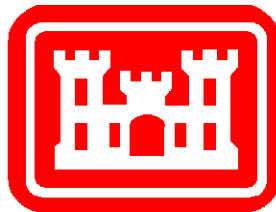


PUBLIC WORKS TECHNICAL BULLETIN 200-1-81
14 JANUARY 2011

**ASSESSING REGIONAL SUSTAINABILITY
WITH THE SUSTAINABLE INSTALLATIONS
REGIONAL RESOURCE ASSESSMENT (SIRRA)
PROGRAM**



Public Works Technical Bulletins are published by the U.S. Army Corps of Engineers, Washington, DC. They are intended to provide information on specific topics in areas of Facilities Engineering and Public Works. They are not intended to establish new Department of the Army (DA) policy.

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
441 G Street NW
Washington, DC 20314-1000

CECW-CE

Public Works Technical Bulletin

14 January 2011

No. 200-1-81

FACILITIES ENGINEERING
ENVIRONMENTAL

ASSESSING REGIONAL SUSTAINABILITY WITH THE
SUSTAINABLE INSTALLATIONS REGIONAL
RESOURCE ASSESSMENT (SIRRA) PROGRAM

1. Purpose.

a. The purpose of this Public Works Technical Bulletin (PWTB) is to transmit information on accessing and using the Sustainable Installations Regional Resource Assessment (SIRRA) Web-based analysis tool.

b. All PWTBs are available electronically (in Adobe® Acrobat® portable document format [PDF]) through the World Wide Web (WWW) at the National Institute of Building Sciences' Whole Building Design Guide web page, which is accessible through URL:

http://www.wbdg.org/ccb/browse_cat.php?o=31&c=215

2. Applicability. This PWTB applies to all U.S. Army facilities engineering activities.

3. References.

a. Executive Order (EO) #13423, Strengthening Federal Environmental, Energy, and Transportation Management, 29 Jan 2007.

b. EO #13514, Federal Leadership in Environmental, Energy and Economic Performance, 5 Oct 2009.

c. Department of Defense (DoD), Strategic Sustainability Performance Plan: FY 2010, 26 Aug 2010.

d. National Environmental Policy Act (NEPA), 1 Jan 1970.

4. Discussion.

a. One of the key concerns for Army installations is their ability to sustain, and sometimes, to change or expand their mission activities. Optimal use of installations in the face of changing missions, closures, and realignments requires an understanding of each installation's capabilities. Regional competition for land, transportation, energy, water, and other resources may put an installation's ability to perform essential activities at risk. Therefore, it is critical that we understand those factors that impact an installation's ability to maintain its mission.

b. The Sustainable Installations Regional Resource Assessment (SIRRA) methodology was developed as a screening tool to assess relative vulnerability in 10 sustainability areas: (1) air quality, (2) airspace, (3) energy, (4) urban development, (5) threatened and endangered species (TES), (6) location-related issues, (7) water, (8) economic issues, (9) quality of life, and (10) transportation. The results of SIRRA analyses are used to identify installations and sustainability issues that require further study using additional data sources. SIRRA was a product of the Strategic Environmental Research and Development Program (SERDP) and was selected as Project of the Year in 2006.

c. SIRRA's Web-based tool provides a screening level capability for characterizing regions surrounding military installations, with the screening based on a set of sustainability risks or stressors. SIRRA draws from existing science and measurement-based data sources which are well documented and publicly available at the national level. These data sources include, but are not limited to the following: (a) U.S. Geological Survey (USGS), (b) U.S. Census Bureau (USCB), (c) U.S. Department of Energy (DOE), (d) Federal Aviation Administration (FAA), (e) U.S. Fish and Wildlife Service (USFWS), (f) U.S. Bureau of Labor Statistics (BLS), and (g) U.S. Environmental Protection Agency (USEPA). The SIRRA database currently contains 54 GIS data layers that encompass 10 sustainability issues. It also contains the boundary files of more than 308 Department of Defense (DoD) installations with their testing and training ranges. The intersection of these files provides vulnerability ratings of each indicator for all

installation regions. Data queries may be conducted by Service, Installation, Sustainability Issue Area, or Indicator. Data obtained then can be exported to a Microsoft Excel® spreadsheet file.

d. The availability of a wide spectrum of data at the national scale to help evaluate and compare multiple factors is a compelling tool to aid decision makers. SIRRA data has been accessed by users in support of a range of decisions. Whether these decisions are for base closure and realignment, regional ecosystem, transportation, water resource, economic and land use planning, easement planning, or major construction projects – multiple complex factors need to be considered.

e. Applications of SIRRA have included: (a) Screening of Department of Defense (DoD) Installations for Vulnerability to Encroachment, (b) Evaluation of DoD Testing and Training Ranges in Support of the 320/366 Report to Congress, (d) Watershed Screening Methodology, and (e) the NEPA Screening Tool. These applications are documented on the SIRRA Web site.

f. The value of a validated national screening tool for sustainability assessments is two-fold. National data sets provide sustainability indicator status for a region or local area. National maps and data sets also allow comparisons among and between regions or installation areas. SIRRA can quickly provide a sustainability screening to highlight and prioritize issues that need more detailed analysis, saving time and money needed to gather similar data on a case by case basis.

g. This PWTB provides an overview of the SIRRA Web-based analysis tool, instructions on navigating the SIRRA Web site, application of SIRRA toward several resource planning questions, and documentation of the metadata behind the 54 sustainability indicators contained in SIRRA. The SIRRA Web site is:

<http://datacenter.leamgroup.com/sirra/>

h. Appendix A contains a description of the SIRRA Web-based analysis tool including a current list of sustainability indicators.

i. Appendix B describes navigation through the SIRRA Web site.

j. Appendix C includes a set of instructions for applying the SIRRA methodology to a number of regional planning scenarios that might be encountered by Army installation staff.

PWTB 200-1-81
14 January 2011

k. Appendix D explains how to retrieve the metadata for all 54 of the SIRRA sustainability indicators. Metadata is information about the data contained in SIRRA, that is: data variable, geographic scale, year of data, source, logic for why each indicator is important, how often the data changes, directions on how to obtain the data and do calculations if required, indicator measure, and rules for interpreting multiple data points for one installation region.

l. Appendix E contains a list of acronyms and abbreviations used in this PWTB, paired with their spellouts.

m. Appendix F cites related Engineer Research and Development Center - Construction Engineering Research Laboratory (ERDC-CERL) publications.

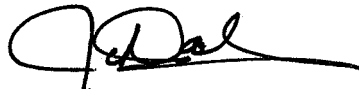
5. Points of Contact.

Headquarters, U.S. Army Corps of Engineers (HQUSACE) is the proponent for this document. The point of contact (POC) at HQUSACE is Mr. Malcolm E. McLeod, CEMP-CE, 202-761-5696, or e-mail: Malcolm.E.Mcleod@usace.army.mil.

Questions and/or comments regarding this subject should be directed to the technical POC:

U.S. Army Engineer Research and Development Center
Construction Engineering Research Laboratory
ATTN: CEERD-CF-E (Elisabeth Jenicek)
2902 Newmark Drive
Champaign, IL 61822-1076
Tel. (217) 373-7238
FAX: (217) 373-6740
e-mail: elisabeth.m.jenicek@usace.army.mil

FOR THE COMMANDER:



JAMES C. DALTON, P.E.
Chief, Engineering and Construction
Directorate of Civil Works

APPENDIX A

Information about SIRRA

Military installations provide many benefits to their local region in terms of economic impact and natural resources. They provide large payrolls that boost local economies and they often provide protection of TES habitat. At the same time, installations can often find themselves in competition for scarce regional resources such as land for growth, water supply, air space, and frequency bandwidth. Installation, local, and regional planners must make decisions collaboratively to avoid or to mitigate long-term mission constraints. The SIRRA tool supports installation sustainability assessment efforts as well as specialized studies such as energy, water, quality of life issues, and NEPA screening. SIRRA can also inform planning and decision making at the national scale to maximize installation sustainability.

Over the last several decades, both the population and the amount of developed land around most U.S. cities and military installations have grown significantly. Meanwhile, military ranges and training lands that have remained undeveloped have become "islands of biodiversity," as population centers have expanded adjacent to or near installation boundaries and as residential development has grown into more remote and previously rural areas. Economic expansion, some probably driven by the installation's economic impact on the local area, has spurred development of new suburban communities near Department of Defense (DoD) installations. Many installations are now at the fringe or else in the midst of large urbanized or urbanizing areas.

The combination of environmental laws and nearby urban development has created significant pressures to alter land use practices on military installations. These pressures are termed "encroachment," which is a general descriptor for the many issues that limit the military use of land, air, and sea spaces. Encroachment issues become stressors to installation sustainability and/or threats to stationing. Stationing may also be affected by restrictions due to air and water quality standards, erosion control requirements, and restrictions on wetland impacts.

The SIRRA approach characterizes regions surrounding installations based on a set of risks or stressors. The process uses a broad set of indicators covering the range of issues that affect DoD installations. Indicators are measurable aspects of a

system that can be used to quantify the state or condition of that system. An effective regional indicator provides information about the impact of the surrounding region on an installation's ability to train and maintain its mission. The sustainability ratings are used to express the relative ranking of installations using single measures, or groups of measures, that define a stress. This standardized approach allows the use of national-level data to evaluate regional aspects of the installation's setting. This evaluation provides a heightened awareness of long-term issues that could threaten mission sustainment.

The SIRRA tool uses existing science and measurement-based national data sources. Though the sustainability ratings reflect a "snapshot in time," the data sources are updated regularly by their proponent(s), e.g., criteria pollutant non-attainment data is updated annually by the U.S. Environmental Protection Agency (USEPA). This data is organized and analyzed, and used to create national geographic information system (GIS) coverages.

Sustainability ratings were developed in several different ways. National regulatory targets exist for some indicators. Examples include the USEPA's six criteria air pollutants that comprise the air quality indicator, the USFWS species at risk designation, and Federal Emergency Management Agency (FEMA) designated seismic zones. Other data sources require statistical analysis or evaluation based on the research literature. Quality of life indicators are examples of these. The SIRRA web-based tool allows users to depict sustainment ratings in a red/amber/green color scheme that illustrates high/medium/low sustainability risk for summary presentations. SIRRA's current five-tiered rating system is an upgrade from SIRRA version 1 that used a three-tiered system. The numeric ratings, reasoning, and actual data are available for each sustainment rating.

The SIRRA web-based analysis tool contains the methodology, documentation, and analytic capability. SIRRA can be found at:

<http://datacenter.leadgroup.com/sirra/>

There are multiple applications for SIRRA including support for installation sustainability planning, regional planning, stationing changes, force transformation, and base realignment and closure decisions. SIRRA was developed under SERDP. Additional funding includes Army Research, Development, Test, and Evaluation (RDT&E) under the Fort Future initiative, a technology suite designed to help installations and units plan

PWTB 200-1-81
14 January 2011

for future requirements. SIRRA was one in a suite of tools that was recognized as the 2006 SERDP Project of the Year.

Specialized SIRRA applications include the ability to conduct sustainability analyses on a watershed basis, evaluating 309 DoD installations to produce rank-order results prioritized for more detailed analyses, and assessing encroachment indicators in the regions containing 500 DoD Testing and Training Ranges in support of the Office of the Secretary of Defense (OSD) 320/366 Report to Congress. These applications are described in Appendix C and documented in Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL) Technical Reports (TR) that are listed in Appendix F.

The SIRRA tool was used to provide auditable data for the Army stationing analysis for Base Realignment and Closure (BRAC) 2005. SIRRA also was used to evaluate an existing installation's ability to absorb additional forces and to evaluate a region's capability of supporting a new installation. SIRRA output was presented at the Fort Stewart modularity master planning charrette and at Installation Sustainability Planning charrettes in the Fall Line region. The list of SIRRA indicators is given in Table A-1. Note that the list changes periodically; for the most recent listing, refer to SIRRA Web site (page A-2).

This work is leveraging resources with other ERDC-CERL research projects, including those that evaluate the environmental aspects of risk assessment, that tier required databases, and that develop common tools. The "Strategic Sustainability Assessment" is one such project, initiated by the Army Environmental Policy Institute (AEPI) and directed at predicting future sustainability impacts.

The SIRRA methodology is being used as the basis for the "USACE Actions for Change" project, Watershed Investment Decision Tool. This special application will be used to inform and support U.S. Army Corps of Engineers (USACE) budgeting decisions and will be deployed as a module on the CorpsMap Web site.

Table A-1. List of SIRRA Sustainability Indicators.

	Indicator	Data Source*	Data Level
Air Quality Sustainability			
AQ1	Criteria Pollutant Non-Attainment	USEPA/EIA	county
AQ2	Noise Sensitivity	USCB	installation
Airspace Sustainability			
AS1	SUA, Fighter Range	FAA	installation
AS2	SUA, Bomber Range	FAA	installation
AS3	Terminal Airspace	FAA	installation
AS4	MTR, Fighter Range	FAA	installation
AS5	MTR, Bomber Range	FAA	installation
Energy Sustainability			
EN1	Electrical Grid Congestion	NERC	NERCSub
EN2	Electrical Reserve Margin	NERC	NERCReg
EN3	Renewable Energy – Wind	NREL	Windgridunit
EN4	Renewable Energy – Solar	NREL	Solargridunit
EN5	Renewable Energy – Biomass	NREL	state
EN6	Electrical Price Structure (Dereg)	EIA	state
EN7	Net metering	Green Power network	state
Urban Development			
UD1	Regional population density	USCB – 10 yrs	county
UD2	Incr. Regional Growth Rate	USCB – 10 yrs	county
UD3	Regional population growth	USCB – 10 yrs	county
UD4	Regional Land Urbanization	NLCD – 5 yrs	installation
UD5	State smart growth plans	APA	state
UD6	Joint Land Use Study (JLUS)	DoD	installation
UD7	Proximity to MSA	USCB	installation
TES Sustainability			
TE1	ESA Listed and Proposed Specie	NatureServe	watershed
TE2	ESA Candidate Species	NatureServe	watershed
TE3	TES Richness	NatureServe	watershed
TE4	TES Hotspots	NatureServe	watershed
Locational Sustainability			
LO1	Federally declared floods	FEMA database	county
LO2	Seismic Zones	USGS maps	zone
LO3	Weather-related damage	NWS/NOAA – annual	state
LO4	Federally declared disasters	FEMA database	county

* Note that Appendix E contains a list of acronyms and abbreviations used in this PWTB, paired with their spellouts.

	Indicator	Data Source *	Data Level
	LO5 Tornadoes	NOAA	county
Water Sustainability			
	WA1 Level of Development	JAWRA	watershed
	WA2 Ground Water Depletion	JAWRA	watershed
	WA3 Flood Risk	JAWRA	watershed
	WA4 Low Flow Sensitivity	JAWRA	watershed
	WA5 Water Quality	JAWRA	watershed
Economic Sustainability			
	EC1 DoD Local Employment	www.bea.gov (REIS)	county
	EC2 Job Availability/unemployment	BLS – annual	county
	EC3 Housing Affordability	USCB – 10 yrs	county
	EC4 Poverty	USCB – 10 yrs	county
	EC5 Income Inequality	PHIND, UNC	county
	EC6 Average Housing Value of New Construction	USCB	county
	EC7 Housing Permits Issued	USCB	county
Quality of Life Sustainability			
	QL1 Crime Rate	NACJD	county
	QL2 Housing Availability	USCB – 10 yrs	county
	QL3 Rental Availability	USCB – 10 yrs	county
	QL4 Healthcare Availability	HHS	zip code
	QL5 Educational Attainment	USCB – 10 yrs	county
	QL6 Commute Times	USCB – 10 yrs	county
Transportation Sustainability			
	TR1 Capacity of Commercial Airports	TAF System	installation
	TR2 Airport Suitability-C5	FAA	installation
	TR3 Airport Suitability-C141	FAA	installation
	TR4 Airport Suitability-C17	FAA	installation
	TR5 Railroad Capacity	FRA	county
	TR6 Proximity to Interstate	IRRIS	installation
	TR7 Roadway Congestion	2002 Urban Mobility & FHWA	state
	TR8 Traffic Volume	TTI & FHWA	state

APPENDIX B Using the SIRRA Web-Based Tool

Introduction

The SIRRA Web environment uses typical Arc GIS navigation methods. Information about SIRRA development, specialized SIRRA applications, and query capabilities are contained in "folders" with labeled "tabs" that make navigation intuitive.

Home Page

The SIRRA Home page (Figure B-1) contains a brief explanation of the SIRRA tool. It also provides contact information for the SIRRA team. Users are encouraged to contact the Project Manager to report problems with the site, or to suggest new or useful applications of SIRRA, or additional data sets that would enhance the SIRRA capability.



Figure B-1. The SIRRA Web-based tool's home page.

Resources Page

The "Resources" page (Figure B-2) contains documentation of the SIRRA methodology in PDF format. If you select the file name "Technical Note" or "Indicator Metadata," you will be prompted to either open or save the file. The SIRRA Technical Note is a four-page summary of the SIRRA methodology. It contains rationale for development of SIRRA and is organized by Problem, Background, Approach, and Application.

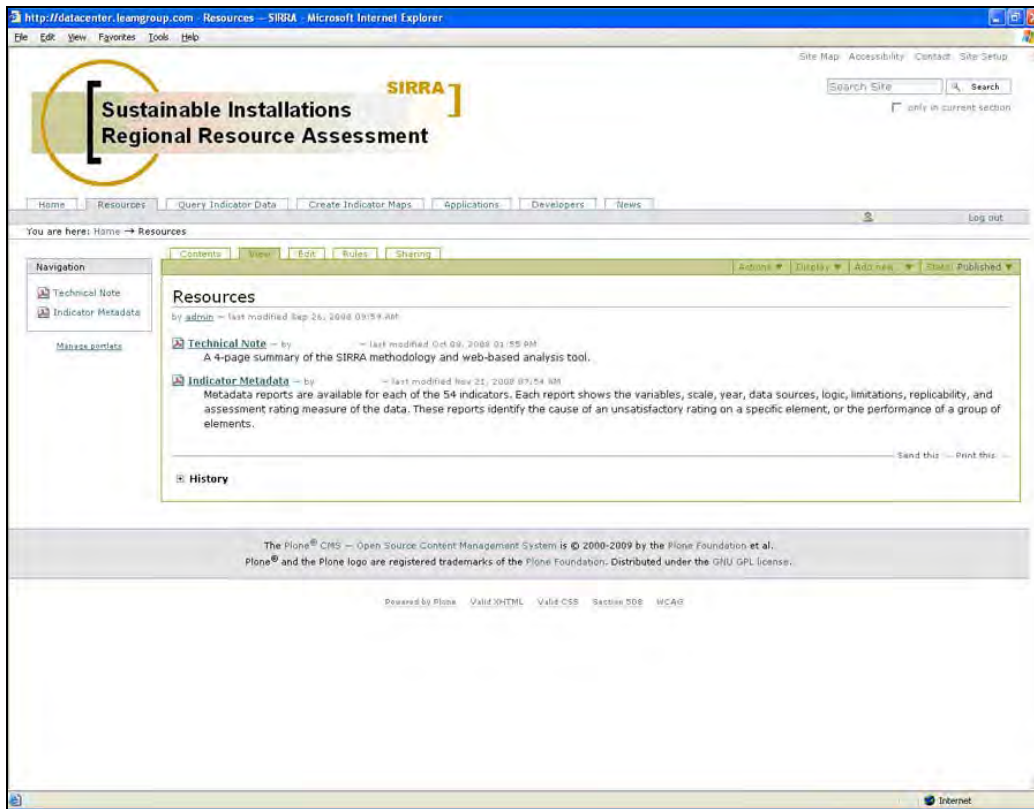


Figure B-2. The SIRRA Web-based tool's "Resources" page.

The "Indicator Metadata" document contains the entire set of metadata for all 54 sustainability indicators. This report includes the variables, scale, year, data sources, logic, limitations, replicability, and assessment rating measure of the data. This documentation identifies the cause of an unsatisfactory rating on a specific element or the performance of a group of elements.

Query Indicator Data Page

The "Query Indicator Data" page (Figure B-3) allows sustainability queries to be conducted on an installation or set of installations, providing tabular data results. The Navigation

PWTB 200-1-81
14 January 2011

window on the upper left corner of the window allows access to indicator metadata files.

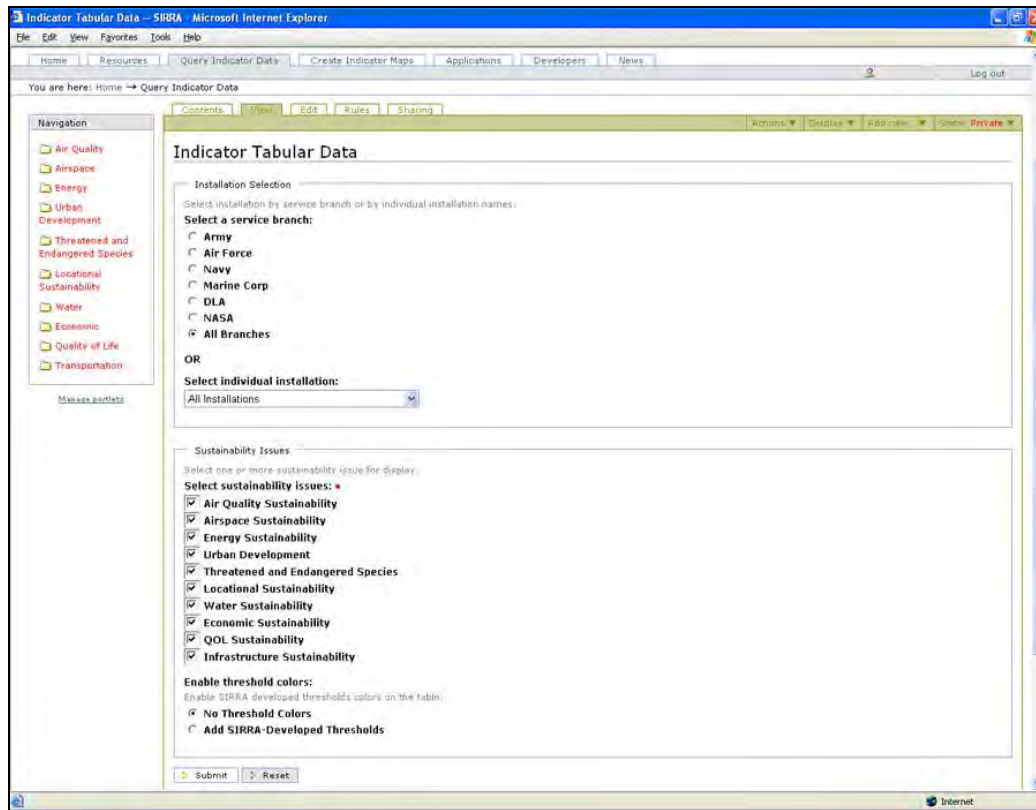


Figure B-3. The SIRRA Web site's "Query Indicator Data" page.

Three choices are required to conduct a tabular query. First, the user chooses the installation to analyze. The user can select all installations within a service branch or federal agency (Army, Air Force, Navy, Marine Corps, Defense Logistics Agency, National Aeronautic and Space Administration), all service branches, or a specific installation. The pull-down list contains 628 individual sites in alphabetical order.

The second choice is to select one or more sustainability issue areas for analysis. View the individual indicators contained in each issue area by selecting the folders in the "Navigation" window.

The third choice is whether or not to display colors in the tabular data results. Selecting "No Threshold Colors" will generate a results table without colors. Selecting "Add SIRRA-Developed Thresholds" will generate a results table that is color-coded based on a five-division scale of sustainability. Colors range from dark green for high sustainability to red for low sustainability. Information on the development and

significance of the thresholds can be found in individual indicator metadata. Individual indicator metadata may be viewed by selecting the output table heading for that indicator. Figure B-4 shows the results table for a sustainability query.

The screenshot shows a web browser window displaying the SIRRA website. The main heading is 'Sustainable Installations Regional Resource Assessment'. Below the navigation menu, there is a table titled 'SIRRA - Sustainable Installations Regional Resource Assessment' with a 'Download Spreadsheet' link. The table has columns for 'Installation by State' and two main categories: 'Urban Development' and 'Water Sustainability'. The data row for 'Fort' shows the following values:

Installation	State	Urban Development						Water Sustainability					
		Regional Population Density (people/sq.mile)	Incr. Regional Growth Rate (% incr. growth rate)	Regional Population growth (% growth rate)	Regional Land Urbanization (% urbanized within 20 miles)	State Smart Growth Plans (status) (rating)	Joint Landuse Study (status)	Proximity to MSA (miles)	Level of Development (% developed)	Groundwater Depletion (% depleted)	Flood Risk (# pop in 500-yr floodplain)	Low Flows Sensitivity (cubic feet sq. / sec)	Water Quality (Rating)
Fort		226.57	-2.0	20.69	4.46	Moderate Returns or Pursuing Additional Reforms	Completed	0	Average	Low	Average	0.07	1

Figure B-4. SIRRA Web site’s results table resulting from a tabular sustainability query.

It is possible to export the indicator data into a Microsoft Excel® spreadsheet or to copy and paste data into Excel. To export, click the link “Download Spreadsheet” located above the query result table. This opens an Excel workbook containing three separate worksheets. The first worksheet lists the SIRRA indicators and their data sources. The second worksheet details sustainability rating thresholds for each indicator (i.e., denoting value ranges within the red/amber/green scale). Finally, the third worksheet provides the raw data for each indicator.

To manage the data in isolation, users can highlight the resultant table and use traditional “copy and paste” functions to transfer the data into their preferred format.

Create Indicator Maps

The "Create Indicator Maps" page (Figure B-5) allows sustainability queries to be conducted on individual sustainability indicators, producing indicator maps as output. Producing an indicator map requires only one decision, the "indicator of interest." Indicators within a sustainability issue area can be found by selecting the folder of the issue.

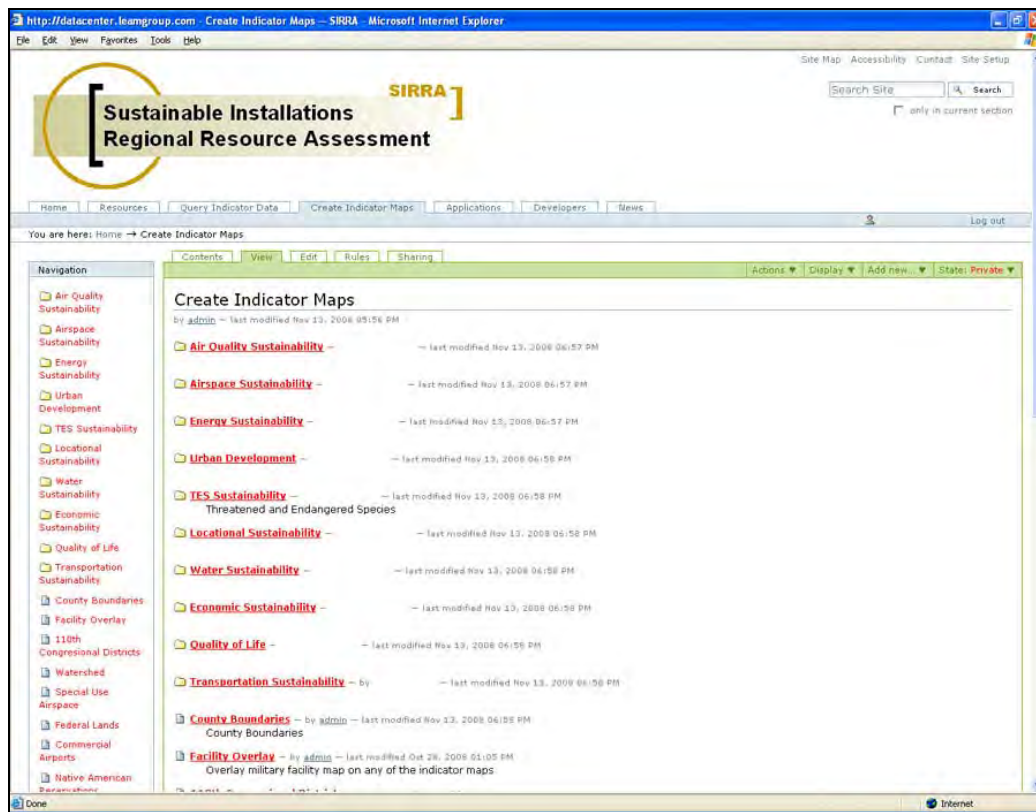


Figure B-5. The SIRRA Web site's "Map Query" page.

Once the data map is produced, it is possible to use typical GIS tools to zoom or pan to different areas of the United States. It is also possible to select a boundary overlay from the left menu bar. Available overlays include installations, counties, 110th Congressional Districts, hydrologic unit code (HUC)-8 watersheds, special use airspace, Federal lands, commercial airports, Native American reservations, USACE Districts, USACE Divisions, watershed basins, populated places, Military Training Routes (MTR) entry and exit, terminal airspace, dams, and county world geodetic system (WGS). Figure B-6 shows the results of a map query for the water sustainability indicator, "low flow sensitivity." The map is zoomed to the Southeastern U.S., with an overlay showing military facilities.

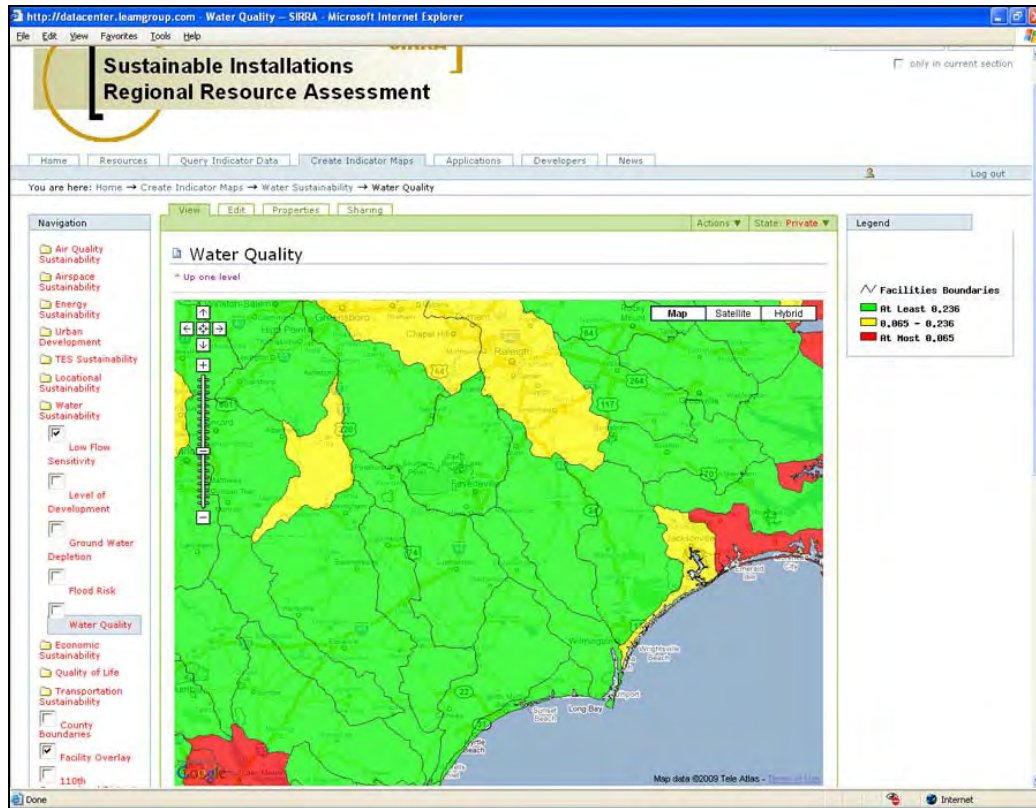


Figure B-6. An example of SIRRA Web site's "Map Query."

Other Capabilities

The "Applications" page contains information and documentation of four specialized applications of SIRRA. Further details about these applications are contained in Appendix C, "Applications of the SIRRA Methodology."

The "Developers" (password-protected) page allows authorized users to make changes to SIRRA. The "News" page will be used to document future changes to SIRRA.

APPENDIX C

Applications of the SIRRA Methodology

Introduction

There are several specialized applications of the SIRRA methodology that use all or a subset of the 54 existing indicators. Several special applications of the SIRRA methodology have been created to support users' special needs. Methods from those special applications are captured in the software's macro-enabled spreadsheets that can be queried to support the user's needs. The spreadsheets, instructions, and complete documentation of each application can be found on the SIRRA Web site. A description of each of the SIRRA specialized applications follows.

Sustainability Assessment Based on Primary Mission

The SIRRA methodology was adapted to consider the primary military mission as a weighting factor in determining vulnerability to a set of sustainability issues. The purpose of this was to identify the most vulnerable installations within each DoD service, and to determine those installations that would benefit from further study and intervention.

The analysis methodology consists of initially characterizing and weighting sustainment issues at DoD installations using the SIRRA system. The full set of the original 48 indicators from SIRRA version 1a, plus an additional six indicators, were used for this evaluation. The complete set of indicators is listed in the technical report, ERDC/CERL TR-06-22 (see link provided in Appendix F).

The indicator weighting scheme relates the regional issues to specific missions or functions of an installation. For example, a storage depot facility is affected less by housing availability issues and affected more by interstate transportation availability for the movement of its goods. By contrast, an expeditionary training facility is affected greatly by housing availability for its soldiers and affected minimally by interstate transportation availability. Both housing and transportation availability are considered sustainment issues that contribute to regional encroachment, but the weight given to each type of installation for those indicators would be different. Therefore, the regional sustainability ranking approach provides a weighted summary of assessment indicators that determine an overall mission sustainment or vulnerability

rating for that region hosting the given installation. These weighted assessments can then be used as a screening tool to assess installations where additional studies, planning, and actions are recommended to ensure continued mission readiness.

Figure C-1 shows the resulting rankings of the 308 DoD installations' mission Vulnerability Scores. The Vulnerability Scores for the regions ranged from 169-454. Possible overall sustainability scores range from 84-675, where 84 represents lowest vulnerability and 675 represents the maximum vulnerability.

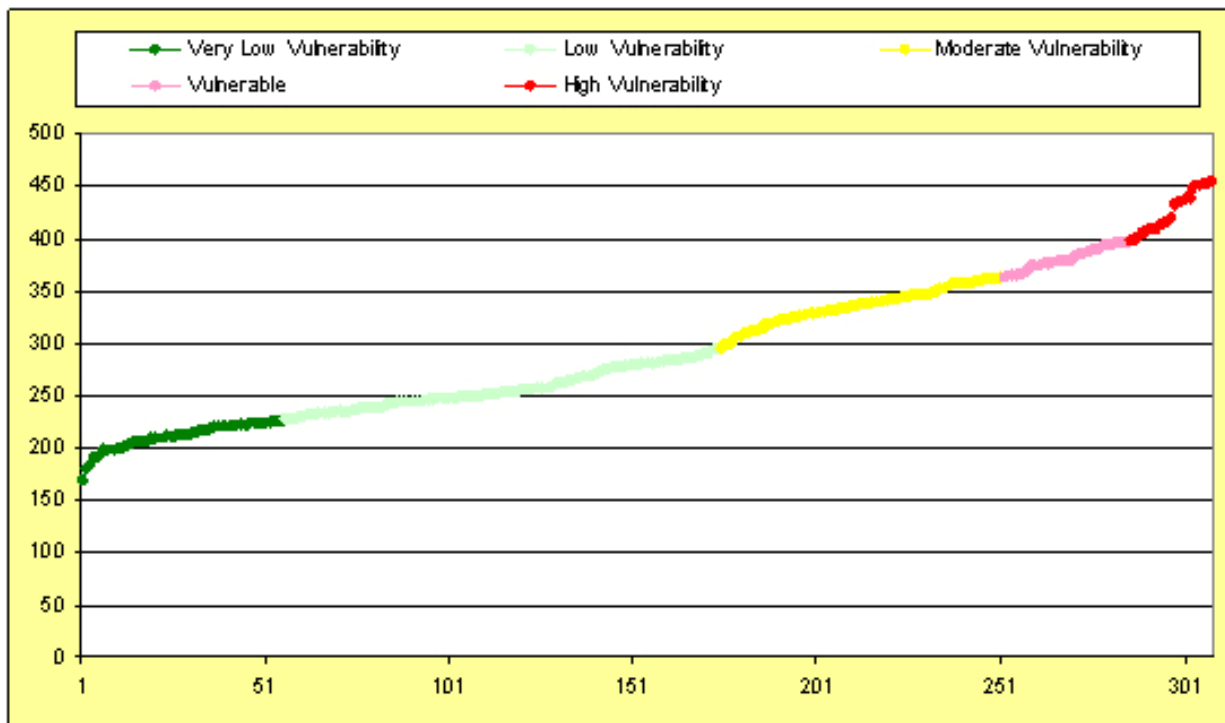


Figure C-1. Statistical distribution of mission "Vulnerability Scores."

Table C-1 lists the actual range of scores and their statistical analysis. Table C-2 lists the score range that defines each of the various vulnerability classifications.

Table C-1. DoD installations' "Vulnerability Scores."

Statistical Analysis	Score
Median	280
Average	294.2
Standard Deviation	68.1
Lowest Score	169
Highest Score	454

Table C-2. DoD installations' vulnerability ranges.

Vulnerability Range	Definition
Very Low Vulnerability	Less than 1 Std Dev below Mean (< 226.1)
Low Vulnerability	Between 1 Std Dev below Mean and Mean (226.1 – 294.2)
Moderate Vulnerability	Between 1 Std Dev above Mean and Mean (294.2 – 362.3)
Vulnerable	Between 1 Std Dev above Mean and 1.5 Std Dev above Mean (362.3 – 396.3)
High Vulnerability	Above 1.5 Std Dev above Mean (> 396.3)

Installations with the highest vulnerability tended to be expeditionary installations located in or near large metropolitan areas, or those located in either California or Hawaii. Installations in areas rated the least vulnerable tended to be non-expeditionary training or administrative facilities located in rural areas or settings in the lesser populated areas. Administrative and industrial facilities were not negatively impacted by being located in or near metropolitan areas.

All locations have some sustainability issues that create vulnerabilities, as shown by the fact that the lowest rating score was still significantly higher than the lowest possible score. Also, the highest scored region was less than the maximum possible score, indicating that installation settings vary and that not all of the indicators are high for any one location.

The range of scores was fairly linear across the range except for either extreme. The regions with the highest vulnerability have a fairly steep rise in scores, indicating that vulnerabilities were worsening en masse. The same is true for regions rated least vulnerable, where the indicators tended to get much better as a whole.

Complete documentation of this application may be found in the technical report ERDC/CERL TR-06-22. This report is online on the SIRRA Web site and via a link provided in Appendix F of this report.

Sustainability Assessment of Department of Defense Ranges

Planners for DoD installations and ranges face increasingly complex challenges due to rapid changes in land use, stakeholder involvement in planning processes, and the transformation of forces, technologies, and global circumstances. The application of SIRRA was developed to assess sustainability of DoD ranges in response to these challenges. This SIRRA application was one

response to a Congressional requirement to outline the impacts of urban encroachment on military installations and ranges. This information may inform plans designed to ensure the DoD's ability to sustain, change, or expand mission activities at these sites. Optimal use of ranges in the face of changing missions, closures, and realignments requires an understanding of each range's requirements.

In this case, the SIRRA methodology was adapted to provide a scientific, quantifiable, reliable, data-sourced system of determining vulnerability to a set of sustainability issues based on regional data. This methodology can be used by DoD to identify which range installations are most vulnerable to encroachment issues. The region encompassing each range installation is rated based on individual indicators organized by sustainability issue areas. This allows a review of issues to help identify those ranges that would benefit from further study, intervention, and planning.

The analysis methodology consisted of initially characterizing sustainment issues at all of the range installations using the SIRRA system. The full set of indicators used for this evaluation included the original 48 indicators from SIRRA 1a, plus an additional six indicators. The full set of 54 indicators is contained in the technical report ERDC/CERL TR-06-22 (see Appendix F). The full set of indicators is used for completeness and the user may choose to ignore certain indicators or issue areas, if desired.

The indicator characterizations for each installation or range were then summed to arrive at an overall sustainability score that characterizes a level of encroachment potential or vulnerability of the site for sustainability issues. Indicator ratings were also averaged by sustainability issue to provide additional insight into the results.

Figure C-2 shows the resulting vulnerability ratings of the sustainability scores achieved by 400 ranges. The sustainability scores for the ranges varied from 112-179. Overall range vulnerability ratings shown in Figure C-2 were determined by subjecting the data to statistical analysis (Table C-3 and Table C-4).

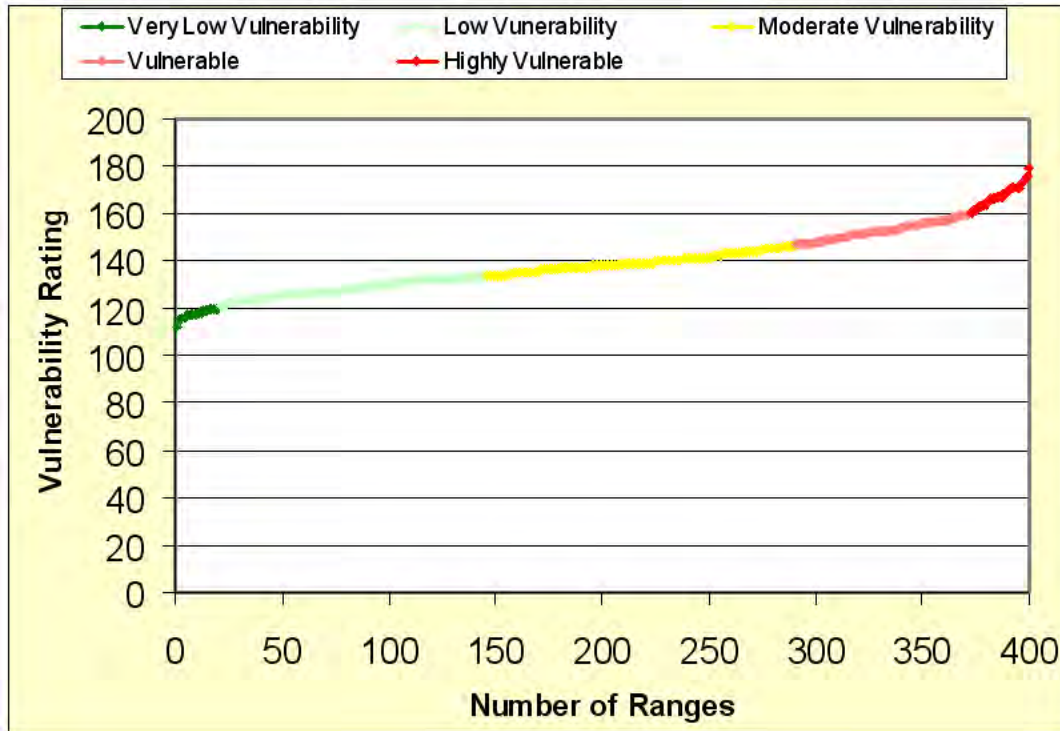


Figure C-2. Statistical distribution of Range Vulnerability Scores.

Overall sustainability scores could vary from 54-270, where the lowest score would represent the lowest potential vulnerability (54 indicators x value of 1) and the highest score would represent the highest potential vulnerability (54 indicators x value of 5). Table C-3 provides the score statistics and Table C-4 lists the overall data spread for the various vulnerability classifications.

Table C-3. Statistical analysis of Range Vulnerability Scores.

Statistic	Score
Median	138
Mean	140
Standard Deviation	13
Lowest Score	112
Highest Score	179

Table C-4. Classifications of vulnerability based on statistics.

Vulnerability Category	Definition of Vulnerability Category
Very Low Vulnerability	Less than 1 Std Deviation below Mean (< 120.5)
Low Vulnerability	Between 1 Std Deviation below Mean and Mean (120.5 – 133.5)
Moderate Vulnerability	Between 1 Std Deviation above Mean and Mean (133.5 – 146.5)
Vulnerable	Between 1 and 1.5 Std Deviation above Mean (146.5 – 159.5)
High Vulnerability	Above 1.5 Std Deviation above Mean (> 159.5)

Ranges with the highest vulnerability tended to be in areas with high levels of urban development or near large metropolitan areas. Regions showing the highest vulnerability were in Hawaii, California, and the Mid-Atlantic coastal states. Ranges in areas rated the least vulnerable tended to be located in rural areas or settings with low population.

All locations have some vulnerabilities or sustainability concerns, as evidenced by the fact that the lowest rating score was still significantly higher than the lowest possible score. However, the highest scored range was still a good deal lower than the highest possible score. This shows that indicators vary considerably within a region and that not all of the indicators are high or low for any given location. This is somewhat due to the large set of indicators applied and how they relate to the various encroachment issues. As noted, not all indicators are germane to all range installations.

Also note that the range of scores was fairly linear through the middle three categories of vulnerability with significant change at either extreme. The range installations with the highest vulnerability scores have a fairly steep rise in the number of indicators scoring high. This shows that vulnerabilities and encroachment factors tend to worsen as a group. The same is true for regions rated least vulnerable; the indicators tended to get much lower or better as a group.

Complete documentation of this application may be found in ERDC/CERL TR-06-26, *A Characterization of Land Use Trends Around the Perimeter of Military Ranges* (Jenicek et al. 2006). This report is online at the SIRRA Web site or via a link provided in Appendix F of this report.

National Environmental Policy Act Screening Using SIRRA

This application illustrates the use of the SIRRA data as a NEPA screening tool. The intent is to provide guidance for installation Commanders, U.S. Army Reserve Support Commands,

PWTB 200-1-81
14 January 2011

National Guard Adjutant Generals, and the like in using SIRRA to reduce time and cost required to perform a NEPA analysis.

NEPA analyses and awareness applications not only support compliance with NEPA documentation requirements, but also can help improve an installation's planning practices and therefore its ability to effectively maintain stewardship of its environmental resources.

SIRRA was developed with the concept that it would be useful for a variety of applications. SIRRA was not designed to support the entire NEPA process. A NEPA analysis is a comprehensive investigation tailored to the nature and scope of the proposed action. The proposed action, along with environmental characteristics, determines the appropriate issues to address at the appropriate level of analysis. SIRRA provides only characterizations of environmental and socio-economic conditions for a given region, but this advises NEPA assessments in the scoping process by helping to determine significant issues. For instance, SIRRA aids in determining whether an Environmental Assessment (EA) or Environmental Impact Statement (EIS) is appropriate, and helps identify issues that are critical to investigate and issues of minor significance.

More specifically, SIRRA aids in fulfilling the NEPA regulation that requires early regional scoping to identify important issues related to a proposed action. SIRRA data provides a quick screening of environmental conditions prior to the preparation of a draft EA/EIS. It can also provide an open forum for public discussion and involvement.

The NEPA process recognizes that installations and the surrounding communities must make decisions jointly to promote and maintain long-term training and testing opportunities. An important step in resolving some of the issues is to ensure that participants clearly understand the dynamic and spatial interactions between the military community's mission and land use needs (which underlie the proposed action), and the adjacent community's goals, planning policies, and future spatial growth patterns. SIRRA is a publicly accessible tool that can aid in informing decision makers and the public alike as to these regional characteristics.

SIRRA's regional data do not describe specific environments particular to a proposed action. However, SIRRA's data act as a "screening tool" to identify critical issues for a given region. This is the "regional scoping" aspect of a NEPA analysis. The driving force behind NEPA was the recognition that federal

PWTB 200-1-81
14 January 2011

properties are not "islands," independent of what happens around them. Rather, what happens "off-post" impacts what occurs "on-post." Regional policies and conditions play a role in assessing environmental impacts.

Applying SIRRA data to a NEPA analysis involves collecting data for a specific region from SIRRA, characterizing what the data means, and applying it to the proposed action.

These steps will provide an initial screening. Additional data sources are required to meet the guidelines of a complete NEPA analysis. NEPA analyses address an array of indicators at a national level that SIRRA cannot address.

Complete documentation of this application may be found online on the SIRRA Web site.

Watershed Application of SIRRA

USACE recognized the need for a systemwide approach to ecosystem management in its efforts to provide environmental sustainability in the stewardship of the nation's water resources. As the Corps increases its activities in sustainable watershed and water resource management, it will require expanded use of new and existing tools. Application of the SIRRA methodology to watershed assessments helped support the development of a Web-based decision support framework to allow access to information, databases, numerical models, index models, habitat models, and socio-economic models. Characterization of the nation's watersheds using an existing approach that has been applied to military installations leveraged existing research for a new application. This work characterized the nation's watersheds by using a subset of indicators from SIRRA and developed a methodology to identify watersheds with potential sustainment problems which it could then rank by their relative vulnerability to such problems. The work was sponsored by USACE's System Wide Water Resource Program (SWWRP).

Using the SIRRA methodology in a watershed context provided a list of watersheds that required further analysis and evaluation. Of the 2,250 HUC8 watersheds in the nation, the analysis indicated that 296 (about 13 percent) of the watersheds are vulnerable or highly vulnerable. Another 726 (one-third) of the watersheds were rated as moderately vulnerable. The remaining 1228 (55 percent) of the watersheds were rated as having low or very low vulnerability. The most endangered watersheds were located in areas of high growth and urbanization

including Arizona, California, Florida, and the New Jersey/New York City region. Watersheds in areas rated the least vulnerable tended to be located in rural areas or settings with low population. Figure C-3 shows a map of the United States that consolidates the results with red indicating most vulnerable.

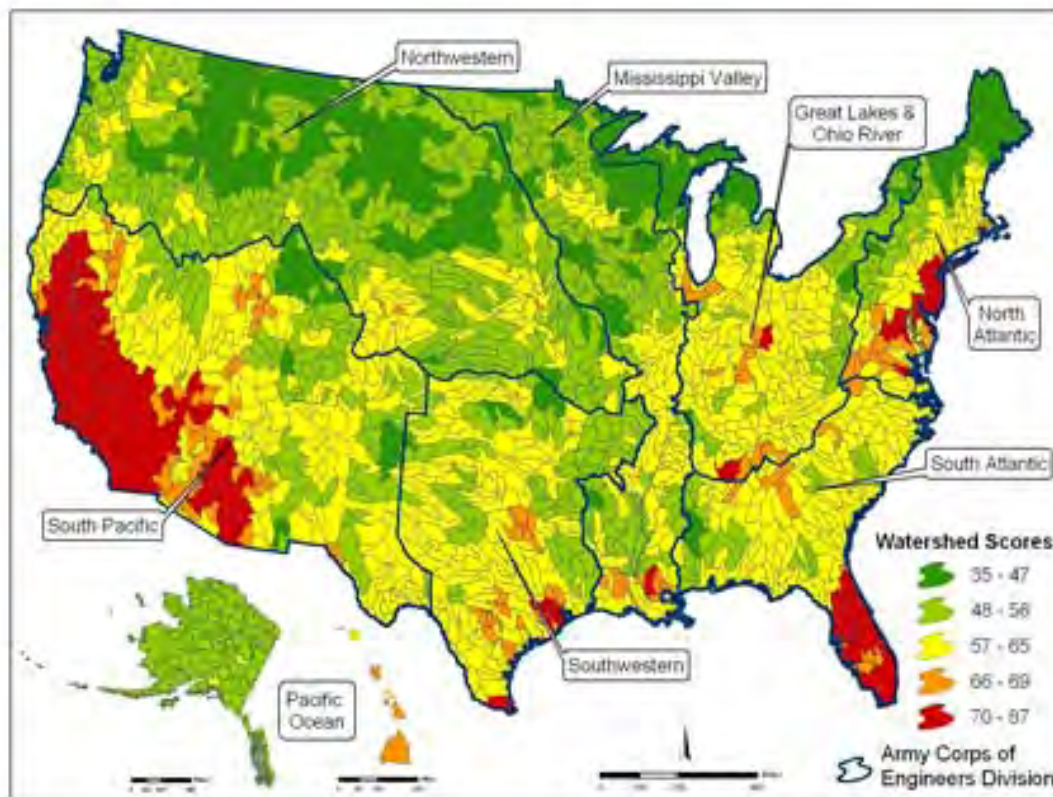


Figure C-3. Watershed vulnerability scores.

All locations had some vulnerability to sustainability issues, as evidenced by the fact that the lowest rating score was still significantly higher than the lowest possible score. However, the highest-scored watershed was still a good deal lower than the highest possible score. This indicates that watersheds do vary and that not all of the indicators are high or low for any given location.

Indicated scores were fairly linear across the range of scores except for either extreme. The watersheds with the highest vulnerability had a fairly steep rise in scores, indicating that as a group, vulnerabilities were worsening. The same is true for regions rated least vulnerable; the indicators tended to get much lower (better) as a group.

PWTB 200-1-81
14 January 2011

This watershed application allows personnel who are involved with systemwide studies such as watershed, ecosystem restoration, and water reallocation studies to obtain a first-cut evaluation of a watershed using national data sets. Such personnel could include USACE Division and District planners and project managers, regulators, and operation and maintenance managers.

The SIRRA-based watershed analysis capability provides an information link that increases the effectiveness of partnering with other agencies and private stakeholders. The watershed-based screening tool also may reduce costs associated with determining the watersheds that need study and encourage sustainable management of our natural resources.

Complete documentation of this application may be found in ERDC/CERL TR-05-24 (Jenicek et al. 2005). This report is available online at the SIRRA Web site and also through a link provided in Appendix F.

APPENDIX D SIRRA Metadata

Metadata reports are available for each of the 54 indicators. Each report shows the variables, scale, year, data sources, logic, limitations, replicability, and assessment rating measure of the data. These reports identify the cause of an unsatisfactory rating for a specific indicator, or the performance of a group of indicators.

Metadata may be accessed on the SIRRA Web site in one of two ways. The entire set of metadata for all 54 sustainability indicators is contained in a PDF format under the "Resources" tab (Figure D-1). Select the file name "Indicator Metadata" and you will be prompted to either open or save the metadata file.

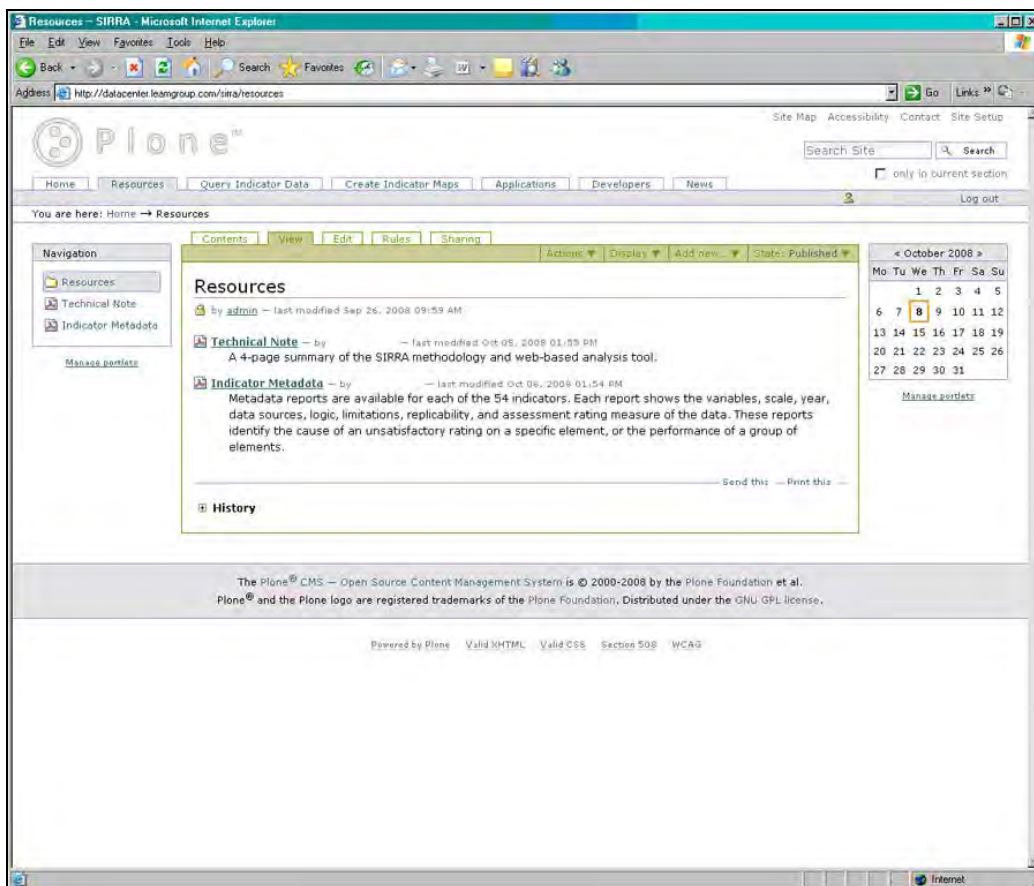


Figure D-1. The "Resources" folder showing "Indicator Metadata" file.

The second opportunity for the user to access metadata is when conducting a query on the indicator tabular data, accessed through the "Query Indicator Data" main tab. The output of a query is a table. The header of each table column is an indicator title. Each indicator title is "hot-linked" to the metadata information for that indicator. This allows immediate access to the data behind the data used to complete the query.

Figure D-2 shows the results of a data query. Metadata for each indicator is shown when the column heading is selected. Figure D-3 shows the result from selecting the column heading for Electrical Grid Reserve Capacity.

The screenshot shows a web browser window titled "Indicator Tabular Data - SIRRA - Microsoft Internet Explorer". The address bar shows the URL: http://dalacenter.leaingroup.com/sirra/indicator-tabular-data/indicator-tabular-data. The page content includes a navigation menu, a search bar, and a table of data. The table is titled "SIRRA - Sustainable Installations Regional Resource Assessment" and includes a "Download Table as Spreadsheet" link. The table has the following structure:

Installation by State		Energy Sustainability						Water Sustainability					
Installation	State	Electrical Reserve Margin (% margin)	Electric Grid Congestion (congestion level)	Renewable Energy-Wind (power class)	Renewable Energy-Solar (insolation value)	Renewable Energy-Biomass (tons/sq.mile)	Electrical Price Structure (deregulation)	Net Metering (action)	Level of Development (%)	Groundwater Depletion (%)	Flood Risk (# of people)	Low Flow Sensitivity (cubic feet sq. / sec)	Water Quality ()
Fort Bragg (Army)	STATE	7.8	Low Congestion	1	5.04	85.39	No Regulation	No Action	Average	Low	Average	0.37	1

Below the table, there is a "Manage outlets" link and a footer section containing copyright information: "The Plone CMS - Open Source Content Management System is © 2000-2008 by the Plone Foundation et al. Plone and the Plone logo are registered trademarks of the Plone Foundation. Distributed under the GNU GPL license." and technical details: "Powered by Plone Valid XHTML Valid CSS Section 508 WCAG".

Figure D-2. Table results of "Query Indicator Data."

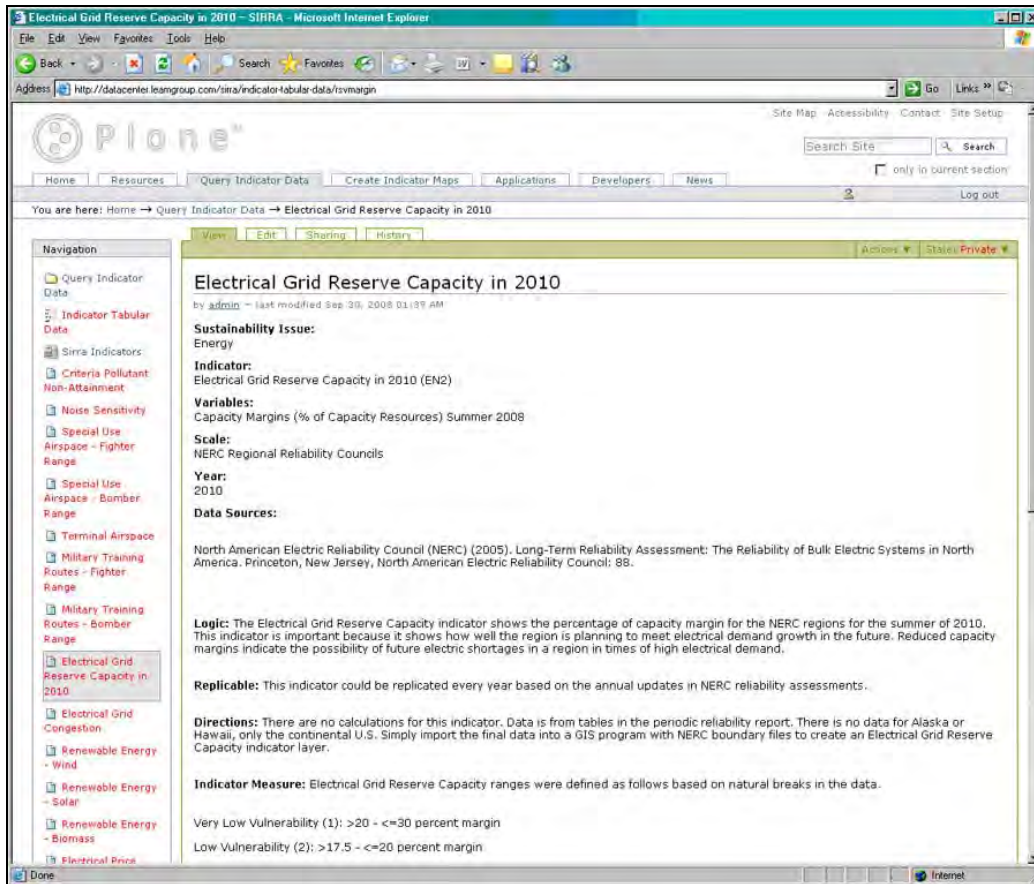


Figure D-3. Metadata for "Electrical Grid Reserve Capacity."

Appendix E **Acronyms and Abbreviations**

Term	Spellout
AEPI	American Environmental Policy Institute
APA	American Planning Association
BLS	Bureau of Labor Statistics
BRAC	Base Realignment and Closure (Act)
CERL	Construction Engineering Research Laboratory
BLS	Bureau of Labor Statistics
DA	Department of the Army
DoD	Department of Defense
DOE	Department of Energy
EA	environmental assessment
EIA	Energy Information Administration
EIS	environmental impact statement
ERDC	Engineer Research and Development Center
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
GIS	geographic information system
HHS	United States Department of Health and Human Services (HHS)
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HUC	hydrologic unit code
IRRIS	Intelligent Road/Rail Information Server
JAWRA	Journal of American Water Resources Association
JLUS	Joint Land Use Study
MSA	metropolitan statistical areas
MTR	Military Training Routes
NACJD	National Archive of Criminal Justice Data
NEPA	National Environmental Policy Act
NERC	North American Electricity Reliability Council
NLCD	National Land Use Data
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
NWS	National Weather Service
OSD	Office of the Secretary of Defense
PDF	portable document format
PHIND	Public Health Indicators and National Data (PHIND)
POC	point of contact
PWTB	Public Works Technical Bulletin
RDT&E	research, development, test and evaluation
REIS	U.S. Department of Commerce, Bureau of Economic Analysis
SERDP	Strategic Environmental Research and Development Program
SIRRA	Sustainable Installations Regional Resource Assessment
SMART	systemwide modeling, assessment, and restoration techniques
SUA	special use airspace
SWWRP	System-Wide Water Resources Program
TAF	terminal aerodrome forecasts
TES	threatened and endangered species
TR	technical report
TTI	Travel Time Index

PWTB 200-1-81
14 January 2011

Term	Spellout
UNC	University of North Carolina – Chapel Hill
URL	universal resource locator
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
USEPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Survey
USGS	U.S. Geological Survey
WGS	World Geodetic System
WWW	World Wide Web

Appendix F
Related ERDC-CERL Publications

Jenicek, Elisabeth M., Donald F. Fournier, Natalie R. Downs, and Brad Boesdorfer. 2005. *Watershed application of the sustainable installations regional resource assessment tool*, ERDC/CERL TR-05-24. Champaign, IL: Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL), available at (accessed June 2010):
http://www.cecer.army.mil/techreports/Jenicek_SIRRA_Watershed_TR/Jenicek_SIRRA_Watershed_TR.pdf

Jenicek, Elisabeth M., Natalie R.D. Myers, Brad Boesdorfer, and Donald F. Fournier. 2006. *A comparison of regional vulnerability factors for DoD installations*, ERDC/CERL TR-06-22. Champaign, IL: Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL), available at (accessed June 2010):
http://www.cecer.army.mil/techreports/ERDC-CERL_TR-06-22/ERDC-CERL_TR-06-22.pdf

Jenicek, Elisabeth M., Donald F. Fournier, Natalie R.D. Myers, and Brad Boesdorfer. 2006. *A characterization of land use trends around the perimeter of military ranges*, ERDC/CERL TR-06-26. Champaign, IL: Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL), available at (accessed June 2010):
http://www.cecer.army.mil/techreports/ERDC-CERL_TR-06-26/ERDC-CERL_TR-06-26.pdf

This publication may be reproduced