SOURCE WATER ASSESSMENT REPORT

Ground Water Sources

GREENWOOD WD
Public Water System ID: CO0203009

ENGLEWOOD, CO

ARAPAHOE County

11/8/2004

Colorado Department of Public Health and Environment
Water Quality Control Division
Source Water Assessment and Protection Program
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

SOURCE WATER ASSESSMENT SUMMARY

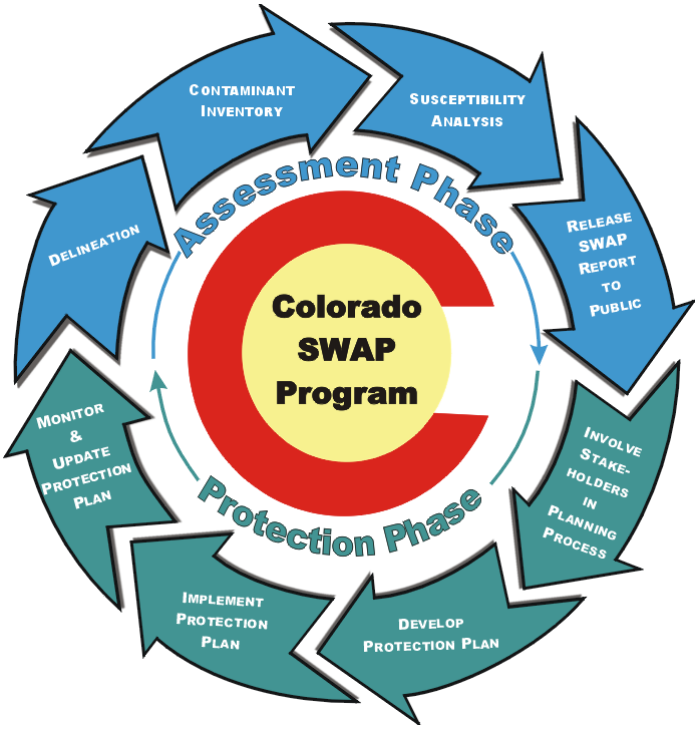
Background

The Colorado Department of Public Health and Environment (CDPHE) has completed a source water assessment for **GREENWOOD WD** as required by the 1996 Safe Drinking Water Act amendments and in accordance with Colorado's Source Water Assessment and Protection (SWAP) program. The purpose of this assessment is to analyze the potential susceptibility of each public drinking water source to contamination, and to supply pertinent information so that decision-makers voluntarily can develop and implement appropriate preventive measures to protect these water sources. The Safe Drinking Water Act requires that the public water system and its consumers be informed of the assessment results.

SWAP Process

The SWAP program is a multi-step two-phased process (Figure 1) designed to assist public water systems in preventing accidental contamination of their untreated drinking water supplies. These phases include the assessment phase and the protection phase as depicted in the upper and lower portions of Figure 1, respectively.

Figure 1. Source Water Assessment and Protection Process.



The assessment phase involves understanding where each public water system's source water comes from, what contaminant sources potentially threaten the water source(s), and how

susceptible each water source is to potential contamination. The product of the assessment phase is contained in this report.

The protection phase occurs when local decision-makers use the source water assessment results and other pertinent information to develop management and response strategies to protect the water sources from potential contamination.

Assessment Process

As depicted in the upper portion of Figure 1, the source water assessment for all public water systems consists of four primary elements. These elements include:

1) delineating the source water assessment area for each drinking water source;
2) conducting a contaminant source inventory to identify potential sources of contamination within each of the source water assessment areas;
3) conducting a susceptibility analysis to determine the potential susceptibility of each public drinking water source to the different sources of contamination and;
4) reporting the results of the source water assessment to the public water systems and the general public.

Public water systems were given the opportunity to review and provide corrections and/or feedback on draft versions of their source water assessment area delineations and their contaminant source inventories. All pertinent corrections and feedback were incorporated into this assessment.

Delineation of Source Water Assessment Area

The source water assessment area defines the area or region of the watershed or aquifer contributing untreated water to the public water system's source water intake. The area also defines where potential contamination of this water source could occur.

A public water system may have rights to use one or more source water types for drinking water. These source water types include:

- Surface water source - any "untreated" water source that is diverted directly from a stream, river, lake, pond or similar surface water body.
- Ground water source - any "untreated" water source that is diverted directly from an underground source of water (i.e., an aquifer).
- Ground water source under the direct influence of surface water - any "untreated", shallow, ground water source that testing has shown to be in hydrologic connection to a nearby surface water body.

For ground water systems, the source water assessment area essentially includes the area of the aquifer drained by the source water intake. In the case of ground water systems, the intake would most commonly include wells, and to a lesser extent include spring boxes and infiltration galleries.

A public water system also may have purchased water sources. A purchased water source includes any "treated" surface water source, ground water source and/or ground water source under the influence of surface water that is purchased from another public water system.

This assessment report presents the results only for active ground water sources that the public water system has rights to use for drinking water. Assessment results for any purchased ground water sources that the public water system may have are presented in the source water assessment report(s) for the public water system that supplies the purchased ground water source.

Contaminant Source Inventory

Drinking water sources are susceptible to contamination from a wide variety of natural and man-made threats. Figure 2 illustrates some of the potential contaminant sources that might be encountered for surface water and ground water sources, and how contaminants from these sources can enter the source water. Potential contaminant sources include anything likely to manufacture, produce, use, store, dispose, or transport regulated and unregulated contaminants of concern. Potential contaminant sources were divided into two groups for this assessment:

- Discrete contaminant sources – generally include facility-related operations from which the potential release of contamination would originate from a relatively small area.
- Dispersed contaminant sources – generally include broad based land uses and miscellaneous sources from which the potential release of contamination would be spread widely over a relatively large area.

Figure 2. Examples of Potential Contaminant Sources and How Contaminants Can Enter Your Source Water.

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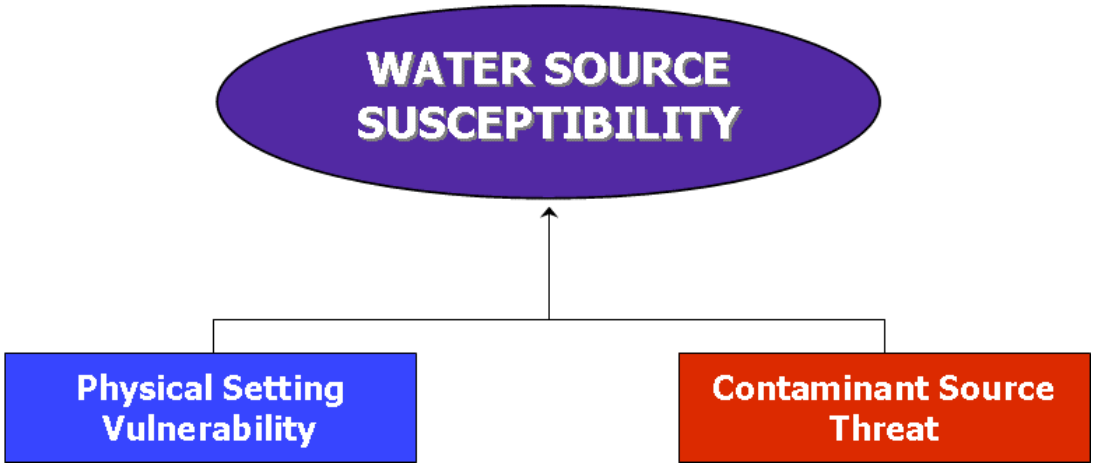
Susceptibility Analysis

The current analysis looks at the susceptibility of a water source to individual potential contaminant sources (referred to as individual susceptibility), as well as the total susceptibility of a water source to all of the individual potential contaminant sources that were inventoried within its source water assessment area. The susceptibility of a ground water source to an individual potential contaminant source depends on the two primary factors: physical setting vulnerability and contaminant source threat, as shown in Figure 3.

Figure 3. Components of Water Source Susceptibility.



Physical Setting Vulnerability – involves an evaluation of the ability of the ground water flow system in the source water assessment area to provide a sufficient buffering capacity to mitigate potential contaminant concentrations in the source water. This ability is affected by physical characteristics like the ground water flow properties of the aquifer, the total depth of the water source and its intake, the depth to first water, the flow rate of the water source, as well as the structural soundness of the intake itself.

Contaminant Source Threat – involves an evaluation of the potential for a contaminant source to provide contaminants in sufficient amounts for the source water to become contaminated at concentrations that may pose a health concern to consumers of the water. The potential threat is affected by the types and volumes of potential contaminants that might be present, the likelihood that contaminants might be released, the proximity of the contaminant source to the source water intake, and soil properties and water levels in the vicinity of the contaminant source.

The total susceptibility of a water source is determined from its cumulative susceptibility to all of the discrete contaminant sources and all of the dispersed contaminant sources that were inventoried in its source water assessment area. In other words, the total susceptibility of a water source is a reflection of the combined individual susceptibilities posed by all of the discrete and all of the dispersed contaminant sources inventoried in the source water assessment area. Therefore, the susceptibility of a water source to all discrete contaminant sources is a reflection of the combined individual susceptibilities posed by each discrete contaminant source that was

inventoried. Likewise, the susceptibility of a water source to all dispersed contaminant sources is a reflection of the combined individual susceptibilities posed by each dispersed contaminant source that was inventoried.

In order to determine the susceptibility of a water source to potential contamination, the Colorado Department of Public Health and Environment developed a unique susceptibility analysis model and scoring system to evaluate the different physical setting vulnerability and contaminant threat factors that contribute to the susceptibility of a water source. This unique model and scoring system serves as the benchmark by which the potential susceptibility of other like water sources in the state can be measured or judged. *Therefore, the results of your source water assessment are not directly comparable to results from other states. These assessment results are only meaningful when compared to other ground water sources in Colorado.*

To provide the reader a general sense of the degree of potential risk to a water source, the total susceptibility scores, individual susceptibility scores and physical setting vulnerability scores are assigned qualitative ratings of Low, Moderately Low, Moderate, Moderately High, or High based on statistical indicators established by the Colorado Department of Public Health and Environment. In developing the qualitative ratings for these particular factors, a commonly applied statistical approach is used to group the scores for each of these factors into the five possible rating categories. This approach is not unlike what a teacher uses in grading student test scores. The statistical approach determines the factor score's relative position within the statewide populations of total susceptibility scores, individual susceptibility scores or physical setting vulnerability scores for the more than 2,700 ground water sources that were analyzed.

In general, the higher the susceptibility rating for the water source, the greater the risk for potential contamination of the water source. For example, a total susceptibility rating of Moderately High or High generally means that the potential vulnerability posed by the physical setting of the water source and the cumulative potential threats posed by the various contaminant sources are proportionately higher than the vulnerability and cumulative threats posed to an average ground water source in the state. Similarly, an individual susceptibility rating of Moderately High or High generally means that the potential vulnerability posed by the physical setting of the water source and the potential threat posed by an individual contaminant source is proportionately higher than the vulnerability and individual threat posed to an average ground water source in the state.

Likewise, the higher the physical setting vulnerability rating for the water source, the more vulnerable the water source is to potential contamination. A physical setting vulnerability rating of Moderately High or High generally means that the physical setting of the water source potentially provides proportionately less buffering capability to mitigate potential contaminant concentrations in the source water when compared to an average ground water source in the state.

The results of the statistical evaluations are easier to understand by plotting the statewide distribution of the total and individual susceptibility ratings, and the physical setting vulnerability ratings for all ground water sources that were analyzed. The final statewide total susceptibility, individual susceptibility and physical setting vulnerability rating distribution plots

generated from the evaluations are presented in the assessment results section of this report. These rating distribution plots present the numerical scoring ranges associated with a given rating category, and the number of water sources or contaminant sources throughout the state that received a specific rating.

The Colorado Department of Public Health and Environment has provided two source water assessment methodology documents that can be downloaded from the Colorado SWAP web site (**www.cdphe.state.co.us/wq/sw/swaphom.html**) and reviewed. These documents present a more detailed discussion on the assessment methodology used for surface water sources and ground water sources under the direct influence of surface water, and ground water sources for people who are interested.

Protection Process

Public water systems and communities are strongly encouraged to use their source water assessment information to voluntarily enter the protection phase of SWAP. The next step involves developing and continuously implementing a source water management or protection plan at the local level. **No statutory authority has been given to the Colorado Department of Public Health and Environment to force the adoption or implementation of source water protection measures. The authority to do so rests with local communities and governments.**

As depicted in the lower portion of Figure 1, the source water protection phase for all public water systems consists of four primary elements. These elements include:

1) involving stakeholders in the planning process;
2) developing a comprehensive protection plan for all of your drinking water sources;
3) implementing the protection plan on a continuous basis to reduce the risk of accidental contamination of the drinking water sources; and
4) monitoring the effectiveness of the protection plan and updating it accordingly as future assessment results indicate.

Involve Stakeholders

Public participation is crucial to the overall success of Colorado's SWAP program. Source water protection was founded on the concept that informed citizens, equipped with fundamental knowledge about their drinking water source and the threats to it, will be the most effective advocates for protecting this valuable resource.

The public water supplier or any other well-suited local interest group may take the lead in organizing public participation in the local SWAP protection planning effort. For public participation to be effective, there must be a well-organized effort to raise public awareness, identify groups and individuals interested in helping, and to define and implement the necessary assessment and planning tasks. The lead group is encouraged to involve all types of stakeholders

– individuals, groups, organizations and local decision-makers affected by or concerned with the community's drinking water – in the local source water protection planning efforts.

Develop Protection Plan

A source water management or protection plan essentially identifies (1) the specific management tools the public water system and community will use or the actions they will take to protect their source water, and (2) how the public water system and community will carry them out. A companion contingency plan is usually developed as part of the overall management plan. The contingency plan is essentially an emergency response plan for the water system that lays out a coordinated plan for responding rapidly, effectively, and efficiently to any emergency incident that threatens or disrupts the community water supply. Emergency incidents are any man-made events (e.g., chemical contamination, fire, vandalism, terrorism) or natural events (e.g., drought, fire, tornado) that can adversely affect the capability of the public water system to provide a steady supply of safe drinking water to its consumers. Public water systems and communities are encouraged to be creative in developing these plans.

Implement Protection Plan

The reduction of risk of accidental contamination of drinking water sources is affected by how well the public water system and community carry out the specific management tools they use or the actions they take to protect their source water. This requires a proper commitment of funding resources and personnel by the public water system and community to implement the source water protection measures they have developed. Considering the high cost of cleaning up contaminants once they have been released to the environment, this commitment may well be a reasonable investment to protect the natural quality of the drinking water source and avoid potential costly treatment of a contaminated water supply and/or costly development of a new water supply. The Colorado Department of Public Health and Environment also encourages public water systems and decision-makers to use their source water assessment results in making local land use decisions. Public water systems and communities interested in developing and implementing source water protection measures may be able to find limited financial assistance through the Colorado Department of Public Health and Environment.

Monitor and Update Protection Plan

Public water systems and communities are encouraged to monitor the effectiveness of the source water protection measures they have implemented and to update their source water protection plan accordingly as future assessment results indicate. In developing a protection plan, each public water system is encouraged to identify measurable results that can be used to monitor the success of the protection measures they have implemented. Source water protection plans may need to be revised to address new potential threats over time as new assessment results become available. As shown in Figure 1, SWAP was designed to be an iterative process, alternating back and forth between assessment and protection phases.

The primary elements of the protection phase discussed above are meant as a guide to public water systems and communities. In actual practice, developing and implementing source water

protection may be more or less complicated depending on the local community's willingness to adopt and implement source water protection measures. Additional source water protection information can be obtained by going to the U.S. Environmental Protection Agency's source water protection website (**www.epa.gov/safewater/protect.html**). Staff members at the Colorado Department of Public Health and Environment also are available to provide assistance with source water protection efforts.

Assessment Results

The source water assessment for **GREENWOOD WD** rendered the following results:

- At the time of this assessment, the water supply consists of:

  - 2 active ground water sources
  - 0 active, purchased ground water sources

- Table 1 presents the cumulative results of the total susceptibility of the water source(s) to potential contamination from both discrete and dispersed contaminant sources. Water sources with total susceptibility ratings of Moderately High or High generally are at greater risk for potential contamination than those receiving lower ratings. As shown in Table 1, 1 active water source(s) was/were determined to have a Moderately High or High susceptibility to potential contamination.

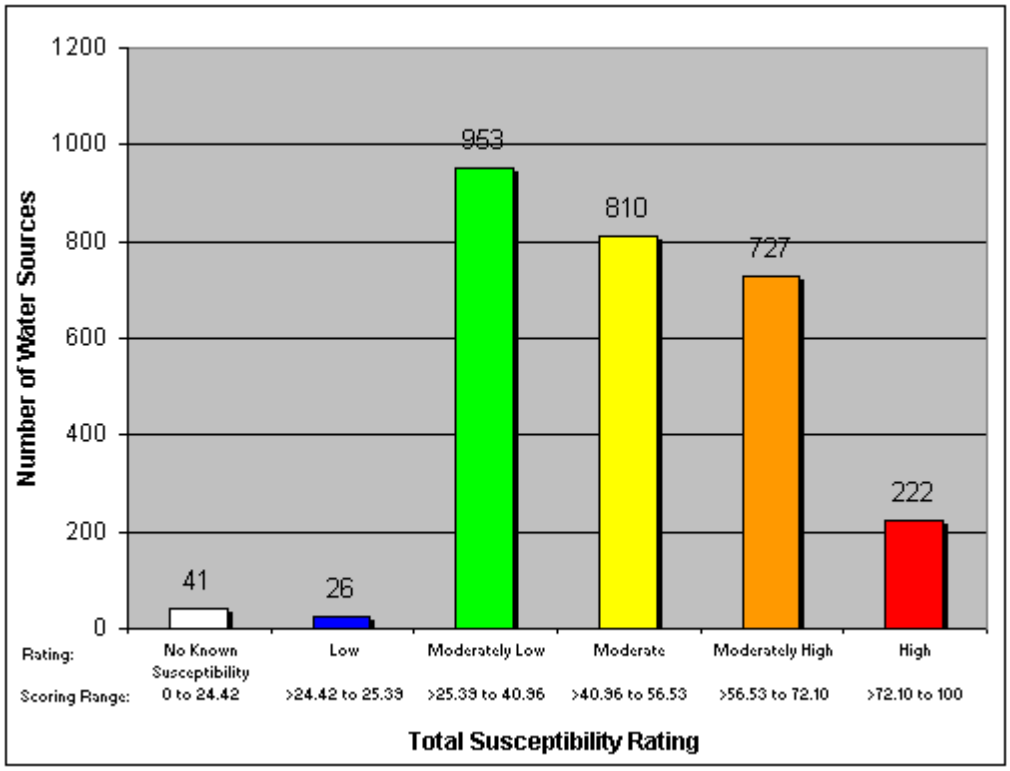
  There may be cases where the assessment was unable to verify the presence of discrete and dispersed contaminant sources based on the databases used for the contaminant inventory. In these cases, unless new information is identified and analyzed, the water source(s) is/are not currently known to be susceptible to potential contamination from any known discrete or dispersed contaminant sources. This situation is indicated in Table 1 by water sources receiving an overall susceptibility rating of "No Known Susceptibility."

  Table 1. Total Susceptibility Ratings for Water Sources.

Number of Water Sources	Susceptibility Rating
0	No Known Susceptibility
0	Low
0	Moderately Low
1	Moderate
1	Moderately High
0	High

  Figure 4 presents the statewide total susceptibility rating distribution plot for all ground water sources that were analyzed. The rating distribution plot presents the numerical scoring ranges associated with a given rating category, and the number of ground water sources throughout the state that received a specific qualitative rating. By comparing the results in Table 1 to Figure 4, one can see how the total susceptibility of the water source(s) in Table 1 compared to the total susceptibility of the other ground water sources throughout the state.

Figure 4. Statewide Total Susceptibility Rating Distribution Plot.



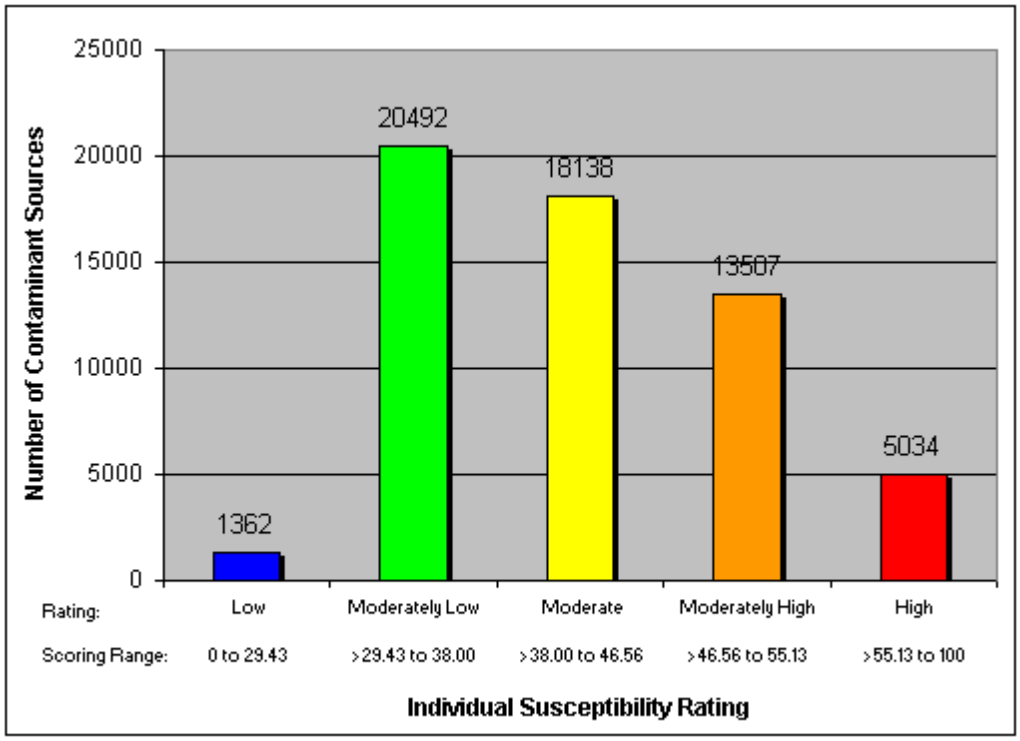
- Table 2 presents a summary of the individual susceptibility of the water source(s) to various types of discrete contaminant sources that were evaluated. Water sources with a Moderately High or High individual susceptibility to a discrete contaminant source generally are at greater risk for potential contamination from the discrete contaminant source than water sources receiving lower individual susceptibility ratings to similar or different discrete contaminant sources. The water source(s) has/have the greatest risk to potential contamination from the following types of discrete contaminant sources:

Table 2. Susceptibility of Water Source(s) to Discrete Contaminant Sources.

Contaminant Source Type	Individual Susceptibility Rating Summary (cumulative count for all water sources)				
	Low	**Mod. Low**	**Moderate**	**Mod. High**	**High**
EPA Superfund Sites	0	0	0	0	0
EPA Abandoned Contaminated Sites	0	0	0	0	0
EPA Hazardous Waste Generators	9	43	1	0	0
EPA Chemical Inventory/Storage Sites	0	7	13	0	0
EPA Toxic Release Inventory Sites	0	0	0	0	0
Permitted Wastewater Discharge Sites	0	1	0	0	0
Aboveground, Underground and Leaking Storage Tank Sites	0	184	29	0	0
Solid Waste Sites	0	0	0	0	0
Existing/Abandoned Mine Sites	0	3	1	0	0
Concentrated Animal Feeding Operations	0	0	0	0	0
Other Facilities	28	147	39	0	0
TOTAL:	**37**	**385**	**83**	**0**	**0**

Figure 5 presents the statewide rating distribution plot of the individual susceptibility to various types of discrete contaminant sources for all ground water sources that were analyzed. The rating distribution plot presents the numerical scoring ranges associated with a given rating category, and the number of discrete contaminant sources throughout the state that received a specific qualitative rating. By comparing the total count results in Table 2 to Figure 5, one can see how the individual susceptibility results of the water source(s) in Table 2 compared to the combined individual susceptibility results of the other ground water sources throughout the state.

Figure 5. Statewide Rating Distribution Plot of Individual Susceptibility to Discrete Contaminant Sources.



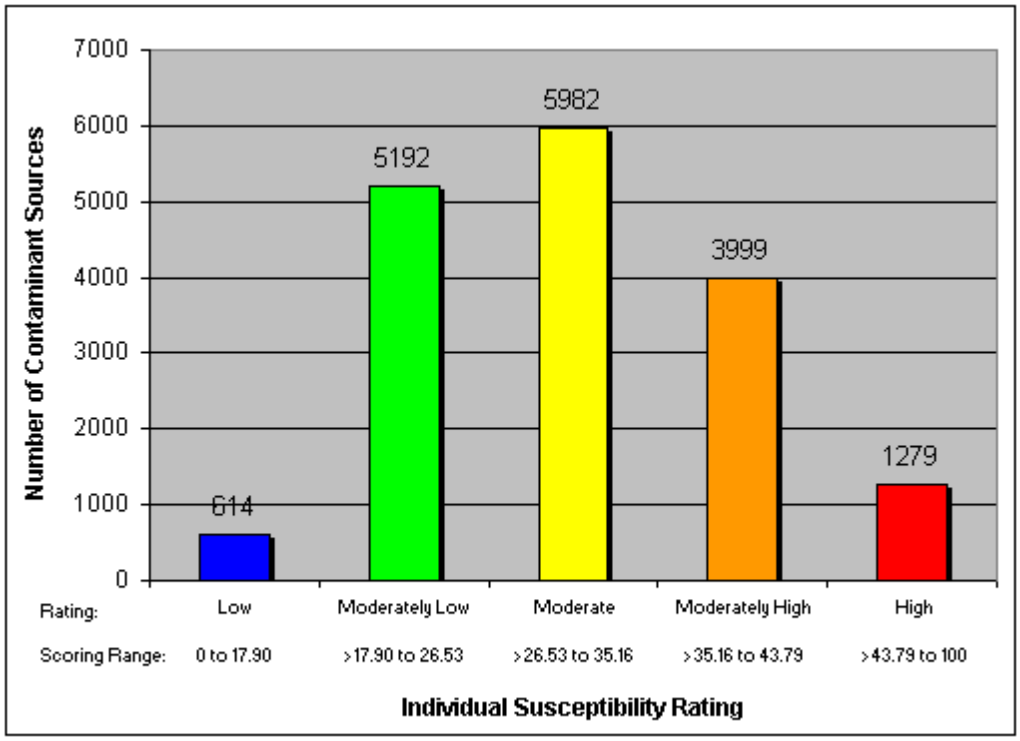
- Table 3 presents a summary of the individual susceptibility of the water source(s) to various types of dispersed contaminant sources that were evaluated. Water sources with a Moderately High or High individual susceptibility to a dispersed contaminant source generally are at greater risk of potential contamination from the dispersed contaminant source than water sources receiving lower individual susceptibility ratings to similar or different dispersed contaminant sources. The water source(s) has/have the greatest risk to potential contamination from the following types of dispersed contaminant sources:

Table 3. Susceptibility of Water Source(s) to Dispersed Contaminant Sources.

Contaminant Source Type	Individual Susceptibility Rating Summary (cumulative count for all water sources)				
	Low	**Mod. Low**	**Moderate**	**Mod. High**	**High**
LAND USE / LAND COVER TYPES:					
Commercial/Industrial/Transportation	0	2	0	0	0
High Intensity Residential	1	1	0	0	0
Low Intensity Residential	0	1	1	0	0
Urban Recreational Grasses	0	2	0	0	0
Quarries / Strip Mines / Gravel Pits	0	0	0	0	0
Row Crops	2	0	0	0	0
Fallow	1	1	0	0	0
Small Grains	1	1	0	0	0
Pasture / Hay	1	1	0	0	0
Orchards / Vineyards / Other	0	0	0	0	0
Deciduous Forest	0	0	0	0	0
Evergreen Forest	0	0	0	0	0
Mixed Forest	0	0	0	0	0
OTHER TYPES:					
Septic Systems	0	0	1	1	0
Oil / Gas Wells	0	0	0	0	0
Road Miles	0	0	2	0	0
TOTAL:	**6**	**9**	**4**	**1**	**0**

Figure 6 presents the statewide rating distribution plot of the individual susceptibility to various types of dispersed contaminant sources for all ground water sources that were analyzed. The rating distribution plot presents the numerical scoring ranges associated with a given rating category, and the number of dispersed contaminant sources throughout the state that received a specific qualitative rating. By comparing the total count results in Table 3 to Figure 6, one can see how the individual susceptibility results of the water source(s) in Table 3 compared to the combined individual susceptibility results of the other ground water sources throughout the state.

Figure 6. Statewide Distribution Plot of Individual Susceptibility to Dispersed Contaminant Sources.



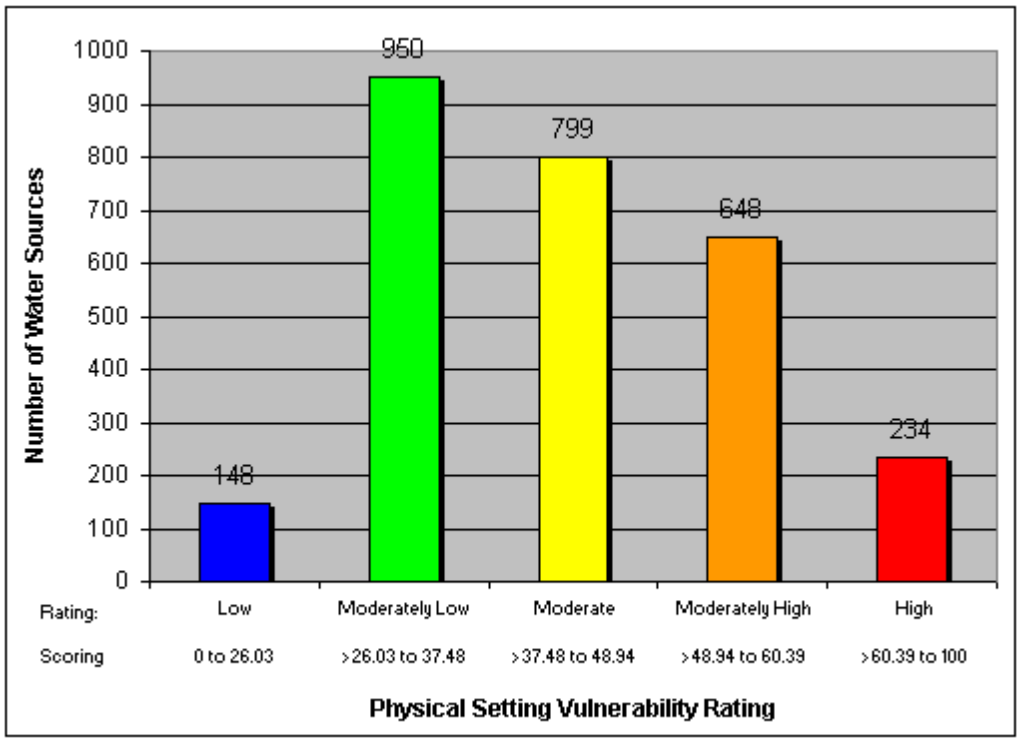
- Table 4 presents the cumulative results of the physical setting vulnerability ratings of the water source(s). A vulnerable physical setting generally means the water source(s) will be more susceptible to potential contamination. Water sources with physical setting vulnerability ratings of Moderately High or High generally are expected to have higher levels of potential susceptibility to contamination. As shown in Table 4, 0 active water source(s) was/were determined to have a Moderately High or High physical setting vulnerability.

Table 4. Physical Setting Vulnerability Ratings for Water Sources.

Number of Water Sources	Physical Setting Vulnerability Rating
0	Low
2	Moderately Low
0	Moderate
0	Moderately High
0	High

Figure 7 presents the statewide physical setting vulnerability rating distribution plot for all ground water sources that were analyzed. The rating distribution plot presents the numerical scoring ranges associated with a given rating category, and the number of ground water sources throughout the state that received a specific qualitative rating. By comparing the results in Table 4 to Figure 7, one can see how the physical setting vulnerability of the water source(s) in Table 4 compared to the physical setting vulnerability of the other ground water sources throughout the state.

Figure 7. Statewide Physical Setting Vulnerability Rating Distribution Plot.



The physical setting vulnerability remains important even where no or very few potential contaminant sources (discrete and/or dispersed) have been identified within the source water assessment area. In this case, if the physical setting vulnerability for a water source is estimated to be Moderately High or High, it could cause an increased susceptibility to contamination in the future if certain discrete and/or dispersed contaminant sources were located within the source water assessment area. This potential impact ultimately will depend on the degree of contaminant threat posed by the specific potential contaminant sources. Public water systems are strongly encouraged to consider this in their source water protection planning efforts, and to be vigilant to the introduction of potential contaminant sources within highly vulnerable physical settings. Such information may be useful to local land use planning agencies making land use and zoning decisions related to the siting of these future potential contaminant sources.

Additional Considerations

The source water assessment provides a screening-level evaluation of the likelihood that a potential contamination problem could occur rather than an indication that a potential contamination problem has or will occur. This evaluation is comparable to what a doctor might use to screen a patient for a particular medical condition. The results of this assessment reflect the best efforts of the Colorado Department of Public Health and Environment and its contractors to simplify several complex physical, chemical and operational processes, and to assemble quality data sets for use in the assessment. Future improvements to the source water assessment results are envisioned as additional data become available. The Colorado Department of Public Health and Environment is confident that this assessment provides useful information to communities concerning the contaminant sources to which their water supply is potentially most susceptible. Public water systems also can use this information to evaluate the need for improvement to current water treatment capabilities, so as to be better prepared for future contamination threats.

This report represents the public version of the source water assessment that the Colorado Department of Public Health and Environment is required to make available under the Safe Drinking Water Act. The public version differs from the public water system version in that more detailed supporting information (e.g., input data and maps) was provided to each public water system as part of their report. Some of this supporting information is viewed by the Colorado Department of Public Health and Environment and many public water systems as security sensitive. Under the Colorado Open Records Act, certain information can be withheld from public disclosure if the information can be characterized either as "details of security arrangements or investigations" [section 27-72-204(3)(a)(XVII) C.R.S] or as information whose disclosure "would do substantial injury to the public interest" [section 24-72-204(6)(a) C.R.S.]. The Colorado Department of Public Health and Environment has determined that the following security sensitive information meets one or both of the preceding characterization criteria and will be withheld from public disclosure:

- Location information about the public water system's intakes/wells, treatment facilities, and diversion/conveyance structures, as well as location information about potential sources of contamination. Location information would include location coordinates, physical addresses and maps showing the locations of the intakes/wells, treatment facilities, diversion/conveyance structures, and potential sources of contamination;
- Hazardous chemical quantities, type, processes, and/or likelihood of release;
- Well/intake depths; and
- Structural integrity information concerning the drinking water intakes/wells.

Public water systems also will be given the opportunity to provide the Colorado Department of Public Health and Environment with rationale for excluding additional supporting information from public disclosure once they have received and reviewed their source water assessment report. Their rationale must meet one or both of the preceding characterization criteria established under the Colorado Open Records Act to be acceptable.

Consumers are encouraged to contact ***GREENWOOD WD*** at ***303-740-9724*** if you are:

- interested in knowing more about the supporting information provided to the public water system; or
- interested in what source water protection measures the water system may be developing.

If you have questions concerning the results presented in the public version of the source water assessment, the methodologies used in the source water assessment, or the SWAP program in general, please contact the Colorado Department of Public Health and Environment at (303) 692-3592.

DISCLAIMER

This Source Water Assessment utilized information from a variety of public and other sources, and as such, no warranty of merchantability or of fitness for a particular purpose, expressed or implied, shall apply and the Colorado Department of Public Health and Environment specifically disclaims the making of such warranties. In no event shall the Colorado Department of Public Health and Environment be liable to anyone for special, incidental, consequential or exemplary damages.