

## **2008 Project Abstract**

For the Period Ending June 30, 2011

**Project Title: Statewide Ecological Ranking of CRP and Other Critical Lands**

**Project Manager:** Greg Larson

**Affiliation:** MN Board of Water and Soil Resources

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**City / State / Zip:** St. Paul, MN 55155

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**FAX Number:** 651-297-5615

**Web Page address:** [www.bwsr.state.mn.us](http://www.bwsr.state.mn.us)

**Funding Source:** Environment and Natural Resources Trust Fund

**Legal Citation:**

**(1) M.L. 2007, Chap. 30, Sec. 2, Subd. 7**

**Appropriation Language:**

**\$160,000 is from the trust fund to an emerging issues account as authorized in Minnesota Statutes, section 116P.08, subdivision 4, paragraph (d).[\$13,000 of the total \$160,000 was allocated toward this project]**

**(2) M.L. 2008, Chap. 367, Sec. 2, Subd. 7**

**Appropriation Language:**

**\$155,000 is from the trust fund for an emerging issues account as authorized under Minnesota Statutes, section 116P.08, subdivision 4, paragraph (d).**

**(3) M.L. 2009, Chp. 143, Sec. 2, Subd. 4g**

**Appropriation Language:**

**\$107,000 is from the trust fund to the Board of Water and Soil Resources to continue the efforts funded by the emerging issues account allocation to identify and rank the ecological value of conservation reserve program (CRP) and other critical lands throughout Minnesota using a multiple parameter approach including soil productivity, landscape, water, and wildlife factors.**

**Appropriation Amount: \$275,000**

### **Overall Project Outcomes and Results**

To allocate scarce fiscal resources to natural resource programs, identifying the location and ranking the ecological value of critical lands is important. Using parameters of soil productivity, soil erosion risk, water quality risk, and habitat quality, an ecological ranking tool was developed. An economic model was also incorporated to analyze CRP (Conservation Reserve Program) parcels and determine the likelihood of contract renewal given anticipated crop prices and land quality. A parameter for soil erosion risk was developed using several factors from the Universal Soil Loss Equation. To identify lands posing a risk to water quality, or lands that are most likely to contribute overland runoff to surface waters, terrain analysis was used. Runoff rankings from terrain analysis were then integrated with a proximity analysis of surface water features based

on DNR 24k surface water data. A parameter for habitat quality was derived from an update to the work done as part of the Minnesota Conservation and Preservation Plan (LCCMR, 2008). Combining the data sets therein, and assessing them with a “weight of evidence” approach, produced a ranking of wildlife quality. These several parameters were combined into an environmental benefits index (EBI). High EBI translates into high risk. Therefore, a high EBI score implies a site has a high value for conservation. CRP or other parcels deemed critical for conservation can be assessed simultaneously on the basis of multiple ecological benefits. The EBI tool has demonstrated utility as users can establish thresholds for EBI values based on program goals and amount of funding available.

### **Project Results Use and Dissemination**

The EBI was first presented to a general audience through a WEBINAR. A follow-up technical training session, geared to GIS professionals, was developed. The technical sessions were attended by 42 conservation professionals representing local units of government, state and federal agencies, non-governmental organizations and private companies.

A majority (70%) of participants at the three technical training sessions said they planned to use the ecological ranking tool in their professional work. Given the diverse professional affiliations of the participants, their active involvement in conservation planning and delivery, and their connection to the network of natural resource professionals, it is likely that the Ecological Ranking Tool will be integrated into many conservation activities throughout Minnesota.

Presentations of the project and project results were provided to the LCCMR, Lessard-Sams Outdoor Heritage Council and the Board of Water and Soil Resources.

A final report was prepared. The report describes all results in more detail and includes maps and graphics and suggestions for use. A website was established by the Board of Water and Soil Resources

[www.bwsr.state.mn.us/ecological\\_ranking/](http://www.bwsr.state.mn.us/ecological_ranking/)

that provides an overview of the ranking methodology. The BWSR website also includes links to an interactive ranking tool (located at the University of Minnesota, Natural Resources Research Institute (NRRI) and the final report, which is available in downloadable format.

**Environment and Natural Resources Trust Fund 2008 Work Program Final Report**

**Date of Report:** August 30, 2011

**Final Report**

	<b>M.L. 2007</b>	<b>M.L. 2008</b>	<b>M.L. 2009</b>
<b>Date of Work program Approval:</b>			June 16, 2009
<b>Project Completion Date:</b>	June 30, 2009	June, 30 2010	June 30, 2011

**I. PROJECT TITLE:** Statewide Ecological Ranking CRP and Other Critical Lands

**Project Manager:** Greg Larson  
**Affiliation:** MN Board of Water and Soil Resources  
**Mailing Address:** 520 Lafayette Road North  
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**Location:** Statewide

**Total Trust Fund Project Budget:**

	<b>M.L. 2007</b>	<b>M.L. 2008</b>	<b>M.L. 2009</b>	<b>Total</b>
<b>Trust Fund Appropriation:</b>	<b>\$13,000</b>	<b>\$155,000</b>	<b>107,000</b>	<b>\$275,000</b>
<b>Minus Amount Spent:</b>	<b>\$13,000</b>	<b>\$155,000</b>	<b>\$106,997</b>	<b>\$274,997</b>
<b>Equal Balance:</b>	<b>\$0</b>	<b>\$0</b>	<b>\$3</b>	<b>\$3</b>

**Legal Citation: M.L. 2007, Chap. 30, Sec. 2, Subd. 7**

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\$107,000 is from the trust fund to the Board of Water and Soil Resources to continue the efforts funded by the emerging issues account allocation to identify and rank the ecological value of conservation reserve program (CRP) and other critical lands throughout Minnesota using a multiple parameter approach including soil productivity, landscape, water, and wildlife factors.

## **II. and III. FINAL PROJECT SUMMARY**

### **Overall Project Outcomes and Results**

To allocate scarce fiscal resources to natural resource programs, identifying the location and ranking the ecological value of critical lands is important. Using parameters of soil productivity, soil erosion risk, water quality risk, and habitat quality, an ecological ranking tool was developed. An economic model was also incorporated to analyze CRP (Conservation Reserve Program) parcels and determine the likelihood of contract renewal given anticipated crop prices and land quality. A parameter for soil erosion risk was developed using several factors from the Universal Soil Loss Equation. To identify lands posing a risk to water quality, or lands that are most likely to contribute overland runoff to surface waters, terrain analysis was used. Runoff rankings from terrain analysis were then integrated with a proximity analysis of surface water features based on DNR 24k surface water data. A parameter for habitat quality was derived from an update to the work done as part of the Minnesota Conservation and Preservation Plan (LCCMR, 2008). Combining the data sets therein, and assessing them with a “weight of evidence” approach, produced a ranking of wildlife quality. These several parameters were combined into an environmental benefits index (EBI). High EBI translates into high risk. Therefore, a high EBI score implies a site has a high value for conservation. CRP or other parcels deemed critical for conservation can be assessed simultaneously on the basis of multiple ecological benefits. The EBI tool has demonstrated utility as users can establish thresholds for EBI values based on program goals and amount of funding available.

### **Project Results Use and Dissemination**

The EBI was first presented to a general audience through a WEBINAR. A follow-up technical training session, geared to GIS professionals, was developed. The technical sessions were attended by 42 conservation professionals representing local units of government, state and federal agencies, non-governmental organizations and private companies.

A majority (70%) of participants at the three technical training sessions said they planned to use the ecological ranking tool in their professional work. Given the diverse professional affiliations of the participants, their active involvement in conservation planning and delivery, and their connection to the network of natural resource professionals, it is likely that the Ecological Ranking Tool will be integrated into many conservation activities throughout Minnesota.

Presentations of the project and project results were provided to the LCCMR, Lessard-Sams Outdoor Heritage Council and the Board of Water and Soil Resources.

A final report was prepared. The report describes all results in more detail and includes maps and graphics and suggestions for use. A website was established by the Board of Water and Soil Resources

[www.bwsr.state.mn.us/ecological\\_ranking/](http://www.bwsr.state.mn.us/ecological_ranking/)

that provides an overview of the ranking methodology. The BWSR website also includes links to an interactive ranking tool (located at the University of Minnesota, Natural Resources Research Institute (NRRI) and the final report, which is available in downloadable format.

**IV. OUTLINE OF PROJECT RESULTS:**

**Result 1:** Prioritize statewide CRP lands that will expire by 2014 according to soil productivity.

**Description:** The potential for growing annual crops on CRP lands was assessed. Because of their ability to produce agricultural crops, expiring CRP lands with the highest soil productivity would be difficult to acquire or convert to long term conservation cover. This GIS analysis identified the location of expiring CRP lands and their soil productivity rating. The location of each CRP project was mapped. The premise is that expiring CRP lands with low soil productivity may be candidates for continued protection through conservation programs. For this result, the University of Minnesota utilized the previously developed Crop Productivity Index which was provided to BWSR, and BWSR conducted the analysis to determine which expiring CRP lands fell within the target range of soil productivity.

**Summary Budget Information for Result 1:**

	M.L. 2007	M.L. 2008	M.L. 2009	Total
<b>Trust Fund Appropriation:</b>	<b>\$13,000</b>	<b>\$3,000</b>	<b>\$0</b>	<b>\$16,000</b>
<b>Minus Amount Spent:</b>	<b>\$13,000</b>	<b>\$3,000</b>	<b>\$0</b>	<b>\$16,000</b>
<b>Equal Balance:</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>

<b>Deliverable</b>	<b>Completion Date</b>	<b>Budget</b>
<b>1. Economic analysis and identifying yields based on soil productivity</b>	March 30, 2009	\$8,000
<b>2. Estimated potential loss and location of CRP acreage</b>	March 30, 2009	\$8,000

**Completion Date:** April 1, 2009

**Final Report Summary:**

An economic model was developed to analyze all CRP parcels and determine whether contract renewal was financially prudent. The logic is simple: if the price offered for a given crop is high enough, the owner will switch from whatever was being grown before (if different) to the demanded crop. The prediction model considers factors such as crop prices and production costs. CRP parcels were those as of 2007 (the most recent available data). Results of the analysis predicted 774,540 acres to exit based on 2010 crop prices. An assessment of the crop productivity (CP) of exiting parcels suggests that it may be more economically optimum to let highly productive parcels (CP>60) exit the program. Of the exiting acres, there are 56,000 acres of CRP with CP values <60. If expiring CRP acres are to be targeted for re-enrollment, on the basis of fiscal prudence and quality of the land, these 56,000 acres are suggested candidates.

**Result 2:** Determining which of the CRP parcels identified in Result 1 that have low productivity and high potential erosion rates.

**Description:** This analysis included taking the CRP parcels that meet the CPI criteria from Result 1 and intersecting them with soils that have high potential erosion rates to determine CRP parcels that have both low productivity and high potential erosion rates. In order to determine the value for “high erosion” a panel of experts from BWSR, USDA, FSA, MN Dept of Ag, and the University of Minnesota was formed to establish the breakpoint erosion rates. Once these critical erosion rates were determined, low productivity expiring CRP parcels were identified. CRP parcels were then sub-divided into groups based on contract expiration dates and type of conservation practice (permanent wildlife habitat, wetland restoration, perennial grass, buffer strips, etc). Expiring CRP parcels were ranked according to environmental vulnerability, crop productivity, erosion potential and critical habitat identified in the Statewide Conservation Plan. The highest ranked CRP parcels were identified and mapped. BWSR developed recommendations concerning which expiring CRP lands are most deserving of protection. This information was shared with the LCCMR, Lessard Outdoor Heritage Council, the BWSR Board and others through presentation formats and the data and information was made available through appropriate GIS data portals.

**Summary Budget Information for Result 2:**

	M.L. 2007	M.L. 2008	M.L. 2009	Total
<b>Trust Fund Appropriation:</b>	\$0	\$55,000	\$0	\$55,000
<b>Minus Amount Spent:</b>	\$0	\$55,000	\$0	\$55,000
<b>Equal Balance:</b>	\$0	\$0	\$0	\$0

<b>Deliverable</b>	<b>Completion Date</b>	<b>Budget</b>
1. Recommendations on the expiring CPR lands ranked as the highest priority for continued protection through conservation programs.	September 30, 2009	\$55,000

**Completion Date:** September 30, 2009

**Final Report Summary:**

(For details concerning the ranking of CRP parcels on the basis of soil productivity, see the final report summary for Result1.)

To develop a data layer for lands, including CRP parcels, with high potential soil erosion, rainfall runoff, soil erodibility, and slope actors from the Universal Soil Loss Equation were integrated with NRCS soil survey data and statewide county climate maps. These data were subsequently divided into terrain zones and ranked on the basis of risk from water erosion. Soil management factors such as vegetation and conservation practices were not included. This is because there are no reliable statewide data representing these factors. Moreover, management factors are temporal and will change over time. Since only non-management factors were used, the resulting data layer should be viewed as a “worst-case” scenario. Although the soil loss numbers may be exaggerated, the data layer offers a qualitative

comparison of landscape risk to water-borne soil loss. As used in this model, the higher the erosion potential, the greater the conservation need. The resulting data layer was part of the final ranking methodology that included elements described in results 3 and 4.

**Result 3:** Identify and prioritize other critical lands on a statewide basis by land and surface water features and overlay the CRP critical lands identified in Results 1 and 2.

**Description:** The University of Minnesota and NRRI (Natural Resources Research Institute) used terrain analysis of statewide digital elevation models and surface hydrologic features, such as impaired waters, to identify lands that are not currently enrolled in the CRP program but are critical for maintaining and improving wildlife habitat and water quality. The results of conservation efforts were improved by targeting these critical lands with conservation projects such as riparian buffer strips, perennial or cover crop plantings, and wetland restoration.

**Summary Budget Information for Result 3:**

	M.L. 2007	M.L. 2008	M.L. 2009	Total
<b>Trust Fund Appropriation:</b>	\$0	\$53,000	\$8,000	\$61,000
<b>Minus Amount Spent:</b>	\$0	\$53,000	\$8,000	\$61,000
<b>Equal Balance:</b>	\$0	\$0	\$0	\$0

<b>Deliverable</b>	<b>Completion Date</b>	<b>Budget</b>
1. Ranking of CRP and other critical lands according to erosion, proximity to water, and potential for delivery of sediment and nutrients to surface waters.	December 1, 2010	\$61,000

**Completion Date:** December 1, 2010

**Final Report Summary:**

A data layer was developed to illustrate areas that are most likely to contribute overland runoff to surface waters. Two data sources were used in the assessment: stream power index (SPI) and proximity to water. Terrain analysis is used to estimate SPI, a runoff potential based on 30 meter digital elevation models. SPI is estimated from flow accumulation and slope steepness. As flow accumulation and slope steepness increase, runoff potential also increases. The Minnesota landscape was ranked according to SPI. The SPI rankings were then integrated with a proximity analysis of surface water features. The DNR 24k surface water features (Lake or intermittent/perennial stream) data layer was used to assess proximity to surface water. Land in close proximity to surface water generally has a higher sediment delivery ratio than land farther away. The resulting data layer identifies land areas (and CRP parcels) posing the highest risk to contribute overland runoff to surface waters.

**Result 4:** Further identify and prioritize the expiring CRP and other critical lands mapped in Results 1, 2 and 3 with biological and other habitat criteria.

**Description:** The University of Minnesota, NRRI, overlaid the lands identified in Results 2 and 3 with GIS data for wildlife management areas, scientific and natural areas, biological indices, other sites of significant biodiversity, forest resources, and integrated terrestrial and aquatic habitat scores. This final iteration provided a comprehensive map and corresponding GIS layers that greatly improved the targeting of conservation program funds and therefore will result in better environmental outcomes including improved water quality and wildlife habitat.

**Summary Budget Information for Result 4:**

	M.L. 2007	M.L. 2008	M.L. 2009	Total
<b>Trust Fund Appropriation:</b>	<b>\$0</b>	<b>\$44,000</b>	<b>\$17,000</b>	<b>\$61,000</b>
<b>Minus Amount Spent:</b>	<b>\$0</b>	<b>\$44,000</b>	<b>\$17,000</b>	<b>\$61,000</b>
<b>Equal Balance:</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>

<u>Deliverable</u>	<u>Completion Date</u>	<u>Budget</u>
1. Maps and GIS data of expiring CRP and other critical lands according to soil productivity, erosion, proximity to water, potential for delivery of sediment to surface waters, and relevant natural resource features potential will be produced.	February 1, 2011	\$61,000

**Completion Date:** February 1, 2011

**Final Report Summary:**

Habitat quality was the final data layer. The mapping used for this layer was updated from the work done as part of the Minnesota Conservation and Preservation Plan (LCCMR, 2008). The primary goal of habitat mapping was to collate available information to prioritize important areas for conservation by integrating both positive (resources) and negative (threats to resources) factors. Combining data sets and assessing them with a “weight of evidence” approach produced a ranking of wildlife habitat.

The final part of Result 4 was development of an environmental benefits index (EBI). EBI is a composite score of multiple ecological benefits. The score is based on a 0-300 scale, where a score of 300 is most valuable from a conservation perspective. The EBI is the sum of three independent layers: soil erosion risk (Result 2), water quality risk (Result 3), and wildlife habitat quality values (Result 4). Each of those component layers contributes 0-100 points to the EBI. High EBI translates into high risk. Therefore, a high EBI score implies the site has a high value for conservation. CRP or other parcels deemed critical for conservation can be assessed simultaneously on the basis of multiple ecological benefits. Land areas or parcels with high EBI scores can be further screened by Crop Productivity Index (CPI) values. The rationale behind combining these two values is that incentives to place

marginal land in conservation programs will generally be less costly than incentives to place productive crop land in conservation programs. As an example, roughly 36,000 acres of cropland statewide are extremely marginal for crop production (CPI values <25) and have very high EBI scores. The EBI tool has great utility as users can establish thresholds, and produce output, for EBI values based on program goals and amount of funding available. The tool is available at [www.nrri.umn.edu/EcolRank](http://www.nrri.umn.edu/EcolRank).

**Result 5:** Promotion and providing training to conservation program delivery system partners and staff.

**Description:** University of Minnesota Extension staff and BWSR project development staff developed appropriate materials and provided training, mostly on-line, to BWSR field staff and conservation field staff in other agencies, such as the DNR and Dept of Ag, and conservation project organizations, such as Ducks Unlimited and Pheasants Forever and those engaged in the Working Lands Initiative. The training provided background information on the development of this information and how it can best be applied and used for targeting conservation program decisions at the local level. These professionals will then work one-on-one with their LGUs and organizations to custom fit the data and information available from this project to the local needs, priorities and funding available.

**Summary Budget Information for Result 5:**

	<b>M.L. 2007</b>	<b>M.L. 2008</b>	<b>M.L. 2009</b>	<b>Total</b>
<b>Trust Fund Appropriation:</b>	<b>\$0</b>	<b>\$0</b>	<b>\$62,000</b>	<b>\$62,000</b>
<b>Minus Amount Spent:</b>	<b>\$0</b>	<b>\$0</b>	<b>\$62,000</b>	<b>\$62,000</b>
<b>Equal Balance:</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>

<b>Deliverable</b>	<b>Completion Date</b>	<b>Budget</b>
<b>1.</b> Training and education of Soil and Water Conservation District and other appropriate program implementers of conservation programs on the conservation targeting tools developed above.	June 30, 2011	\$62,000

**Completion Date: June 30, 2011**

**Final Report Summary:**

The EBI was first presented to a general audience through a WEBINAR. Three hands-on technical training sessions, geared to GIS professionals, were held during June 2011 in St.Cloud, Moorhead and Marshall, Minnesota to provide data and methodology on the Ecological Ranking Tool to local units of government and other conservation partners. The purposes of these training sessions were to:

- Introduce the Environmental Benefits Index (EBI) and components to local users
- Train local GIS users on performing EBI calculations

- Provide examples of how to supplement EBI with a variety of different data sources
- Interpret results on the landscape for specific examples provided

The sessions were attended by 42 conservation professionals representing local units of government, state and federal agencies, non-governmental organizations and private companies.

A majority (70%) of participants at the three technical training sessions said they planned to use the ecological ranking tool in their professional work and they provided many different examples -- and some heretofore unknown and useful data layers -- of how the tool would improve their ability to identify and rank priority conservation areas. Given the diverse professional affiliations of the participants, their active involvement in conservation planning and delivery, and their connection to the network of natural resource professionals, it is likely that the Ecological Ranking Tool will be integrated into many conservation activities throughout Minnesota.

**Result 6:** Develop and deliver recommendations for acquisition and protection of CRP and other critical lands.

**Description:** A final report was prepared that reviews this project and project results, including case study information, along with policy and funding recommendations for future conservation program efforts. Presentations of the project and project results were provided to the LCCMR, Lessard-Sams Outdoor Heritage Council, and the BWSR. GIS data is available and provided through appropriate GIS portals. Reports and other pertinent summary materials are available on the BWSR website.

**Summary Budget Information for Result 6:**

	M.L. 2007	M.L. 2008	M.L. 2009	Total
<b>Trust Fund Appropriation:</b>	\$0	\$0	\$20,000	\$20,000
<b>Minus Amount Spent:</b>	\$0	\$0	\$20,000	\$20,000
<b>Equal Balance:</b>	\$0	\$0	\$0	\$0

<b>Deliverable</b>	<b>Completion Date</b>	<b>Budget</b>
1. Completion of Final Report, which will include an example application of the targeting strategy.	June 30, 2011	\$20,000

**Completion Date: June 20, 2011**

**Final Report Summary:**

A final report was completed. The report describes results 1 through 5 in more detail and includes maps and graphics and suggestions for use. A website was established by the Board of Water and Soil Resources

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that provides an overview of the ranking methodology described herein. The BWSR website also includes links to an interactive ranking tool (located at the University of Minnesota, Natural Resources Research Institute (NRRI) and the final report, which is available in downloadable format.

#### **V. TOTAL TRUST FUND PROJECT BUDGET:**

**Staff:** Board of Water and Soil Resources (BWSR): **\$55,000**

- GIS Specialist: conducted GIS analysis, managed data, interpreted data, assisted in overall project coordination, field training, report development, and participated in project meetings. 10% FTE
- Soil Scientist: managed data, interpreted data, assisted in overall project coordination, field training, report development, and participated in project meetings 5% FTE
- Training Coordinator: worked with the project team to develop training materials and training program, conducted training and provided follow-up assistance 7% FTE

**Contract Services:** University of Minnesota: **\$ 220,000**

- Soil, Water & Climate in St. Paul, GIS Specialist: conducted GIS analysis, managed data, interpreted data, assisted in overall project coordination, report development, and participated in project meetings 20%FTE
- Soil, Water & Climate in St. Paul, Grad Research Asst: conducted GIS analysis, managed data, interpreted data, assisted in report development, and participated in project meetings 50%FTE
- Involvement of UM Extension experts: developed on-line training materials
- Department of Applied Economics in St. Paul: Developed an economic model
- NRRI in Duluth, Scientist: analyzed and interpreted data, assisted in overall project coordination, report development, and participated in project meetings 8.3%FTE
- NRRI in Duluth, Scientist: interpreted data, assisted in overall project coordination, report development, and participated in project meetings 25%FTE
- NRRI in Duluth, Info Tech Prof: conducted GIS analysis, managed data, interpreted data and participated in project meetings 15%FTE
- NRRI: Supplies, In-state Travel, and GIS Lab fees

**TOTAL TRUST FUND PROJECT BUDGET: \$ 275,000**

(M.L. 2007 Emerging Issues= \$13,000; M.L. 2008 Emerging Issues = \$155,000; M.L. 2009 = \$107,000)

**Explanation of Capital Expenditures Greater Than \$3,500: NA**

## **VI. PROJECT STRATEGY:**

### **A. Project Partners**

The project team included Greg Larson, State Soil Specialist and Project Manager, BWSR; Julie Blackburn, Assistant Director, BWSR; Aaron Spence, GIS Specialist, BWSR; Professors David Mulla, George Host and Steve Taff, UM, and Joel Nelson, GIS Specialist, UM, and UM Extension staff specialist, Ann Lewandowski.

### **B. Other Funds Spent during 2008 and 2009:**

BWSR provided in-kind contributions of about \$5,000 annually.

### **C. Spending History:**

N/A

### **D. Time:**

2007 funds were spent by June 30, 2009

2008 funds were spent by June 30, 2010

2009 funds were spent by June 30, 2011

**VII. DISSEMINATION:** As described in Results 5 and 6, BWSR established a website that includes a description of the project, the ranking methodology and a link to the interactive ranking tool and the final report.

## **VIII. REPORTING REQUIREMENTS:**

Periodic work program progress reports were submitted July 20, 2009; January 19, 2010; July 21, 2010 and February 01, 2011. A final work program report and associated products was submitted August 30, 2011.

## **IX. RESEARCH PROJECTS: N/A**

