## 5.3. Element 3: Hydrology and Water Use.

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**5.3.1. Water Rights and Use.** Water supply in the Jackson Creek Watershed consists of surface water, ground water, and reservoir storage. A report of the Oregon Water Resources Department (OWRD) Water Rights Information System (WRIS) system shows 31 primary diversions for surface water, 37 for ground water, and 6 for reservoir storage. Secondary diversions include 3 for surface water and 3 for ground water. The primary and secondary diversions consist of all the non-canceled water rights on Jackson Creek and its tributaries. The earliest surface water right on record with OWRD for the watershed is a 0.16 cubic feet per second (cfs) right dated 12/31/1853. The earliest ground water right on record is a 115 gallons per minute (g.p.m.) right dated 12/31/1920.

**Terminology:**

**Baseflow** = that portion of streamflow that consists of ground water which discharges to the stream.
**Climate Generator** = a computer model used to generate daily values of climatic variables such as precipitation, air temperature, wind speed and solar radiation based on long term records from a weather station. A climate generator is used to estimate climatic conditions for areas where little or no data are available.
**Direct runoff** = that portion of streamflow that flows over the land surface as a result of rainfall or snowmelt.
**Evapotranspiration (ET)** = a collective term for all the processes by which water in the liquid or solid phase at or near the earth's surface becomes atmospheric water vapor. It includes evaporation from rivers and lakes, bare soil, and vegetative surfaces; evaporation from within the leaves of plants (transpiration); and sublimation from ice and snow surfaces.
**Exceedance-** 50% exceedance flow is the amount of streamflow that occurs on average of one out of two years (50% of the time). This value is used to determine if water is available for the issuing of a new water right for surface water storage; 80% exceedance flow is the amount of streamflow that occurs on average four out of five years (80% of the time). This value is used to determine if water is available for issuing a new surface water right (OWRD).
**Model Calibration** = the process by which the values of model parameters are identified for use in a particular application. Calibration consists of the use of rainfall-runoff data and a procedure to identify the model parameters that provide the best agreement between simulated and recorded flows.
**OWRD-** Oregon Water Resources Department
**SCS Runoff Curve Number** = A procedure developed by the Soil Conservation Service to determine the amount of direct runoff that will result from a rainstorm of a given magnitude.
**SWAT -** Soil and Water Assessment Tool; USDA-SCS
**WARS -** Water Availability Report System
**WRIS -** Water Rights Information System

Table 5-1 is a compilation of primary diversion water use by stream reach for surface water, ground water, and reservoir storage. Values shown in the table are reported in cubic feet per second for surface and ground water, and in acre feet for reservoir storage.

**Table 5-1. Surface, and Ground Water Use by Stream Reach on Jackson Creek.**

| Reach | Total (cfs) | Irrigation | Fish/Wildlife | Industrial/ Domestic |
|---|---|---|---|---|
| **Surface/Stream Water** | | | | |
| **Jackson Cr. > Bear Cr.** | 24.42 | 24.41 | Water right applied for, but not granted | 0.01 |
| **Dean Cr. > Jackson Cr.** | 0.75 | 0.74 | 0 | 0.01 |
| **Horn Cr. > Jackson Cr.** | 0.23 | 0.21 | 0 | 0.02 |
| **Walker Ck. > Jackson Cr.** | 1.21 | 1.21 | 0 | 0 |
| **Miller Gulch > S.F. Jackson Cr.** | 0.02 | 0 | 0 | 0.02 |
| **Rock Cr. > Miller Gulch** | 0.1 | 0.1 | 0 | 0 |
| **Ground Water** | | | | |
| **Jackson Cr. > Bear Cr.** | 7.33 | 7.33 | 0 | 0 |
| **Dean Cr. > Jackson Cr.** | 0.6 | 0.6 | 0 | 0 |
| **Horn Cr. > Jackson Cr.** | 0.6 | 0.6 | 0 | 0 |
| **Jacksonville Reservoir (acre feet)** | 7 | 0 | 0 | 0 |
| **Total (cfs)** | 35.26 | 35.20 | 0 | 0.06 |

Source: Oregon Water Resources Department, 2000.

Note: Jacksonville Reservoir when constructed in 1903 was designed to retain 800 acre feet of water. Over the years the reservoir has filled in with sediment, and today retains approximately 7 acre feet of water.

As shown in Table 5-1, of the reported 35.26 cfs for primary use, diversion by surface water accounts for about 76% and ground water about 24% of the total water use. Irrigation comprises 99.7% of the surface water use. The largest portion of surface water use occurs in the last ½ mile of Jackson Creek below Dean Creek, where irrigation and agriculture account for 94% of the primary surface water diversions. Similarly, irrigation accounts for 99% of the primary ground water diversions in the stream reach below Dean Creek.

**5.3.2. Water Availability**. Water availability is the amount of water that is physically and legally available for future appropriation, based on the natural streamflow at the 80% flow exceedance level, the consumptive use of diverted water, and the instream water rights.[1] Table 5-2 is a water availability report for Jackson Creek that was developed from the OWRD Water Availability Report System (WARS) program.

**Table 5-2. Water Availability for Jackson Creek at the 80% Flow Exceedance Level.**

| Month | Natural Stream Flow (cfs) | Net Minimum Flow(cfs) | Instream Water Rights (cfs) | Net Water Available(cfs) |
|---|---|---|---|---|
| 1 | 6.1 | 5.63 | 14 | -8.37 |
| 2 | 7.6 | 7.03 | 17 | -9.98 |
| 3 | 7.03 | 6.55 | 14 | -7.45 |
| 4 | 4.54 | 2.36 | 9 | -6.64 |
| 5 | 2.86 | -0.62 | 6 | -6.62 |
| 6 | 1.65 | -3.25 | 3 | -6.25 |
| 7 | 0.57 | -6.01 | 1 | -7.01 |
| 8 | 0.33 | -5.09 | 0.5 | -5.59 |
| 9 | 0.27 | -3.27 | 0.4 | -3.67 |
| 10 | 0.3 | -0.84 | 0.4 | -1.24 |
| 11 | 0.71 | 0.61 | 2 | -1.39 |
| 12 | 3.11 | 2.78 | 9 | -6.22 |

***As shown in the "Net Water Available" column of Table 5-3, all flows are negative, indicating that there is no water available in the Jackson Creek subbasin for future appropriation.***

The estimated 50 % flow exceedance at the mouth of Jackson Creek ranges from 0.36 cfs in September to 17.1 cfs in February. The 80 % flow exceedance values range from 0.27 cfs in September to 7.6 cfs in February. Results of the WARS program for Jackson Creek are not unlike most of the other streams in the Rogue Basin, where surface water is unavailable for future appropriation.

[1] The WARS program produces both the 50% and 80% values of flow exceedance, along with the associated water availability for each month. The 50% and 80% flow exceedance values refer to discharges that occur at least 50% and 80% of the time during a given month. The 80% flow exceedance value is used to determine if water is available for issuing a new surface water right. The 50% flow exceedance value is used to determine if there is sufficient water for the issuing of a water right for surface water storage.

**5.3.3. Influence of Irrigation on Streamflow**. Streamflows in Jackson Creek are significantly influenced by diversions and interbasin transfers as a result of irrigation practices by Medford Irrigation District (MID) and Rogue River Valley Irrigation District (RRVID) during the irrigation season. A complex system of canals, diversions and transfers exists within the watershed, including RRVID's use of Jackson Creek as a means of conveyance for delivering water to its respective points of diversion. The conveyance, transfer, and return flow of irrigation water results in substantially higher flows than would normally exist under more natural conditions. The magnitude of these differences is evidenced in Table 5-3 on a monthly basis by a comparison of measured streamflow discharges versus those predicted by the Soil and Water Assessment Tool (SWAT) without the influence of irrigation on the watershed.

**Table 5-3. Streamflows on Jackson Creek and Bear Creek.**

| Irrigation Season | Non-Irrigation Season | Bear Creek Streamflow (cfs) | # measurements on Jackson Cr. | Streamflow on Jackson Cr. | Predicted Streamflow on Jackson Cr. by SWAT |
|---|---|---|---|---|---|
| May | | 131 | 6 | 39.4 | 6 |
| June | | 73 | 12 | 34.6 | 1.8 |
| July | | 31 | 3 | 27.9 | 1.3 |
| August | | 32 | 5 | 28.1 | 0.6 |
| September | | 35 | 5 | 24.1 | 0.4 |
| October | | 34 | 11 | 8.7 | 0.4 |
| | November | 63 | 37 | 7 | 2.7 |
| | December | 161 | N.D. | N.D. | 15 |
| | January | 219 | 4 | 8.4 | 27 |
| | February | 221 | 4 | 14.5 | 31 |
| | March | 202 | 7 | 39.6 | 22 |
| | April | 199 | 5 | 71.3 | 13 |

Source: Oregon Water Resources Department, 2000.

Table 5-3 shows that monthly runoff discharges during the irrigation season are almost an order of magnitude greater than those that would be expected to occur under natural conditions. The significant impact of irrigation on Jackson Creek warrants the need for monitoring streamflow at a handful of sites along the channel during the irrigation season.

**5.3.4. Measured Monthly Streamflow Data on Jackson Creek and Bear Creek**. Miscellaneous streamflow measurements collected on Jackson Creek during the 1995 to 1997 period and a 62 year streamflow record for the U S Geological Survey gaging station on Bear Creek in Medford are also shown in Table 5-3. Also reported in the table are the monthly streamflow values predicted by SWAT in cfs.

Considerable differences may be noted between the streamflow values measured on Jackson Creek versus those predicted by SWAT. Two reasons may be cited for the significant differences. First of all, the predicted streamflow values estimated by SWAT do not consider the influence of water transfer from irrigation canals to Jackson Creek that occurs during the irrigation season. Second, the measured values of streamflow reported in the table represent an average of instantaneous observations obtained from a limited data set. These measured values therefore do not necessarily reflect the mean monthly flow conditions. The installation of a continuous streamgage recorder on Jackson Creek would provide an accurate way to monitor daily streamflow variations as well as the influence of irrigation diversions and transfers within the watershed.

**5.3.5. Water Balance**. The Soil and Water Assessment Tool (SWAT)[2] developed by the USDA Agricultural Research Service was used to estimate a monthly water balance for the Jackson Creek Watershed. The Watershed was divided into five sub-basins to account for topographic, soils, and land use differences on the catchment. Any hydrologic impacts associated with the diversion of water for domestic, municipal, or irrigation purposes were not included in the analysis. Since Jackson Creek is an ungaged stream channel, it was necessary to use gaged data from another watershed in the region to calibrate parameters governing the ground water (baseflow) contribution to surface runoff in the model.

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[2] Arnold, J.G., J.R. Williams, R. Srinivasan, K.W. King, and R.H. Griggs. SWAT: Soil and Water Assessment Tool. USDA ARS, Temple, TX., 1994.

**Table 5-4. Water Balance for Jackson Creek, Based on 30 yr. SWAT Simulation.**

| Month | Precipitation (mm) | Evapo-transpiration | Direct Runoff (mm) | Baseflow (mm) | Total Water Yield (mm) |
|---|---|---|---|---|---|
| **January** | 99 | 25 | 1.1 | 29.9 | 31 |
| **February** | 75 | 40 | 1.4 | 30.6 | 32 |
| **March** | 69 | 68 | 0.6 | 25.4 | 26 |
| **April** | 43 | 90 | 0.1 | 14.9 | 15 |
| **May** | 39 | 66 | 0.1 | 6.9 | 7 |
| **June** | 29 | 48 | 0 | 2 | 2 |
| **July** | 5 | 43 | 0 | 1.5 | 1.5 |
| **August** | 8 | 15 | 0 | 0.7 | 0.7 |
| **September** | 20 | 15 | 0 | 0.4 | 0.4 |
| **October** | 51 | 26 | 0.1 | 0.4 | 0.5 |
| **November** | 85 | 25 | 0.6 | 2.4 | 3 |
| **December** | 112 | 20 | 0.9 | 16.1 | 17 |
| **Total** | 633 | 481 | 4.9 | 131.2 | 136.1 |

Source: Oregon Water Resources Department, 2000.

Table 5-4 shows monthly values of evapotranspiration, baseflow, and direct runoff simulated by the model for a 30 year seasonal distribution of precipitation on the watershed. Simulation results reflect the impact of urban, residential, and agricultural development, but do not account for the diversion or transfer of water for domestic or irrigation purposes within the catchment. The highest rate of evapotranspiration simulated by the model occurred during the month of May, which accounted for about 16% of annual ET. Annual values of precipitation, ET, and total runoff estimated by SWAT were 633, 481, and 136 mm, respectively. Values of evapotranspiration and runoff are assumed to be estimated to within ±15%. Simulation results show that direct runoff and baseflow runoff from ground water respectively account for about 4% and 96% of the total runoff on the watershed. As shown in Table 5-4, direct runoff occurs primarily from November to March. Test results further show that evapotranspiration and runoff comprise 76% and 21% of annual precipitation, respectively. Deep aquifer ground water losses and changes in soil moisture storage account for the remaining 3% of annual precipitation.

### 5.3.6. Direct Runoff Comparison for Pre-development and Current Watershed Conditions.

Runoff curve numbers were changed in the model to reflect a pre-development watershed condition consisting almost entirely of forestland. SWAT was then rerun to estimate monthly values of evapotranspiration and runoff. Test results showed virtually no difference in the annual values of ET or total runoff. For the pre-development watershed condition, the model predicted an annual direct runoff amount of 1.0 mm compared to 4.9 mm for present day conditions. On a daily basis, however, the test results between current and pre-development conditions are much more pronounced. The simulation results with SWAT show that a daily rainfall volume of about 16 mm can produce as much as 1.5 mm of direct runoff for current conditions on the watershed. The model simulation shows the same amount of daily rainfall produces virtually no direct runoff for the pre-development watershed condition.

**5.3.7. Hydrologic Condition Assessment.** A hydrologic assessment of the Jackson Creek Watershed was conducted to identify land use activities that have the potential to impact the hydrology of the catchment. In this study the impacts of timber harvest, agricultural/rangeland development, and urban/residential development were analyzed. The five sub-basins used for developing a water balance with SWAT were also used to analyze the impacts of the different land use activities.

**5.3.7.1. Impact of Timber Harvest.** The peak flow generating processes for each of the sub-basins were analyzed to determine the impacts of timber harvest on runoff. Results of the analysis indicate that less than 25% of each of the sub-basins may be characterized as exhibiting rain-on-snow or spring snowmelt properties. Therefore, it was assumed that the potential risk of peak-flow enhancement due to timber harvest on the watershed was not appreciable.

**5.3.7.2. Impact of Agricultural and Rangeland Development.** The 2 year, 24 hour precipitation was used to assess the impacts of agriculture and rangeland on watershed runoff. The rainfall volume for a storm of this magnitude on the catchment is 2.5 inches. Using the runoff curve number method developed by the SCS and a curve number of 70 for the agricultural sub-basin in the watershed, the runoff depth was estimated as 0.46 inches. This compared to a background (pre-development) runoff depth of 0.00 inches for a runoff curve number of 45. Since the difference between the background and present day runoff depth was less than 0.5 inches, it was assumed that the potential risk of peak-flow enhancement due to agriculture and rangeland on watershed runoff was low.

**5.3.7.3. Impact of Urban and Residential Development.** The percentage of impervious surfaces in the Jackson Creek Watershed was calculated to assess the impacts of urban and residential development on runoff. The potential risk for peak-flow enhancement was found to be negligible for each of the sub-basins except for Jacksonville and Central Point municipalities. For the Jacksonville sub-basin, the potential risk was assumed to be high. Monitoring of runoff from the Jacksonville area must therefore be a priority in order to evaluate the potential impacts for flooding and water quality degradation in Jackson Creek.

**5.3.7.4. Other Impacts.** The Jacksonville Reservoir is the only reservoir present in the

Jackson Creek Watershed. Because of its small storage capacity, the impact of the reservoir on streamflow is relatively small, except that is does serve as a catchment basin for sediment from the foothills. Although it is anticipated that the reservoir wetland results in improved water quality conditions for Jackson Creek, the impact on the water balance for the catchment is negligible.

**5.3.7.5. Accumulative Impacts.** Each of the events above have their separate effect upon the total landscape and ecosystem, but when the events are combined (as they are in reality), there can be a superordinate *accumulative* effect B or in other words, the total effect is greater than the sum of the parts. For example, the effects of timber harvest or residential development affect soil water retention, wildlife, climate, and human uses of a landscape. This effect can also function for restoration efforts, in that one small restoration improvement can affect other ecosystems, producing a profound effect. Thus, it is important to look at the total effects of systems combined, as well as effects of specific actions.