares park locations with demographic data to map neighborhoods that are underserved by parks and open space—where children have no place to play within easy reach of home.

"GIS allows us to demonstrate which neighborhoods are poor and which are rich, both financially and in terms of parks," says Peter Harnik, director of TPL's Center for City Park Excellence, which is spearheading the work in partnership with TPL's GIS managers.

In Chicago, TPL's greenprint data is being used to update the city's own 1997 analysis, which compared total population with total park acreage and set the goal of providing at least two acres of parkland per thousand residents in each of Chicago's 77 neighborhoods. Such measures, however, overlook inequities of park access that can occur in any city—even one as rich in waterfront parkland as Chicago is. The city's much-publicized new

Chicago's West Lawn Ballfields, protected with TPL's help.

Millennium Park, for example, is a magnificent downtown park, but it is not located within easy reach of most Chicagoans. TPL's GIS analysis revealed that more than 45,000 Chicago children live more than a half mile from the nearest park.

"Chicago has a fabulous park system, but more than half of Chicago neighborhoods still lack adequate parks close to home," says Chris Slattery, director of TPL's Chicago office. GIS mapping allows TPL to target its project work where it is needed most—such as near Logan Square, where TPL is working with community groups to help expand an overcrowded park to serve that park-poor neighborhood's residents, including the more than 2,000 children who live within a quarter mile of the park.

In Los Angeles, TPL's greenprint analysis revealed that two-thirds of children are without access to a park, playground, or natural area. Here, TPL's Parks for People initiative has set a goal of creating 25 new parks over the next ten years. TPL Los Angeles director Larry Kaplan and his staff use the demographic data in TPL's LA greenprint to identify and prioritize neighborhoods in which to work. "It's about identifying those communities most in need," Kaplan says.

Other cities for which TPL has completed park-access greenprints include Boston, New York, San Francisco, Seattle, San Diego, Dallas, Atlanta, and Miami. Peter Harnik says that GIS maps "help people visualize the role parks play in the urban environment. TPL has always made the case that the city people need access to parks. The power of GIS maps amplifies our message."

For more information on TPL's Parks for People initiative, go to **www.tpl.org/pforp**.
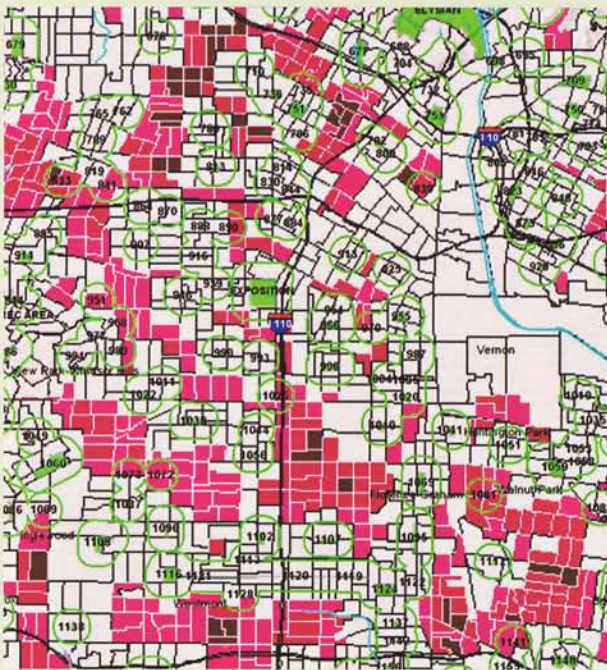
Detail of TPL map showing park needs in Los Angeles. Green circles show quarter-mile distance from existing parks. Park needs are shown in shades of red. The darker the color, the higher the need based on park location, population density, and other factors.

King County is a national conser-
vation leader. In 2001, TPL helped
the county protect a portion of
Tollgate Farm in North Bend, on
the western fringe of the Seattle
metropolitan area.

"This is the first time anyone has undertaken such a complex landscape-level analysis," says Roger Hoesterey, director of TPL's Northwest and Rocky Mountain Region. "The project encompasses not just biological data and mapping. It combines natural systems, demographics, and social and economic considerations such as park equity and development threats to help King County prioritize future acquisitions."

King County Executive Ron Sims recalls that previously the county "had no sense of which pieces were the most critical. Now we can think parcel by parcel, from the highest peaks to the bottom of Puget Sound. It is absolutely key to have that capacity because we can answer questions such as 'What land do we need for salmon?' With this tool you can really see and understand the land."

AN OBJECTIVE MEASURE OF CONSERVATION NEED

"For 20 years I've been asking for something that can help determine gaps and prioritize among choices," says Terry Lavender, who has been working on county conservation efforts for more than two decades and chairs the citizens' advisory committee for King County's Conservation Futures Fund.

The old methodology for determining protection priorities involved colored pencils and large pieces of paper, Lavender recalls. But those maps couldn't be updated—when parcels were developed, for example—as the computerized greenprint can be. "Having the ability to show people the changes is going to be very powerful," Lavender predicts. "The most important and threatened parcels are going to jump out at us and say, we need to get that conserved."

Another strength of the greenprint, Lavender points out, is that it can objectively highlight critical conservation lands that may not enjoy vocal political constituencies—places like the still sparsely settled area targeted by Lisa Parsons and the Middle Green Coalition. "A lot of really important open space doesn't have champions to push for it," she notes. "The maps will be visual champions for those places."

Kayakers on King County's Snoqualmie River. Protection of rivers and river corridors was one goal of the King County greenprinting effort.

"[With the greenprint] we can think parcel by parcel, from the highest peaks to the bottom of Puget Sound."
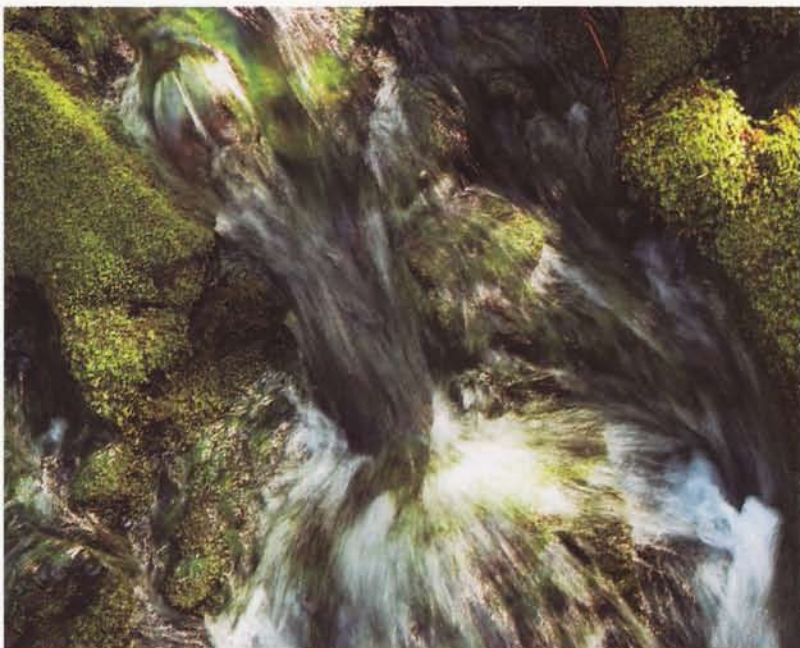
King County Executive Ron Sims

County Executive Ron Sims agrees. "Decisions have sometimes been made because a particular property had a gallant spokesperson who knew how to work the system and said 'Save this!' With the greenprint as a guide, King County will be able to respond appropriately. Sometimes the spokesperson's efforts will be rewarded and sometimes they are going to have to wait because we will be able to judge how the property fits in to the big picture."

Already the greenprint has provided important insights. TPL and consultants for the Point Wilson Group, another project partner, conducted one-on-one interviews with the leaders of 24 of the county's 39 municipalities. From this work a single map has been produced that includes a complete inventory of properties acquired by all agencies, priority acquisitions for each community, and a vision for how a regional system of parks and natural areas might be created and connected. By comparing existing parks and open space with census data, the greenprint reveals where new parks are needed to serve changing populations. And by including underwater and shoreline data, the greenprint shows what land needs to be protected to save aquatic resources and increase public access to Puget Sound.

The new greenprint is also yielding important insights for those who must prioritize conservation purchases among WLRD's five conservation programs. A TPL analysis based on the greenprint identified 30,000 acres whose conservation would serve all five of the program areas. Likewise it specified an additional 39,000 acres that could support four areas, and an additional 35,000 that would be important to at least three areas. The parcel where Icy Creek meets the Green River rates high for forestry and ecological value.

TPL is already studying how to fund an ambitious slate of priority acquisitions based on the greenprint. In the opinion of ESRI's Bill Miller, TPL's integrated

approach to conservation—its ability to follow up greenprints by helping to raise funds and complete transactions—sets the organization's work apart from other GIS efforts. "TPL integrates the process that identifies land resources with the ability to implement conservation action. Lots of advanced analysis gets done, but often nothing happens. You just get a nice plan to put on the dusty shelf with other plans. TPL takes the analysis to the ground."

Roger Hoesterey is thrilled with the greenprint for King County and its potential to aid the conservation community. He has every intention of taking it to the ground. "We can go forward with a positive message that says, 'Specific actions can preserve and improve ecological health even in a heavily developed area.' With this tool, we can help local, county, state, and federal entities work together in more strategic ways with the funds that are available. Plus, we can enhance economic development by steering growth to low-priority lands while protecting the places that preserve the character of the region."

This message is sure to be welcomed by Lisa Parsons of the Middle Green Coalition and by others racing to protect important natural resources across King County. Parsons remembers driving by the entrance to the Icy Creek headwaters parcel, seeing the subdivision notice, and saying, "You have got to be kidding! We're going to allow development of one of the most pristine places in the Green River watershed?!" With the King County GIS Greenprint to back up her passion, perhaps the next new sign will read "This property protected for salmon and the citizens of King County."

Former TPL staffer Sandra Tassel is a conservation consultant and freelance writer based in Seattle. For more information on greenprinting and GIS applications, go to **www.tpl.org/greenprinting** *and/or* **www.esri.com**.

DAN LAMONT

The King County Greenprint rates the spot where Icy Creek meets the Green River as high for forestry and ecological value.

Fast Facts: CONSERVATION SERVICES OF THE TRUST FOR PUBLIC LAND

Conservation Vision
TPL helps agencies and communities define conservation priorities, identify lands to be protected, and plan networks of conserved land that meet public need, often through the use of GIS greenprinting technology.

Conservation Finance
TPL helps agencies and communities identify and raise funds for conservation from federal, state, local, and philanthropic sources.

Conservation Transactions
TPL helps structure, negotiate, and complete land transactions that create parks, playgrounds, and protected natural areas.

Research & Education
TPL acquires and shares knowledge of conservation issues and techniques to improve the practice of conservation and promote its public benefits.