Operations and Compliance Plan

Bear River Hydroelectric Project
FERC Project No. 20
December 22, 2004

Prepared by:

PacifiCorp
Portland, Oregon

INTRODUCTION

PacifiCorp received a new license for the Bear River Hydroelectric Project (Project) (FERC No. 20) on December 22, 2003. The Project includes three hydroelectric developments located on the Bear River in Caribou and Franklin Counties, Idaho (Figure 1). The 30-year license allows for the continued operation and maintenance of the Soda Development, the Grace and Cove Developments, and the Oneida Development.

This Operations and Compliance Plan (Plan) has been prepared, as required by **Article 415** of the license, to describe compliance with minimum flow requirements and ramping rates as directed in Articles 408 and 412, respectively.

The Plan includes the following information for each development of the Bear River Project:

- the proposed methodology and locations for monitoring minimum flows and ramping rates;

- specific measures to ensure that the monitoring system would operate under all conditions, including loss of external electric power to the project;

- the design of the monitoring devices, including any pertinent hydraulic calculations, technical specifications or proposed instrumentation, erosion and sediment control measures, as appropriate, and design drawings of the system;

- a description of the relative extent of manned versus automatic operation of the monitoring equipment;

- a description of the methods and schedule for installing, calibrating, operating and maintaining the monitoring equipment;

- proposed data collection and storage protocols;

- provisions for reporting the recorded data to the Commission and the consulted agencies;

- provisions for reporting incidents in which minimum flows or ramping rates deviate from license requirements; and

- a schedule for implementation.

The Plan was developed in consultation with the ECC and U.S. Geological Survey (USGS); ECC members and the USGS were provided 30 days to review and provide comments on a draft version of the Plan. Comments received were addressed in the final Plan.

Figure 1.

1.0 MINIMUM FLOWS

1.1 Soda

The new license requires that a year-round flow below the Soda dam shall be a minimum of 150 cfs, or inflow into Soda reservoir, whichever is less.

This minimum flow requirement for the Soda plant has been in effect for a number of years in compliance with a Federal Energy Regulatory Commission (FERC) Order issued July 2, 1997; therefore, PacifiCorp (Company) has many years of experience in meeting this flow requirement. For the most part, the Company will continue to use the same method of providing the minimum flow as in the past.

During spring runoff, the irrigation season, and periods of average or above flow in the Bear River, the flow below the Soda dam is passed through the generators. The available flow in the river during any of the above conditions is greater than the minimum flow requirement. The primary risk of flow dropping below 150 cfs under such conditions is if the generators trip off-line. The Soda plant operating procedure calls for the operator to first attempt to return the generator(s) to service to restore the 150 cfs minimum flow. If the system requires repair work in order to be returned to service, the by-pass valve is opened to provide the minimum flow until the generating units can be returned to service. It should, however, be noted that at no time would the flow below the plant drop below about 40 cfs because of the leakage from the dam.

During drought periods, when available inflow is below 250 cfs (flow required for generation), the minimum flow may be passed through the plant by-pass valve. It is difficult to calibrate the valve for specific flows. The operator makes changes in the valve opening and, when the flow has stabilized, checks the stream gauge below the plant to see if the desired flow has been reached. If not, the valve is readjusted. This process continues until the desired flow from the valve is reached. The winter months of the last 5 drought years have provided the opportunity for the Company to gain experience in controlling flows of 150 cfs or inflow as required by the license. The by-pass valve can be adjusted to pass whatever flow is entering the reservoir to meet the license requirement of 150 cfs or inflow using reservoir level as an indicator.

1.1.1 Minimum Flow Monitoring Methodology

Monitoring location

The minimum flow downstream of the Soda dam is monitored by the USGS gauge station (Gauge No. 10079500) located several hundred yards downstream of the dam. PacifiCorp has the responsibility of maintaining this gauge station and providing the data to the USGS for final review and publishing.

The low-flow method of monitoring the minimum flow is used to track the change in reservoir elevation. The sensor to monitor the reservoir elevation is located in a stilling well in the gatehouse on top of the dam.

Manned monitoring

The plant operator monitors the plant operation, reservoir elevations and the flow in the Bear River downstream of the dam in accordance with the system orders. Company Systems

Operations staff coordinate the overall Bear River operations and issue operation instructions to the Soda plant operators based on the demands being placed on the river.

The operator reads and records the reservoir elevation in the plant data logs. The operator uses this elevation information to calculate inflow changes and to make the appropriate adjustments to the plant operation for the day to match system orders. The morning elevation reading serves as the official reservoir elevation for the day and is reported to the Systems Operations.

Automatic monitoring

The river flow is measured, recorded and temporarily stored in an electronic data logger located in the gaging station downstream of the plant. The data logger is programmed to read at defined intervals, converts raw signals to values, and records the measured values. As a back-up, a mechanical strip chart recorder or other device is used to record the flow in the river. This process is automatic with no control from the operators. Since the most critical gaging stations will be polled hourly via GOES satellite or in real-time via the Supervisory Control And Data Acquisition (SCADA) system, the need for the back-up equipment is greatly decreased. Spare parts are kept on hand so that should the system malfunction, it can be quickly replaced. In most cases it can be replaced in two days or less.

The reservoir elevation is measured by a float and real-time sensor that sends a signal to a display monitor in the control room. The display monitor provides a signal to a local computer and to Systems Operations.

Monitoring at less than minimum flow

The license requires that the minimum flow downstream the Soda dam be 150 cfs or inflow into the Soda reservoir. Severe drought conditions, especially during the winter months following the irrigation season, is generally the time when inflow may drop below 150 cfs. The method for controlling the outflow, when inflow is less than 150 cfs, is to keep the reservoir elevation relatively constant to ensure that inflow to the reservoir is passed downstream. The reservoir elevation, at the time the inflow drops below 150 cfs, will be used as the base elevation from which to monitor and control flow. When outflow reaches 150 cfs, the reservoir elevation will be monitored more closely. When the elevation begins to drop the operator will know that the inflow has dropped below 150 cfs. The reservoir elevation, at the time this is observed, will become the *target* elevation. The operator will make adjustments to outflow to keep the reservoir elevation within a dead-band of ± 0.25 feet of the target elevation. There is a tolerance of ± 0.50 feet of the target elevation that would need to be exceeded before it is considered an incident.

> Exception: *The exception to maintaining this dead-band will be during extreme cold spells that cause ice jams to form upstream and reduce the flow of water. Such cold spells happen several times during the winter months and can last from 1 to 14 days at a time. When the cold spell ends the ice jams break loose and flow rapidly increases for a short time period. The operator would have to make many changes to the outflow to try to keep the reservoir elevation within the dead-band and would likely not be successful as it takes several hours for each change to settle out.*
>
> *A constant outflow will be maintained during these very cold periods and the elevation will be allowed to decrease below the lower limit of the dead-band during cold periods. When the temperature warms up and the ice jams break loose, the rapid increase in the inflows will bring the reservoir elevation back up into the dead-band*

range again. Once the higher inflows subside, changes will be made to the outflow, if necessary, to keep the elevation within the dead-band as stated above.

The operators have considerable experience operating the plant through the full range of flows in the river. During times when flows are about average and during irrigation season, changes in river flow result as irrigation demands on the river change, which are coordinated river-wide by Systems Operations. If a change in flow is required it is normally made at the beginning of the day shift so there is time for the downstream plant, Grace, to make adjustments before the end of the shift. Changes late in the day reach the downstream plant after normal work hours and cause problems for that plant. There are times when changes are not required for several days because the demands on the river have not changed.

When the inflow is below 150 cfs, flow changes are made in the river no more than once a day, and are often made every few days. Based on operating experience in the last several years of drought, making as few changes as possible and only at the beginning of the day shift works best to keep the reservoir inflow matched to the outflow and eliminate cyclic disturbances downstream. It also keeps the reservoir elevation within the dead-band range, when necessary, and keeps the downstream flow fluctuations to a minimum.

The elevation used to measure compliance, as discussed in Section 1.1.4, is the 24-hour moving average. The moving average reading is obtained by averaging the current hourly reading with the previous 23 readings.

The reservoir elevation dead-bands used to verify compliance may be shifted downward for operational considerations such as emergency power generation. This results in flows to the river greater than inflow for a short period of time, but not less than inflow. The dead-band will not be raised for any reason. Any storage deficit will be filled when inflow to the reservoir is greater than the minimum flow at which point compliance would be verified by the downstream flow gauge.

1.1.2 Minimum Flow Monitoring Equipment

<u>Design and specifications</u>

The USGS gauge station downstream of the Soda plant utilizes a Sutron data logger, currently model 8200-A, to electronically measure the river stage (water depth) and record the stage measurement in electronic format. A Sutron shaft encoder, model 5600, has a wheel, with spokes around the circumference, attached to the shaft. A perforated steel tape hangs around the wheel and has a float attached to one end that floats on the water and a counter weight attached to the other end. As the float moves up and down with the change in water level, the tape rotates the wheel and shaft, which causes the encoder to generate an electrical signal that is proportional to the rotation of the shaft. This signal is fed from the encoder into the data logger where an internal program translates the signal and logs the stage data. Appendix A lists the specifications for the Sutron data logger and encoder currently in use. It is anticipated that newer models will be phased in over time or replaced by a comparable system using the Company's SCADA system.

The data logger, encoder, and float tape is calibrated upon installation and checked about every 8 to 12 weeks to ensure that it is still measuring the correct stage. It is checked against a staff gauge that is permanently attached to the side of the stilling well.

A strip chart recorder is maintained and currently used as a backup, should there be a problem with the electronic data logger. The strip chart recorder also uses a float to turn the chart recorder shaft and an ink pen records the level on a moving strip of paper. The calibration of the chart recorder is also checked about every 8 to 12 weeks. As the polling frequency from the electronic data loggers increases from monthly to daily and even hourly for satellite-enabled sites or in real-time via SCADA, the need for backup loggers decreases. Hence, the strip chart recorder may be phased out or replaced by electronic data loggers if a back-up is still deemed necessary.

The reservoir elevation is measured with a Stevens Syncro stand-alone encoder. A wheel, metal tape, and float assembly turns the shaft of the encoder. The encoder has a syncro motor that produces a signal that is sent to a display in the control room. The display in the control room is a Stevens programmable position monitor model 1255. It accepts the signal from the Syncro encoder and is programmed to display the reservoir elevation. The reservoir elevation reading is the reading that the operator records in the logs and reports to Systems Operations as the official elevation for the day. Appendix A lists the specifications for the Syncro encoder and the programmable position monitor.

The position monitor produces a 4–20 milliamp output signal that is fed into the SCADA system and over a microwave channel to Systems Operations. This elevation data is logged in a data file at Systems Operations. The signal is also fed to an A/D converter card, which converts the signal from analog to digital data. A computer accepts and records data from the converter card.

Reliability

The river gaging station is part of the USGS network, which requires a high degree of reliability. The Sutron data logger was used by the USGS as they moved from mechanical strip chart recorders to digital data loggers. The Company followed their lead and installed the same equipment in the gauge stations that are the Company's responsibility to maintain. The Sutron data loggers have been in service since about 1995 within the Company and have proven to be very reliable.

The gauge station below the Soda plant is provided power from the local distribution circuit. A surge suppressor is installed in the circuit to eliminate surges from the distribution circuit. A small instrument transformer steps down and converts the power from 120V AC to 12V DC required by the Sutron. The Sutron has an internal battery capable of supplying power to the data logger for several days if the external power is interrupted. During external power outages, the data logger will still function and measure the river stage as programmed. The internal memory chips that store that measured data is backed up by a 3V lithium battery to keep the data safe even if the 12V battery goes dead during an extended power outage and the data logger stops functioning. The data logger is properly grounded to help protect from static charges that could harm the data logger circuit boards.

Any malfunction of equipment could cause a complete loss of stored data since the last download. As the polling frequency from the electronic data loggers increases from monthly to daily and even hourly for satellite-enabled sites or in real-time via SCADA, the need for the back-up equipment is greatly decreased. Spare parts are kept on hand so that should the system malfunction, it can be quickly replaced. In most cases it can be replaced in two days or less.

The mechanical strip chart recorders are manufactured by Leoppold Stevens and have proved over the years to be very reliable. A stock of paper, pens, ink, and replacement clocks are taken with the hydrographer as he visits the stations every 8 to 12 weeks. He performs any necessary maintenance to keep the recorder running until the next site visit.

1.1.3 Minimum Flow Data Collection and Storage

Collection protocol

The data logged on the Sutron data logger is the water depth measured in the stilling well by the encoder and is referred to as the stage. The stage data is downloaded through the Sutron internal modem by the Company hydrographer in the Salt Lake City office. After downloading the stage data for a month, it is converted to ASCII format and loaded into an Excel spreadsheet. This spreadsheet allows for a correction factor to be applied to the raw data and then uses the corrected stage to calculate the flow in the river in cubic feet per second. The spreadsheet summarizes the data to produce an average stage and flow for each day, and also displays the maximum and minimum flow for each day. The spreadsheet also displays the correction factor that was applied to the raw data for each day. The spreadsheet data is considered provisional until it is reviewed and approved by the USGS after the end of the water year (September 30).

The collection of the lake elevation data is not as complex as the river elevation data collection. There is no need for a correction factor or a rating table when elevation is the only concern. The computer receives raw data from the A/D converter and converts it into a reservoir elevation. The reservoir elevation is then logged in a monthly data file. At the beginning of each month a new data file is created to store the data for the new month. Elevation data is transmitted via the Company SCADA system and stored on Company databases that are accessible in real-time. This data is currently being made more accessible to water management personnel who will monitor the status of the elevation during periods when elevation data are used for compliance purposes – when inflow to the reservoir is less than minimum flow – to indicate that inflow is being passed through the reservoir.

The collection method has been updated to provide real-time flows as required by the license. The real-time flows provided will incorporate the adjustment factor described below. Eventually, the real-time collected stage will be used in place of the monthly download. The data is from the same source, the data logger, but the simpler collection method will streamline the process. The monthly download method described above will continue until the new system has been verified.

Shift

The raw stage data recorded by the data logger does not always reflect accurate river flow. There are a number of conditions that can distort the stage measurement. Two of the most common conditions downstream of the Soda plant happen during the summer months and during the coldest part of the winter.

During the summer months, usually starting sometime in mid-July, vegetation buildup in the river channel starts to affect the stage reading. This vegetative growth impedes the free flow of the water and backs up the water towards the plant. This condition causes a higher stage reading in the stilling well and this altered reading is measured and recorded by the encoder and data logger. The same effect on the stage readings happens in the coldest winter months when ice begins to form in the river channel and along the riverbanks, which causes the water to back up.

To find the correct stage reading (and hence the correct flow) a correction factor known as a *shift* must be calculated and then added to the measured stage. The *shift* is the difference between the current stage measurement and the stage corresponding to the measured flow from the rating table (see next section). Flow measurements are made every 8 to 12 weeks or more often if needed. Once the shift has been calculated (the results can be either a positive or negative number), it is entered into the data logger and is added to the recorded stage to compute the *provisional flow*. For the final, *published flow record*, the *shifts* measured every 8 to 12 weeks are interpolated between measurements. This produces a smoothly varying flow record and is based upon the assumption that changes to river conditions usually happen slowly over a period of several weeks or months. Abrupt changes such as a change in the channel cross-section, faulty equipment, or incorrect settings would be detectable as a run of *shifts* that are consistently of the same sign or very large. If this occurs, the equipment and gaging location is scrutinized and if no technical error is found, the rating table is updated after enough measurements are made. In the intervening period, the *shift* typically provides an accurate way to compensate for abrupt changes.

For real-time flows, the "best" *provisional flow* is the one incorporating the most recent shift. This is the data that is used to indicate compliance with license articles. The *published flow record*, which is produced by interpolating between consecutive *shifts* may indicate "after-the-fact" incidents. These are expected to be rare, but may occur. These will not be reported as they are not true incidents. This issue may arise if a stakeholder identifies a supposed "incident" after the fact. Should this occur, the necessity of relying on *provisional flow* information will be described.

Rating tables

An established relationship between stage and the flow in the river is called a rating table. The rating table indicates the flow in the river for each stage. It is an approximation based on previously measured flows and the associated stage. The approximation is subject to error due to the particular hydraulic conditions in the river when the measurements are made. Typically, the flow in the river is steady and uniform. However, there is no physical constraint on the relationship, which is most prominent at higher and unsteady/nonuniform flow regimes. Hysterisis of the flow-stage relationship is possible. However, the rating table is an adequate approximation with no better alternative available in the state of the science of *in-situ* flow measurement.

The stage values in the spreadsheet are tabulated to hundreds of a foot over the full range of the river flow. When someone wants to know the flow in the river for a particular stage, the correct stage (stage plus shift) is located on the rating table to see what the flow is for that stage. The current rating table for the gauge station below Soda is attached as Appendix B.

When a run of *shifts* that are very large or are consistently of the same sign occur, a new rating table is generated. The first step in creating a rating table is to plot measured flow versus the stage reading. A representative group of the most recently measured flows is plotted on a computer spreadsheet program to make a graph. A polynomial curve is fitted to the graphed points over the full range of flows. If a single polynomial, up to a fifth order, is not adequate to represent all flows within 10 percent of the measured value, a piecewise polynomial is implemented. The functional relationship is used to calculate the flow at each stage from the minimum to the maximum in increments of one-hundredth of a foot. The calculated values are placed in chart form so that it can be printed out. The actual functional relationship is used within the data logger and in spreadsheet computations.

Reservoir lag time

When the inflow to the reservoir is less than the minimum flow, incremental reservoir storage is very large compared to the inflow. This causes changes to happen slowly over a longer period and causes the outflow from the reservoir to lag the inflow. When the inflow is less than the minimum flow, the outflow will be adjusted to maintain reservoir elevation within a target range of ± 0.25 feet. A tolerance range of ± 0.5 feet will be maintained at least 95 percent of the time. Any change in inflow will cause the reservoir elevation to change until the elevation nears a target dead-band limit and then the operator will change the outflow to bring the reservoir elevation back into the dead-band range. The time from when the inflow first changes to when the elevation leaves the dead band is the lag time. When the inflow and reservoir elevation have stabilized, the outflow closely matches the inflow. When inflow is changing, outflow will be adjusted as needed to keep the reservoir elevation within the dead-band, but may lag changes in inflow. However, the lag time does not affect the amount of water that is discharged downstream, only the timing of the discharges. This may reduce the magnitude of outflow fluctuations by making a series of small changes to adjust for larger changes in inflow.

Storage protocol

The hydrographer typically downloads the data from the Sutron data loggers during the first two weeks each month. The monthly raw data is loaded into a spreadsheet. If a shift calculation has been done since the end of the month, then the shift factor is added to the stage and provisional data are ready for use. If a shift factor has not been taken since the end of the month, then the spreadsheet is held and is not ready for use until the shift factor becomes available.

A spreadsheet for the gauge station is created for each month of the year and includes the summarized daily information as well as the raw data. At the end of the water year (September 30) all the monthly data are summarized onto a yearly spreadsheet that shows the average flow for each day of the year. The yearly sheet also displays the monthly average flow, the monthly minimum flow, and the monthly maximum flow.

The monthly flow data spreadsheets are stored on the Company network server that is backed up each night. After approval by the USGS the data are stored on a CD ROM as well as the network server. The yearly data are submitted to and published by the USGS. A summarized monthly spreadsheet (minus the raw data) and yearly spreadsheet are printed out and stored in Company files.

The reservoir elevation files are transmitted via the SCADA system and stored on the Company-wide database, and are backed-up on a regular basis.

Due to the real-time reporting requirements in the license, this procedure will be updated. Until the new procedure is verified the old procedure will continue in parallel operation. The new procedure will replace the monthly download with real-time automated data collection. The three gauges where real-time flows are required will be transmitted hourly via GOES satellite or real-time via SCADA, and the non-real-time sites will be polled via telephone modem on a regular basis ranging from once per day to hourly depending on operational requirements.

The Sutron software XConnect will be used to collect the data into a temporary database from both satellite and modem platforms. This data will be exported to a flat file every hour and imported into the Company database, where it will be available for immediate analysis. This will provide integration with other real-time SCADA system data such as reservoir elevations and will enhance management and reporting capabilities. As new technologies become available, it may become beneficial to transmit river stage directly through the SCADA system to provide real-time reporting and data storage. This would obviate the need for the Sutron data loggers and the XConnect software for these sites.

The new system will use data from the Company database instead of monthly manual modem polling. The provisional and final published flows will be stored in the Company database. The format of the data provided to the USGS will not be substantially changed.

1.1.4 Reporting to the Commission

Reporting hourly average

River flow will be reported as hourly averages to verify compliance with the minimum flow requirements.

24-hour moving average for reservoir

The reservoir elevation, as stated above, will be used to monitor and control the outflow from the reservoir when inflow is below the minimum of 150 cfs. The sensor that records the reservoir elevation is located inside of a stilling well to help dampen out the effect that waves have on the elevation. However, wind blowing across the water or other diurnal effects can force more water to one end of the reservoir and give a false elevation reading. Since the Company will be trying to control the reservoir elevation to within the target elevation dead-band, a false reading caused by such factors could result in unnecessary changes to the outflow from the plant and reporting to the FERC. To address this problem the Company will record a moving average of the lake elevation so that false spike readings can be smoothed out and unnecessary changes to downstream flow can be eliminated. During low-flow conditions, inflows are small compared to the reservoir capacity, so changes in reservoir elevation happen very slowly over a 12- to 24-hour period. Therefore, the moving average will not affect the accuracy of the recorded elevation, but simply eliminate any spikes, and dampen the effect of any high or low elevations caused by diurnal events.

The computer will run a program that calculates a 24-hour moving average. This is done by taking the current hour elevation reading and averaging it with the previous 23 readings. This will be the elevation used for the official record and to verify compliance with the requirement of the license that inflow is being passed though dam. The stream gauge downstream of the plant will measure and record the actual hourly average flow, while the reservoir elevation will be used to verify that outflow equals inflow.

Reporting incidents

The operator will monitor the reservoir elevation during times of low flow and, should a reportable incident occur, alert appropriate staff personnel who would be responsible to access the data, verify that the event occurred, and prepare a report about the event.

Any suspected incident reported by the plant operators will be investigated in a timely manner. Should a violation be verified, the Regional FERC office will be notified of the violation within 10 days of the verified event. A complete report of the event will be prepared and sent to the FERC within 30 days after the event is reported to the FERC Regional office.

The report will include the following information:

1. All relevant flow or reservoir elevation data will be provided to verify the incident. The data will be presented in table and graph format for the time period in question.
2. The report will include the results of the investigation to determine the cause, severity, and duration of the incident.
3. The report will include a description of any corrective measures that have been or will be implemented to prevent future incidents from occurring.
4. The report will include any comments or correspondence that was received from interested parties regarding the incident.

The plant is manned 8 hours a day, 7 days a week. Therefore, it is possible that an incident could occur during the unmanned hours and the operators would not know that it occurred. However, 24-hour remote-monitoring coupled with data communication fail-safe alarms provide a high degree of confidence that should conditions indicating an incident occur, prompt action would be taken. However, in no case are the plants left unattended for more than 16 hours. The Company is developing monitoring to promptly detect and alert operators to conditions that could lead to an incident. However, until the system is completed, it is possible that an incident would only be noted during review of the flow and elevation data after the incident occurred. The FERC would be notified of the incident as quickly as it is verified and a report prepared as stated above.

In the compliance management system planned, any condition leading to an incident would trigger an alarm and alert the on-call operator to come to the plant and make appropriate operational changes to ensure that the situation is restored or kept within the operating parameters required by the license. Currently, hourly elevation and hourly-average flows are monitored on a regular basis (week-days) by one or more people, providing reasonable assurances of compliance in the interim.

Unless the Company verifies an incident with data, providing data to the FERC or any agency or nongovernmental organization (NGO) will be done on an as-requested basis only. That is to say, data will be provided in a report should an incident occur that is verified by the Company. Suspected incidents reported by other concerned parties or individuals will be investigated by the Company and data provided to the concerned party if specifically requested. The Company will provide sufficient data to verify the suspected incident occurred. The requesting agency, NGO, or other interested party will need to request the data in writing. The request will need to state the specific purpose for the data, the time period desired, what specific data is needed, and the format in which to supply the data. Since the Company has a large amount of stored data and limited manpower, each request will need to be evaluated as to the time it will take to prepare the requested data. Much of the stored data is raw and may take a significant amount of time and resources in order to respond.

1.1.5 Schedule for Implementation of Monitoring

Testing of equipment

The river monitoring equipment is in place and has been functioning since about 1996. This equipment has been thoroughly tested over that time period. The Sutron data logger below the Soda dam will continue to be used to monitor minimum flow compliance during the new license period. The Company has reviewed the river data download and preparation procedure and has determined that more frequent collection and automated monitoring is required to implement minimum flow data from the river data logger. GOES satellite transmission equipment or radio transmission equipment may be installed to provide the required collection frequency. In the future, changes in technology or costs may require different methods of collection that provide equivalent functionality.

The system that provides the reservoir elevation reading to the operator has been in service for many years and is maintained on a regular basis. This system will continue to be used as part of the operator's normal responsibility. The computer that monitors and records reservoir elevation has also been in service for a number of years and has been reliably providing elevation data. These data will be used to verify compliance when inflow to the Soda reservoir is less than the minimum flow of 150 cfs.

Implementation of the minimum flow monitoring

The Company has been providing the 150 cfs minimum flow as part of the previous license requirements. The Company currently extracts and prepares monitoring data manually, but a procedure is being developed to automate this process, which will notify staff of potential incidents of noncompliance.

1.2 Grace

The new license requires that the year-round flow below the Grace dam shall be 80 cfs plus current leakage, or inflow into the Grace forebay, whichever is less. This minimum flow requirement will be adjusted based on measurement of leakage from the dam, as required in Section 3.2.1 of the Bear River Settlement Agreement.

A minimum flow in the Grace by-pass reach was not required in the previous license. The flow below the dam was limited to leakage past the dam and water feeding into the by-pass reach from springs and other ground water seepage. The new license requires that an additional 80 cfs be passed through the dam as the minimum flow requirement. The dam has flashboards in the spillway bays that are used to control the flow through the spillway. In the past, as long as inflow was 960 cfs or less the flashboards were left in place and all the flow in the river was diverted into the flowline to the Grace plant. If the flow exceeded what the plant could use, some flashboards were removed to allow the excess water to spill over the spillway into the by-pass reach.

Inflow is equal to outflow from Soda reservoir less withdrawal at Last Chance Canal Company and Bench B, leakage from the Grace flowline, and losses or gains in the reach between Soda and Grace. A time lag of approximately 2 hours will be applied for water to arrive from the Soda plant. If the inflow is less than the required minimum flow, that flow will be passed downstream instead of the required minimum flow. Initially, flashboards were removed to pass the required 80 cfs downstream for minimum flow. The Company plans to modify the dam to create a low-level outlet that will pass the required minimum flow at all times unless the inflow is less than that required.

1.2.1 Minimum Flow Monitoring Methodology

Monitoring Location

A USGS gauge station (Gauge No. 10080000) is located about ¼ mile downstream of Grace dam. The Company has the responsibility to operate and maintain this gauge station. The data collected are submitted to the USGS for review and publishing. This gauge station is used to measure and record the flow in the by-pass reach. The data from this station will be used to verify compliance with the minimum flow requirement.

Manned monitoring

The proper operation of the valve (planned for installation in 2007, with a temporary valve planned for installation in 2004) providing the minimum flow will be checked each day, as part of the operator's normal duties. He will check to make sure there is no blockage in the valve and that the minimum flow is being provided. He will check other available information such as reservoir elevation, outflow from the Soda reservoir, and flows in the Last Chance and Bench B canals to determine river conditions and verify that the minimum flow requirement can be met. The minimum flow valve setting and associated flow will be recorded in the plant log.

Automatic monitoring

The actual measuring and recording of the flows in the by-pass reach will be done with electronic measuring equipment, which is controlled by an internal program in the equipment. The measured data is temporarily stored in the equipment until it is downloaded.

Monitoring at less than minimum flow

The inflow to the Grace forebay, during the spring run-off and irrigation seasons, is usually large enough that there will be no problem in meeting the minimum flow requirement. Past records indicate that average inflow to the reservoir during the winter months (the time of lowest flow) is also not usually a problem. Drought conditions, such as the last 5 years, cause very low flow in the river, especially during late summer and fall. These may be the time periods when there may not be the required minimum flow to pass downstream.

A load control computer controls the generators at the plant and adjusts generation to maintain the reservoir elevation between 5554.5 and 5554.2 feet (a 0.3-foot dead-band). As inflow decreases, the computer reduces generation to keep the reservoir elevation within the 0.3-foot dead-band. If the reservoir elevation reaches 5550.0 feet, an alarm is initiated and the operator is notified of the condition. This will allow the operator to make any adjustments that may be needed at the dam to ensure the minimum flow requirement or inflow is being passed downstream.

1.2.2 Minimum Flow Monitoring Equipment

Design and Specifications

The USGS gauge station downstream of the Grace dam utilizes a Sutron data logger, currently model 8200-A, to electronically measure the river stage (water depth) and record the stage measurement in electronic format. A Sutron shaft encoder, model 5600, has a wheel, with spokes around the circumference, attached to the shaft. A perforated steel tape hangs around the wheel and has a float attached to one end that floats on the water and a counter weight attached to the other end. As the float moves up and down with the change in water level, the tape rotates the wheel and shaft, which causes the encoder to generate an electrical signal that is proportional to the rotation of the shaft. This signal is fed from the encoder into the data logger where an internal program translates the signal and logs the stage data. Appendix A lists the specifications for the Sutron data logger and encoder currently in use. It is anticipated that newer models will be phased in over time or replaced by a comparable system using the Company's SCADA system.

The data logger, encoder, and float tape is calibrated upon installation and checked about every 8 to 12 weeks to ensure that it is still measuring the correct stage. It is checked against a staff gauge that is permanently attached to the side of the stilling well.

A strip chart recorder is maintained and currently used as a backup, should there be a problem with the electronic data logger. The strip chart recorder also uses a float to turn the chart recorder shaft and an ink pen records the level on a moving strip of paper. The calibration of the chart recorder is also checked about every 8 to 12 weeks. As the polling frequency from the electronic data loggers increases from monthly to daily and even hourly for satellite-enabled sites or real-time via SCADA, the need for backup loggers will decrease. Hence, the strip chart recorder may be phased out or replaced by electronic data loggers if a back-up is still deemed necessary.

<u>Reliability</u>

The river gaging station is part of the USGS network, which requires a high degree of reliability. The Sutron data logger was used by the USGS as they moved from mechanical strip chart recorders to digital data loggers. The Company followed their lead and installed the same equipment in the gauge stations that are the Company's responsibility to maintain. The Sutron data loggers have been in service since about 1995 within the Company and have proven to be very reliable.

The gauge station below the Soda plant is provided power from the local distribution circuit. A surge suppressor is installed in the circuit to eliminate surges from the distribution circuit. A small instrument transformer steps down and converts the power from 120V AC to 12V DC required by the Sutron. The Sutron has an internal battery capable of supplying power to the data logger for several days if the external power is interrupted. During external power outages, the data logger will still function and measure the river stage as programmed. The internal memory chips that store that measured data is backed up by a 3V lithium battery to keep the data safe even if the 12V battery goes dead during an extended power outage and the data logger stops functioning. The data logger is properly grounded to help protect from static charges that could harm the data logger circuit boards.

Any malfunction of equipment could cause a complete loss of stored data since the last download. As the polling frequency from the electronic data loggers increases from monthly to daily and even hourly for satellite-enabled sites or real-time via SCADA, the need for backup will decrease. Hence, the strip chart recorder may be phased out or replaced by electronic data loggers if a back-up is still deemed necessary. Spare parts are kept on hand so that should the system malfunction, it can be quickly replaced. In most cases it can be replaced in two days or less.

The mechanical strip chart recorders are manufactured by Leoppold Stevens and have proved over the years to be very reliable. A stock of paper, pens, ink, and replacement clocks are taken with the hydrographer as he visits the stations every 8 to 12 weeks. He performs any necessary maintenance to keep the recorder running until the next site visit.

1.2.3 Minimum Flow Data Collection and Storage

Collection protocol

The data logged on the Sutron data logger is the water depth measured in the stilling well by the encoder and is referred to as the stage. The stage data is downloaded through the Sutron internal modem by the Company hydrographer in the Salt Lake City office. After downloading the stage data for a month, it is converted to ASCII format and loaded into an Excel spreadsheet. This spreadsheet allows for a correction factor to be applied to the raw data and then uses the corrected stage to calculate the flow in the river in cubic feet per second. The spreadsheet summarizes the data to produce an average stage and flow for each day, and also displays the maximum and minimum flow for each day. The spreadsheet also displays the correction factor that was applied to the raw data for each day. The spreadsheet data is considered provisional until it is reviewed and approved by the USGS after the end of the water year (September 30).

The collection of the lake elevation data is not as complex as the river elevation data collection. There is no need for a correction factor or a rating table when elevation is the only concern. The computer receives raw data from the A/D converter and converts it into a reservoir elevation. The reservoir elevation is then logged in a monthly data file. At the beginning of each month a new data file is created to store the data for the new month. Elevation data is transmitted via the Company SCADA system and stored on Company databases that are accessible in real-time. This data is currently being made more accessible to water management personnel who will monitor the status of the elevation during periods when elevation data are used for compliance purposes – when inflow to the reservoir is less than minimum flow – to indicate that inflow is being passed through the reservoir.

The collection method has been updated to provide real-time flows as required by the license. The real-time flows provided will incorporate the adjustment factor described below. Eventually, the real-time collected stage will be used in place of the monthly download. The data is from the same source, the data logger, but the simpler collection method will streamline the process. The monthly download method described above will continue until the new system has been verified.

Shift

The raw stage data recorded by the data logger does not always reflect accurate river flow. There are a number of conditions that can distort the stage measurement.

During the summer months, vegetation buildup in the river channel can affect the stage reading. This vegetative growth impedes the free flow of the water and backs up the water towards the plant. This condition causes a higher stage reading in the stilling well and this altered reading is measured and recorded by the encoder and data logger. The same effect on the stage readings can happen in the coldest winter months if ice begins to form in the river channel and along the riverbanks, which would cause the water to back up.

To find the correct stage reading (and hence the correct flow) a correction factor known as a *shift* must be calculated and then added to the measured stage. The *shift* is the difference between the current stage measurement and the stage corresponding to the measured flow from the rating table (see next section). Flow measurements are made every 8 to 12 weeks or more often if needed. Once the shift has been calculated (the results can be either a positive or negative number), it is entered into the data logger and is added to the recorded stage to compute the *provisional flow*. For the final, *published flow record*, the *shifts* measured every 8 to 12 weeks are interpolated between measurements. This produces a smoothly varying flow record and is based upon the assumption that changes to river conditions usually happen slowly over a period of several weeks or months. Abrupt changes such as a change in the channel cross-section, faulty equipment, or incorrect settings would be detectable as a run of *shifts* that are consistently of the same sign or very large. If this occurs, the equipment and gaging location is scrutinized and if no technical error is found, the rating table is updated after enough measurements are made. In the intervening period, the *shift* typically provides an accurate way to compensate for abrupt changes.

For real-time flows, the "best" *provisional flow* is the one incorporating the most recent shift. This is the data that is used to indicate compliance with license articles. The *published flow record*, which is produced by interpolating between consecutive *shifts* may indicate "after-the-fact" incidents. These are expected to be rare, but may occur. These will not be reported as they are not true incidents. This issue may arise if a stakeholder identifies a supposed "incident" after the fact. Should this occur, the necessity of relying on *provisional flow* information will be described.

Rating tables

An established relationship between stage and the flow in the river is called a rating table. The rating table indicates the flow in the river for each stage. It is an approximation based on previously measured flows and the associated stage. The approximation is subject to error due to the particular hydraulic conditions in the river when the measurements are made. Typically, the flow in the river is steady and uniform. However, there is no physical constraint on the relationship, which is most prominent at higher and unsteady/nonuniform flow regimes. Hysterisis is possible. However, the rating table is an adequate approximation with no better alternative available in the state of the science of *in-situ* flow measurement.

The stage values in the spreadsheet are tabulated to hundreds of a foot over the full range of the river flow. When someone wants to know the flow in the river for a particular stage, the correct stage (stage plus shift) is located on the rating table to see what the flow is for that stage. The current rating table for the gauge station below Oneida is attached as Appendix B.

When a run of *shifts* that are consistently of the same sign or very large are encountered, a new rating table is generated. The first step in creating a rating table is to plot measured flow versus the stage reading. A representative group of the most recently measured flows is plotted on a computer spreadsheet program to make a graph. A polynomial curve is fitted to the graphed points over the full range of flows. If a single polynomial, up to a fifth order, is not adequate to represent all flows within 10 percent of the measured value, a piecewise polynomial is implemented. The functional relationship is used to calculate the flow at each stage from the minimum to the maximum in increments of one-hundredth of a foot. The calculated values are placed in chart form so that it can be printed out. The actual functional relationship is used within the data logger and in spreadsheet computations.

Storage protocol

The hydrographer typically downloads the data from the Sutron data loggers during the first two weeks each month. The monthly raw data is loaded into a spreadsheet. If a shift calculation has been done since the end of the month, then the shift factor is added to the stage and provisional data are ready for use. If a shift factor has not been taken since the end of the month, then the spreadsheet is held and is not ready for use until the shift factor becomes available.

A spreadsheet for the gauge station is created for each month of the year and includes the summarized daily information as well as the raw data. At the end of the water year (September 30) all the monthly data are summarized onto a yearly spreadsheet that shows the average flow for each day of the year. The yearly sheet also displays the monthly average flow, the monthly minimum flow, and the monthly maximum flow.

The monthly flow data spreadsheets are stored on the Company network server that is backed up each night. After approval by the USGS the data are stored on a CD ROM as well as the network server. The yearly data are submitted to and published by the USGS. A summarized monthly spreadsheet (minus the raw data) and yearly spreadsheet are printed out and stored in Company files.

The reservoir elevation files are transmitted via the SCADA system and stored on the Company-wide database, and are backed up on a regular basis.

Due to the real-time reporting requirements in the license, this procedure will be updated. Until the new procedure is verified the old procedure will continue in parallel operation. The new procedure will replace the monthly download with real-time automated data collection. The three gauges where real-time flows are required will be transmitted hourly via GOES satellite or real-time via the Company SCADA, and the non-real-time sites will be polled via telephone modem on a regular basis ranging from once per day to hourly depending on operational requirements.

The Sutron software XConnect will be used to collect the data into a temporary database from both satellite and modem platforms. This data will be exported to a flat file every hour and imported into the Company-wide information system, where it will be available for immediate analysis across the Company. This provides integration with other real-time SCADA system data such as reservoir elevations and will enhance management and reporting capabilities. As new technologies become available, it may become beneficial to transmit river stage directly through the SCADA system to provide real-time reporting and data storage. This would obviate the need for the Sutron data loggers and the XConnect software for these sites.

The new system will use data from the Company database instead of monthly manual modem polling. The provisional and final published flows will be stored in the Company database. The format of the data provided to the USGS will not be substantially changed.

1.2.4 Reporting to the Commission

Reporting hourly average

Any reports to the FERC or other agencies concerning the Grace minimum flow will be provided using hourly average flow as the reporting standard.

Reporting incidents

The operator will monitor the flow below the forebay and, should a reportable incident occur, alert appropriate staff personnel who would be responsible to access the data, verify that the event occurred, and prepare a report about the event.

Any suspected incident reported by the plant operators will be investigated in a timely manner. Should a violation be verified, the Regional FERC office will be notified of the violation within 10 days of the verified event. A complete report of the event will be prepared and sent to the FERC within 30 days after the event is reported to the FERC Regional office.

The report will include the following information:

1. All relevant flow data will be provided to verify the incident. The data will be presented in table and graph format for the time period in question.
2. The report will include the results of the investigation to determine the cause, severity, and duration of the incident.
3. The report will include a description of any corrective measures that have been or will be implemented to prevent future incidents from occurring.
4. The report will include any comments or correspondence that was received from interested parties regarding the incident.

The plant is manned 8 hours a day, 7 days a week. Therefore, it is possible that an incident could occur during the unmanned hours and the operators would not know that it occurred. However, 24-hour remote-monitoring coupled with data communication fail-safe alarms provide a high degree of confidence that should conditions indicating an incident occur, prompt action would be taken. However, in no case are the plants left unattended for more than 16 hours. The Company is developing monitoring to promptly detect and alert operators to conditions that could lead to an incident. However, until the system is completed, it is possible that an incident would only be noted during review of the flow and elevation data after the incident occurred. The FERC would be notified of the incident as quickly as it is verified and a report prepared as stated above.

In the compliance management system planned, any condition leading to an incident would trigger an alarm and alert the on-call operator to come to the plant and make appropriate operational changes to ensure that the situation is restored or kept within the operating parameters required by the license. Currently, hourly elevation and hourly-average flows are monitored on a regular basis (week-days) by one or more people, providing reasonable assurances of compliance in the interim.

Unless the Company verifies an incident with data, providing data to the FERC or any agency or NGO will be done on an as-requested basis only. That is to say, data will be provided in a report should an incident occur that is verified by the Company. Suspected incidents reported by other concerned parties or individuals will be investigated by the Company and data provided to the concerned party if specifically requested. The Company will provide sufficient data to verify the suspected incident occurred. The requesting agency, NGO, or other interested party will need to request the data in writing. The request will need to state the specific purpose for the data, the time period desired, what specific data is needed, and the format in which to supply the data. Since the Company has a large amount of stored data and limited manpower, each request will need to be evaluated as to the time it will take to prepare the requested data. Much of the stored data is raw and may take a significant amount of time and resources in order to respond.

1.2.5 Schedule for Implementation of Monitoring

Installation of equipment

The river gauge equipment to be used for monitoring is in place and has been functioning since about 1997. This equipment has been thoroughly tested over that time period. The Company has reviewed the river data download and preparation procedure and has determined that more frequent collection and automated monitoring is required to implement minimum flow data from the river data logger. GOES satellite transmission equipment or radio transmission equipment may be installed to provide the required collection frequency. In the future, changes in technology or costs may require different methods of collection that provide equivalent functionality.

Implementation of the minimum flow monitoring

The flow below the Grace dam will continue to be monitored as an official USGS station. The data collected for the USGS are the same data used to verify minimum flow compliance. Therefore minimum flow data collection is already in place and functioning.

Provision of the minimum flow will require changes to the operation procedure and to the dam's physical structure. A minimum flow valve (planned for installation in 2007, with a temporary valve planned for installation in 2004) is being incorporated into the design for a larger low-level bypass. The minimum flow valve will be calibrated to pass the minimum flow. It will be low enough to be insensitive to fluctuations in reservoir level. When the generators are operating, the valve will be opened until the gauge station reads the minimum flow plus the previously measured leakage. This opening will then be marked on the operating mechanism so that it can be checked by plant operating personnel when making the routine dam inspection.

When inflow to the Grace forebay is less than the minimum flow and no generation is taking place, the inflow will be passed over the top of the flashboards or through the ice gate. This assures that any inflow is passed downstream. The amount of flow into the project during the irrigation season is highly dependent on irrigation demands and downstream flow conditions. It is possible to have very little inflow to the Grace forebay when downstream irrigation demand is met by tributary flows, and no upstream storage is being passed. A similar situation could occur during low flow periods in the fall/winter, which could be exacerbated by drought conditions.

1.3 Cove

The new license requires that the minimum flow below the Cove dam shall be 10 cfs plus current leakage, or inflow into Cove reservoir, whichever is less, from October 1 through March 31, and 35 cfs or inflow, whichever is less, from April 1 through September 30. This minimum flow requirement will be adjusted based on measurement of leakage from the dam, as required in Section 3.2.1 of the Bear River Settlement Agreement.

A minimum flow requirement was not required for the Cove by-pass reach in the previous license. The flow in the by-pass reach was limited to leakage from the dam and water from springs and other ground water seepage. The new license requires that an additional 10 to 35 cfs be passed through the dam as the minimum flow requirement. The dam has flashboards in the spillway bays that are used to control the flow through the spillway. In the past, as long as flow was at about 1227 cfs or less the flashboards were left in place and all the flow in the river was diverted into the flume to the Cove plant. If the flow exceeded what the plant could use, some flashboards were removed to allow the excess water to spill over the spillway into the by-pass reach.

The minimum flow will be passed downstream by removing or adjusting the flashboards. However, several modifications are under consideration to pass up to the maximum minimum flow of 35 cfs plus leakage. However, operation of the Cove project was discontinued at the direction of the FERC in March 2003, and all inflow to the Cove forebay has been passed downstream since that time.

1.3.1 Minimum Flow Monitoring Methodology

Monitoring location

There is no gauge station immediately downstream of the Cove dam. Therefore, upon re-operation of the Cove project, the Company will provide a different method to verify minimum flow compliance. The forebay elevation and a staff gauge will be used to monitor and record the data that will be used for minimum flow verification. A staff gauge will be installed at an appropriate location just downstream of the dam that will allow the minimum flow to be measured. The stage indicated on the staff gauge will be calibrated with a flow meter to associate river stage with river flow.

Manned monitoring

The staff gauge will be checked each day, as part of the operator's normal operation duties. The staff gauge will have calibration marks that indicate the proper river stages for 10 cfs and 35 cfs. The operator will check the gauge to document compliance with the minimum flow. The staff gauge will be re-calibrated with a flow meter every 3 months to determine if the data requires correction due to ice or vegetation causing a shift.

Monitoring at less than minimum flow

The springs in the lower end of Black Canyon (Grace by-pass reach) provide nearly 30 cfs. The only case in which inflow may be less that 10 to 35 cfs would most likely be during a severe drought period or during irrigation season when the spring flow is diverted. When inflow is less than the minimum flow requirement, the generator would be shut down and any inflow would be allowed to pass over the dam. During this type of situation the reservoir level will be held constant as described in Section 1.1.1 to ensure the inflow is being passed through the dam.

The generator at Cove requires a minimum of about 180 cfs to generate. If flows were to drop below about 190 to 200 cfs there would not be enough water for the generator to operate all the time. During such times the forebay would be drawn down to generate for a period of time, and then the generator would be shut down to allow the forebay to fill up again. This method of operation allows the generator to operate at a more efficient load but varies the reservoir elevation by about 3 feet. When this method of operation is used, the staff gauge would be monitored to assure that the minimum flow is provided at the lowest forebay elevation.

1.3.2 Minimum Flow Monitoring Equipment

Design and specifications

The specifications for the Drux pressure transducer used to monitor the elevation of the Cove forebay is located in Appendix A as are the specifications for the A/D converter card. The computer that controls the generator and records the forebay elevation data is an IBM compatible computer. The computer has a 486 processor with 64 k RAM memory. The operating program is written in Microsoft GWBasic.

Reliability

The computer operating system has proven to be very reliable over the years since it was installed. Because the system operates the generator loading, any malfunctions are immediately repaired. During any short periods of time in which the operating system is down an operator will manually read the minimum flow and reservoir elevation to ensure that requirements are being met.

1.3.3 Minimum Flow Data Collection and Storage

Collection protocol

Manual readings are taken by the operator once each day and recorded in the plant logbook. These data are also recorded in a separate water flow log book (known as a blue book). The blue book serves as the official flow record for the plant. Blue books are kept on file with other records (e.g., shift calculations) for the staff gauge below the dam. The daily readings are also entered into a computer spreadsheet that will add the shift to the data. This provides for easily accessible data when needed.

The reservoir elevation data recorded electronically are downloaded quarterly and stored on the Company server and on CD ROM in the raw data format. These data will not generally be prepared for publishing unless there is an expressed need.

Rating tables

A rating table will be developed for the staff gauge below Cove dam. This rating table will be used to determine the flow in the river based on the stage. This rating table will be part of the computer spreadsheet that converts the corrected stage into flow. The rating table is also printed out so that stage values can be converted into flow manually if the need arises.

Data review

All flow data from the blue books will be reviewed as the data are entered onto the monthly computer spreadsheets. The review will include a check to see if the minimum flow requirements were met for each month. Any incidents will be investigated to determine cause.

Storage protocol

All raw flow data in the blue book are kept at the plant until the book is full and sent to the Salt Lake City office for permanent storage. The data entered into monthly spreadsheets are stored on the Company network server. This server backs up the data. The reservoir elevation data are also stored on the Company network server, and all data are stored on CD ROM format.

The multiple storage of the data provides the opportunity to retrieve information if needed. It can be re-created from the downloaded file, re-entered from the blue book, or retrieved from back-up files from the network server.

1.3.4 Reporting to the Commission

Reporting hourly average

Any reports to the FERC or other agencies concerning the Cove minimum flow will be provided using hourly average flow as the reporting standard. The data will be prepared and reported in graphical as well as table format.

Reporting incidents

The operator will monitor the staff gauge and, should a reportable incident occur, alert appropriate staff personnel who would be responsible to access the data, verify that the event occurred, and prepare a report about the event.

Any suspected incident reported by the plant operators will be investigated in a timely manner. Should a violation be verified, the Regional FERC office will be notified of the violation within 10 days of the verified event. A complete report of the event will be prepared and sent to the FERC within 30 days after the event is reported to the FERC Regional office.

The report will include the following information:

1. All relevant flow data will be provided to verify the incident. The data will be presented in table and graph format for the time period in question.
2. The report will include the results of the investigation to determine the cause, severity, and duration of the incident.
3. The report will include a description of any corrective measures that have been or will be implemented to prevent future incidents from occurring.
4. The report will include any comments or correspondence that was received from interested parties regarding the incident.

The plant is manned 8 hours a day, 7 days a week. Therefore, it is possible that an incident could occur during the unmanned hours and the operators would not know that it occurred. However, 24-hour remote-monitoring coupled with data communication fail-safe alarms provide a high degree of confidence that should conditions indicating an incident occur, prompt action would be taken. However, in no case are the plants left unattended for more than 16 hours. The Company is developing monitoring to promptly detect and alert operators to conditions that could lead to an incident. However, until the system is completed, it is possible that an incident would only be noted during review of the flow and elevation data after the incident occurred. The FERC would be notified of the incident as quickly as it is verified and a report prepared as stated above.

In the compliance management system planned, any condition leading to an incident would trigger an alarm and alert the on-call operator to come to the plant and make appropriate operational changes to ensure that the situation is restored or kept within the operating parameters required by the license. Currently, hourly elevation and hourly-average flows are monitored on a regular basis (week-days) by one or more people, providing reasonable assurances of compliance in the interim.

Unless the Company verifies an incident with data, providing data to the FERC or any agency or NGO will be done on an as-requested basis only. That is to say, data will be provided in a report should an incident occur that is verified by the Company. Suspected incidents reported by other concerned parties or individuals will be investigated by the Company and data provided to the concerned party if specifically requested. The Company will provide sufficient data to verify the suspected incident occurred. The requesting agency, NGO, or other interested party will need to request the data in writing. The request will need to state the specific purpose for the data, the time period desired, what specific data is needed, and the format in which to supply the data. Since the Company has a large amount of stored data and limited manpower, each request will need to be evaluated as to the time it will take to prepare the requested data. Much of the stored data is raw and may take a significant amount of time and resources in order to respond.

1.3.5 Schedule for Implementation of Monitoring

Installation of equipment

The river staff gauge will be installed upon re-operation of the Cove project.

Implementation of the minimum flow monitoring

Implementation of the minimum flow monitoring will begin immediately upon re-operation of the Cove project.

1.4 Oneida

The new license requires that the year-round flow below the Oneida powerhouse shall be 250 cfs plus current leakage, or inflow into Oneida reservoir, whichever is less. This minimum flow requirement will be adjusted based on measurement of leakage from the dam, as required in Section 3.2.1 of the Bear River Settlement Agreement.

There was no minimum flow requirement downstream of the Oneida plant in the previous license. There will be some modification to the development, as well as the operating procedure to meet the new requirement. These changes include the addition of automatic controls that will operate one spill gate as a fourth unit. This gate will be opened if all three units trip off line to provide the minimum flow downstream of the plant.

Under normal operating conditions, during spring runoff period, irrigation season, and periods of average or above water condition, the flow below Oneida is passed through the generators. Generally, flows provided to meet irrigation demands are greater than the minimum flow requirement. Under normal conditions, the only risk of flow dropping below the minimum flow of 250 cfs is if the generators trip off-line. Automation of the spill gate will pass the 250 cfs minimum flow should the generators trip off line until a unit can be returned to service. River flow will be monitored, and flow below the minimum will trigger automation of the spill gate.

The 900 cfs goal flow, if available during the irrigation season, will also be passed through the generators. Should the generators trip off-line for any reason the 900 cfs flow will be interrupted until the generating units can be returned to service. The spill gates can be opened to pass enough water to meet irrigation requirements and to keep the reservoir from over filling.

Under relatively low flow conditions, the Company uses a block load mode of operation. Block load mode of operation means that flow above 250 cfs is stored in the reservoir until one or more generators can be put on-line to generate efficiently. Once the reservoir has been drawn down to a predetermined level, the generators will be unloaded so that only the minimum flow is being passed downstream. The flow in excess of 250 cfs will again be stored in the reservoir until the reservoir is near the full pool elevation. Then the generators will be loaded again for efficient operation until the reservoir is drawn down to the predetermined elevation.

During drought periods, if the inflow is below what is needed to generate (between 150 and 200 cfs), it may be necessary to pass the minimum flow through the spill gate. If it becomes too difficult to control very low flows by floating a unit, the unit will be shut down and the spill gate opened to pass the reservoir inflow.

1.4.1 Minimum Flow Monitoring Methodology

Monitoring location

The minimum flow downstream of the Oneida plant will be monitored by the gauge station located several hundred yards downstream of the dam. PacifiCorp has the responsibility of maintaining this gauge station and providing corrected data to the USGS for final review and publishing.

The low-flow method of monitoring the minimum flow will be to track the change in reservoir elevation. The location for monitoring reservoir elevation is from a stilling well located near the spillway on the dam.

Manned monitoring

The operators monitor the plant operation, reservoir elevations and the flow in the Bear River downstream of the dam. System Operations and the Hydro Dispatcher coordinate the operation of the Bear River and the flows that are in the river. They issue operation instructions to the Oneida plant operators based on the demands being placed on the river.

The reservoir elevation is read and recorded manually each morning by the operator on duty that day. The operator uses this information to calculate reservoir changes and to make the appropriate adjustments to the plant operation for the day to match system orders and river conditions. The manually recorded elevation serves as the official reservoir elevation for the day and is reported to the System Operations.

Automatic monitoring

The monitoring, recording, and temporary storage of data for both the river and the reservoir is done by electronic equipment. The monitoring equipment has internal programming that controls data collection at defined intervals, converts raw signals to values, and records the measured values. In addition, a mechanical strip chart recorder is used to record the flow in the river. All recording is done automatically with no control from the operators. As noted above, since the most critical gaging stations will be polled hourly via GOES satellite or real-time via SCADA, the need for the back-up equipment is greatly decreased. Spare parts are kept on hand so that should the system malfunction, it can be quickly replaced. In most cases it can be replaced in two days or less.

The reservoir elevation is also transmitted to the Hydro Dispatcher over the Company's microwave system to provide real-time data concerning the reservoir elevation.

Monitoring at less than minimum flow

The license requires that the minimum flow downstream of the Oneida plant be 250 cfs or the inflow into the Oneida reservoir. Winter months (following the irrigation season) during severe drought conditions is the time when the river downstream of the plant is most likely to drop below 250 cfs (i.e., inflow is less than 250 cfs).

The method for controlling the outflow, when inflow is less than 250 cfs, is to keep the reservoir elevation at a relatively constant elevation to ensure that the inflow to the reservoir is passed on downstream. The reservoir elevation, at the time the inflow drops below 250 cfs, will be used as the target elevation for monitoring compliance. The flow dropping below 250 cfs will be apparent to the operator when the reservoir elevation starts to fall and the minimum flow of 250 cfs is already being passed down stream. The operating regime will be to keep the reservoir elevation within a dead-band of ± 1.5 feet of the target elevation. There is also a tolerance of ± 2.0 feet of the target elevation to stay in compliance.

The operators have considerable experience operating the plant through the full range of flows in the river and keeping the flows relatively constant. During times when flows are about average and during irrigation season, flow changes result as changes to the demands on the river occur, which is coordinated river-wide by the Hydro Dispatcher. These changes are not generally made more than once a day and often are made every few days, weekly or even every few weeks depending on the demand for water.

Making flow changes in the river, when the inflow is below the 250 cfs, will generally be done manually once a day. The operator’s compliance management process will provide notification when the reservoir elevation exceeds the target band (±1.5 feet with a tolerance of ± 2.0 ft.). A sufficient time period between adjustments will allow the effect of the last change to be reflected by the reservoir elevation before another change is made.

The elevation used to measure compliance, as discussed in Section 1.4.4, will be the 24-hour moving average. The moving average reading is obtained by averaging the current hourly reading with the previous 23 readings.

The reservoir elevation dead-bands used to verify compliance may be shifted downward for operational considerations such as emergency power generation. This results in flows to the river greater than inflow for a short period of time, but not less than inflow. The dead-band will not be raised for any reason. Any storage deficit will be filled when inflow to the reservoir is greater than the minimum flow at which point compliance would be verified by the downstream flow gauge.

Monitoring goal flow

During the irrigation season the goal flow of 900 cfs will be passed downstream when available and required for irrigation. However, the availability of 900 cfs may not always be apparent. There are situations that develop during irrigation season where the inflow may exceed 900 cfs, but outflow from Oneida may necessarily be less than 900 cfs due to the need to refill the reservoir for irrigation purposes. There is a 3-day lag time for water to reach Cutler reservoir from Bear Lake. Because of this lag time, water is frequently drawn from the Oneida reservoir to prevent a delay of irrigation water delivery. When water from Bear Lake reaches Oneida, the reservoir is refilled in preparation for the next irrigation call. Under this scenario, the inflow to Oneida could exceed 900 cfs but the outflow could be less than the inflow until the Oneida reservoir is full again.

The USGS gauge station just below the plant will be used to monitor the 900 cfs target flow as well as the 250 cfs minimum flow.

1.4.2 Minimum Flow Monitoring Equipment

Design and specifications

The USGS gauge station downstream of the Oneida plant utilizes a Sutron data logger, model 8200-A, to electronically measure the river stage and record the stage measurement in electronic format. A Sutron shaft encoder, model 5600, provides the input to the data logger and is operated by a steel tape and float. Appendix A lists the specifications for the Sutron data logger and encoder currently in use. It is anticipated that newer models will be phased in over time or replaced by a comparable system using the Company's SCADA system.

The data logger, encoder, and float tape was calibrated upon installation and is checked about every 8 to 12 weeks to ensure that it is still measuring the correct stage. It is checked against a staff gauge mounted in the gauge station housing.

A strip chart recorder is used as a backup to the Sutron recorder at this station. The strip chart recorder has a float assembly to operate the recorder shaft. The calibration of the chart recorder is checked about every 8 to 12 weeks. As the polling frequency from the electronic data loggers increases from monthly to daily and even hourly for satellite-enabled sites or real-time via SCADA, the need for backup loggers will decrease. Hence, the strip chart recorder may be phased out or replaced by electronic data loggers if a back-up is still deemed necessary.

The reservoir elevation is measured in two different ways. The reservoir level is measured using a Celesco PT9420 cable-extension position transducer with a 4-20 ma output. The 350-inch extension cable is attached to a 10-inch float. The 4-20 ma output signal is sent to the plant over a six-pair telephone cable where it is used by the SCADA to send data to the Hydro Dispatcher's computer system. This signal is also used to drive an Omega DP24-E process meter located in the control room that is calibrated to reflect the actual reservoir level. The 4-20 ma signal will also be used to feed into the logic controller to control the plant output and recorded in a data file.

Reliability

The gauge station below the Oneida plant, like the gauge station downstream of Soda, is part of the USGS network of gaging stations. The Company is required to maintain this station and submit the data to the USGS.

This gauge station receives power from the local distribution circuit and has the same protective devices as the below Soda station. It has a surge suppressor; a small AC to DC converter type step-down instrument transformer; an internal battery source; internal memory back-up lithium battery; and the metal housing is properly grounded.

Any malfunction of equipment could cause a complete loss of stored data since the last download. As the polling frequency from the electronic data loggers increases from monthly to daily and even hourly for satellite-enabled sites or real-time via SCADA, the need for backup will decrease. Hence, the strip chart recorder may be phased out or replaced by electronic data loggers if a back-up is still deemed necessary. Spare parts are kept on hand so that should the system malfunction, it can be quickly replaced. In most cases it can be replaced in two days or less.

The mechanical strip chart recorder is manufactured by Leoppold Stevens and has proved over the years to be very reliable. A stock of paper, pens, ink, and replacement clocks are taken with the hydrographer as he visits the stations every 8 to 12 weeks. He performs any necessary maintenance to keep the recorder running until the next site visit.

The reservoir elevation equipment and programmable controller spill gate are operated with power from the dam AC electrical system. The dam AC electrical system has an emergency power generator that can be started should the power from the plant fail for any reason. The operator must open an isolation switch before the generator can be started to insure that the restoration of the normal feed doesn't back feed into the generator. Therefore, the generator doesn't automatically start with a loss of the normal power source.

1.4.3 Minimum Flow Data Collection and Storage

Collection protocol

The data logged on the Sutron data logger is the water depth measured in the stilling well by the encoder and is referred to as the stage. The stage data is downloaded monthly through the Sutron internal modem by the Company hydrographer in the Salt Lake City office. After downloading the stage data for a month, it is converted to ASCII format and loaded into an Excel spreadsheet. This spreadsheet allows for a correction factor to be applied to the raw data and then uses the corrected stage to calculate the flow in the river in cubic feet per second. The spreadsheet summarizes the data to produce an average stage and flow for each day, and also displays the maximum and minimum flow for each day. The spreadsheet also displays the correction factor that was applied to the raw data for each day. The spreadsheet data is considered provisional until it is reviewed and approved by the USGS after the end of the water year (September 30).

The collection of the lake elevation data is not as complex as the river elevation data collection. There is no need for a correction factor or a rating table when elevation is the only concern. The computer receives raw data from the A/D converter and converts it into a reservoir elevation. The reservoir elevation is then logged in a monthly data file. At the beginning of each month a new data file is created to store the data for the new month. Elevation data is transmitted via the Company SCADA system and stored on Company databases that are accessible in real-time. This data is currently being made more accessible to water management personnel who will monitor the status of the elevation during periods when elevation data are used for compliance purposes – when inflow to the reservoir is less than minimum flow – to indicate that inflow is being passed through the reservoir.

The collection method has been updated to provide real-time flows as required by the license. The real-time flows provided will incorporate the adjustment factor described below. Eventually, the real-time collected stage will be used in place of the monthly download. The data is from the same source, the data logger, but the simpler collection method will streamline the process. The monthly download method described above will continue until the new system has been verified.

Shift

The raw stage data recorded by the data logger does not always reflect accurate river flow. There are a number of conditions that can distort the stage measurement.

During the summer months, vegetation buildup in the river channel can affect the stage reading. This vegetative growth impedes the free flow of the water and backs up the water towards the plant. This condition causes a higher stage reading in the stilling well and this altered reading is measured and recorded by the encoder and data logger. The same effect on the stage readings can happen in the coldest winter months if ice begins to form in the river channel and along the riverbanks, which would cause the water to back up.

To find the correct stage reading (and hence the correct flow) a correction factor known as a *shift* must be calculated and then added to the measured stage. The *shift* is the difference between the current stage measurement and the stage corresponding to the measured flow from the rating table (see next section). Flow measurements are made every 8 to 12 weeks or more often if needed. Once the shift has been calculated (the results can be either a positive or negative number), it is entered into the data logger and is added to the recorded stage to compute the *provisional flow*. For the final, *published flow record*, the *shifts* measured every 8 to 12 weeks are interpolated between measurements. This produces a smoothly varying flow record and is based upon the assumption that changes to river conditions usually happen slowly over a period of several weeks or months. Abrupt changes such as a change in the channel cross-section, faulty equipment, or incorrect settings would be detectable as a run of *shifts* that are consistently of the same sign or very large. If this occurs, the equipment and gaging location is scrutinized and if no technical error is found, the rating table is updated after enough measurements are made. In the intervening period, the *shift* typically provides an accurate way to compensate for abrupt changes.

For real-time flows, the “best” *provisional flow* is the one incorporating the most recent shift. This is the data that is used to indicate compliance with license articles. The *published flow record*, which is produced by interpolating between consecutive *shifts* may indicate “after-the-fact” incidents. These are expected to be rare, but may occur. These will not be reported as they are not true incidents. This issue may arise if a stakeholder identifies a supposed “incident” after the fact. Should this occur, the necessity of relying on *provisional flow* information will be described.

Rating tables

An established relationship between stage and the flow in the river is called a rating table. The rating table indicates the flow in the river for each stage. It is an approximation based on previously measured flows and the associated stage. The approximation is subject to error due to the particular hydraulic conditions in the river when the measurements are made. Typically, the flow in the river is steady and uniform. However, there is no physical constraint on the relationship, which is most prominent at higher and unsteady/nonuniform flow regimes. Hysterisis is possible. However, the rating table is an adequate approximation with no better alternative available in the state of the science of *in-situ* flow measurement.

The stage values in the spreadsheet are tabulated to hundreds of a foot over the full range of the river flow. When someone wants to know the flow in the river for a particular stage, the correct stage (stage plus shift) is located on the rating table to see what the flow is for that stage. The current rating table for the gauge station below Oneida is attached as Appendix B.

When a run of *shifts* that are consistently of the same sign or very large are encountered, a new rating table is generated. The first step in creating a rating table is to plot measured flow versus the stage reading. A representative group of the most recently measured flows is plotted on a computer spreadsheet program to make a graph. A polynomial curve is fitted to the graphed points over the full range of flows. If a single polynomial, up to a fifth order, is not adequate to represent all flows within 10 percent of the measured value, a piecewise polynomial is implemented. The functional relationship is used to calculate the flow at each stage from the minimum to the maximum in increments of one-hundredth of a foot. The calculated values are placed in chart form so that it can be printed out. The actual functional relationship is used within the data logger and in spreadsheet computations.

Reservoir lag time

When the inflow to the reservoir is less than the minimum flow, incremental reservoir storage is very large compared to the inflow. This causes changes to happen slowly over a longer period and causes the outflow from the reservoir to lag the inflow. When the inflow is less than the minimum flow, the outflow will be adjusted to maintain reservoir elevation within a target range of ± 1.5 feet. A tolerance range of ± 2.0 feet will be maintained at least 95 percent of the time. Any change in inflow causes the reservoir elevation to change until the elevation nears a target dead-band limit and then the operator will change the outflow to bring the reservoir elevation back into the dead-band range. The time from when the inflow first changes to when the elevation leaves the dead band is the lag time. When the inflow and reservoir elevation have stabilized, the outflow closely matches the inflow. When inflow is changing, outflow will be adjusted as needed to keep the reservoir elevation within the dead-band, but may lag changes in inflow. However, the lag time does not affect the amount of water that is discharged downstream, only the timing of the discharges. This may reduce the magnitude of outflow fluctuations by making a series of small changes to adjust for larger changes in inflow.

Storage protocol

The hydrographer typically downloads the data from the Sutron data loggers during the first two weeks each month. The monthly raw data is loaded into a spreadsheet. If a shift calculation has been done since the end of the month, then the shift factor is added to the stage and provisional data are ready for use. If a shift factor has not been taken since the end of the month, then the spreadsheet is held and is not ready for use until the shift factor becomes available.

A spreadsheet for the gauge station is created for each month of the year and includes the summarized daily information as well as the raw data. At the end of the water year (September 30) all the monthly data are summarized onto a yearly spreadsheet that shows the average flow for each day of the year. The yearly sheet also displays the monthly average flow, the monthly minimum flow, and the monthly maximum flow.

The monthly flow data spreadsheets are stored on the Company network server that is backed up each night. After approval by the USGS the data are stored on a CD ROM as well as the network server. The yearly data are submitted to and published by the USGS. A summarized monthly spreadsheet (minus the raw data) and yearly spreadsheet are printed out and stored in Company files.

The reservoir elevation files are transmitted via the SCADA system and stored on the Company-wide database, and are backed up on a regular basis.

Due to the real-time reporting requirements in the license, this procedure will be updated. Until the new procedure is verified the old procedure will continue in parallel operation. The new procedure will replace the monthly download with real-time automated data collection. The three gauges where real-time flows are required will be transmitted hourly via GOES satellite or real-time via the Company SCADA, and the non-real-time sites will be polled via telephone modem on a regular basis ranging from once per day to hourly depending on operational requirements.

The Sutron software XConnect will be used to collect the data into a temporary database from both satellite and modem platforms. This data will be exported to a flat file every hour and imported into the Company database, where it will be available for immediate analysis. This will provide integration with other real-time SCADA system data such as reservoir elevations and will enhance management and reporting capabilities. As new technologies become available, it may become beneficial to transmit river stage directly through the SCADA system to provide real-time reporting and data storage. This would obviate the need for the Sutron data loggers and the XConnect software for these sites.

The new system will use data from the Company database instead of monthly manual modem polling. The provisional and final published flows will be stored in the Company database. The format of the data provided to the USGS will not be substantially changed.

1.4.4 Reporting to the Commission

Reporting hourly average

River flow will be reported as hourly averages to verify compliance with the minimum flow requirements.

24-hour moving average for reservoir

The reservoir elevation, as stated above, will be used to monitor and control the outflow from the reservoir when inflow is below the minimum of 250 cfs. The sensor that records the lake elevation is located inside of a stilling well to help dampen out the effect that waves have on the elevation. However, wind blowing across the water can also force more water to one end of the reservoir and give a false elevation reading. Since the Company will be trying to control the reservoir elevation to within the target elevation dead-band, a false reading caused by the wind could result in unnecessary changes to the outflow from the plant and reporting to the FERC. To address this problem the Company will record a moving average of the lake elevation so that false spike readings can be smoothed out and unnecessary changes to downstream flow can be eliminated. During a drought, inflows are small compared to the reservoir capacity, so changes in reservoir elevation happen very slowly over a 12 to 24 hour period. Therefore, the moving average will not affect the accuracy of the recorded elevation, but simply eliminate any spikes, and dampen out the effect of any high or low elevations caused by wind events.

The computer will run a program that calculates a 24-hour moving average. This is done by taking the current hour elevation reading and averaging it with the previous 23 readings. This will be the elevation used for the official record and to verify compliance with the requirement of the license that inflow is being passed though dam. The stream gauge downstream of the plant will measure and record the actual hourly average flow, while the reservoir elevation will be used to verify that outflow equals inflow.

Reporting incidents

The operator will monitor the reservoir elevation during times of low flow and, should a reportable incident occur, alert appropriate staff personnel who would be responsible to access the data, verify that the event occurred, and prepare a report about the event.

Any suspected incident reported by the plant operators will be investigated in a timely manner. Should a violation be verified, the Regional FERC office will be notified of the violation within

10 days of the verified event. A complete report of the event will be prepared and sent to the FERC within 30 days after the event is reported to the FERC Regional office.

The report will include the following information:

1. All relevant flow or reservoir elevation data will be provided to verify the incident. The data will be presented in table and graph format for the time period in question.
2. The report will include the results of the investigation to determine the cause, severity, and duration of the incident.
3. The report will include a description of any corrective measures that have been or will be implemented to prevent future incidents from occurring.
4. The report will include any comments or correspondence that was received from interested parties regarding the incident.

The plant is manned 8 hours a day, 7 days a week. Therefore, it is possible that an incident could occur during the unmanned hours and the operators would not know that it occurred. However, 24-hour remote-monitoring coupled with data communication fail-safe alarms provide a high degree of confidence that should conditions indicating an incident occur, prompt action would be taken. However, in no case are the plants left unattended for more than 16 hours. The Company is developing monitoring to promptly detect and alert operators to conditions that could lead to an incident. However, until the system is completed, it is possible that an incident would only be noted during review of the flow and elevation data after the incident occurred. The FERC would be notified of the incident as quickly as it is verified and a report prepared as stated above.

In the compliance management system planned, any condition leading to an incident would trigger an alarm and alert the on-call operator to come to the plant and make appropriate operational changes to ensure that the situation is restored or kept within the operating parameters required by the license. Currently, hourly elevation and hourly-average flows are monitored on a regular basis (week-days) by one or more people, providing reasonable assurances of compliance in the interim.

Unless the Company verifies an incident with data, providing data to the FERC or any agency or NGO will be done on an as-requested basis only. That is to say, data will be provided in a report should an incident occur that is verified by the Company. Suspected incidents reported by other concerned parties or individuals will be investigated by the Company and data provided to the concerned party if specifically requested. The Company will provide sufficient data to verify the suspected incident occurred. The requesting agency, NGO, or other interested party will need to request the data in writing. The request will need to state the specific purpose for the data, the time period desired, what specific data is needed, and the format in which to supply the data. Since the Company has a large amount of stored data and limited manpower, each request will need to be evaluated as to the time it will take to prepare the requested data. Much of the stored data is raw and may take a significant amount of time and resources in order to respond.

1.4.5 Schedule for Implementation of Monitoring

Testing of equipment

The river monitoring equipment is in place and has been functioning since about 1995. This equipment has been thoroughly tested over that time period. The Sutron data logger below the Oneida dam will continue to be used to monitor minimum flow compliance during the new license period. The Company has reviewed the river data download and preparation procedure and has determined that more frequent collection and automated monitoring is required to implement minimum flow data from the river data logger. GOES satellite transmission equipment is being installed to provide the required collection frequency. In the future, changes in technology or costs may require different methods of collection that provide equivalent functionality.

The system that provides the reservoir elevation reading to the operator has been in service for many years and is maintained on a regular basis. This system will continue to be used as part of the operator's normal responsibility.

These data will be used to verify compliance when inflow to the Oneida reservoir is less than the minimum flow of 250 cfs.

Implementation of minimum flow monitoring

The Company has implemented the minimum flow requirement since June 2004.

2.0 RAMPING RATE

2.1 Soda

The new license requires that a ramping rate, ascending and descending, shall not be greater than 1.2 feet per hour downstream of the Soda dam, as measured at USGS Gauge No. 10075000. For example, if a flow of 160 cfs were being released, the stage would correspond to 0.63 ft. If more flow were released the ramping limits would only permit an increase of 1.2 feet, which corresponds to an increase in stage to 1.83 feet (flow of 869 cfs). If this was done and more flow than 869 cfs was desired, the operator would have to wait one hour. After one hour, the river stage could be increased another 1.2 feet to 3.03 feet (flow of 1964 cfs). A similar sequence would apply for down-ramping. The table below shows this example in more detail with generation values also shown.

Time	**Stage**	**Total Flow**	**Increase in Flow**	**Generation**	**Spill**
0 hours	0.63 ft	160 cfs	0 cfs	0 kW	0 cfs
1 hours	1.83 ft	869 cfs	709 cfs	4.4 mW	0 cfs
2 hours	3.03 ft.	1964 cfs	1095 cfs	10.0 mW	0 cfs
3 hours	4.23 ft.	3388 cfs	1424 cfs	14 mW	830 cfs

Full generation by both units is generally not needed to meet irrigation water demands. Above-average spring runoff is the only time the flow in the river could exceed plant capacity and possibly spill excess water through the spillway. The summer months (May-Sept) when the flow is controlled by irrigation demands, the flow will seldom reach the full load.

Irrigation demands usually start out low and then steadily increased over a period of days or weeks at the beginning of the irrigation season. The changes in outflow to meet the demands are usually done in steps that are less than 1.2 feet and are generally made once a day. The table also shows that at higher initial flows, the increase in flow is greater for a stage change of 1.2 feet than it is at lower flows. Therefore, as flows in the river increase, a greater change in flow can occur and still be in compliance with the 1.2 foot rise in stage.

The most likely cause of noncompliance with the 1.2-foot ramp rate is if the plant should trip offline. The flow through the turbines will drop down to near zero but, as the generators are returned to service, the units will be loaded to provide compliance with the ramping rate of 1.2 feet per hour, in order to return to the former discharge rate through the turbines.

The operators will use the Soda Ramping Table (shown in Appendix C) that relates the current outflow to the next allowable outflow (both higher and lower) to stay in compliance with the 1.2 foot per hour ramping limit stated in the license. The table is generated from the Soda Rating Table (Appendix B). When a change in outflow is requested, the operator will use the table to determine if the change needs to made in more than step.

2.1.1 Ramping Rate Monitoring Methodology

<u>Monitoring location</u>

The minimum flow downstream of the Soda dam will be monitored by the USGS gauge station (Gauge No. 10079500) located several hundred yards downstream of the dam. PacifiCorp has the responsibility of maintaining this gauge station and providing the data to the USGS for final review and publishing.

<u>Manned monitoring</u>

The plant operator manually makes all changes to plant generation and flow as part of his normal responsibilities. Any changes to reservoir releases are recorded in the plant log.

<u>Equipment for automatic monitoring</u>

The river flow is measured, recorded and temporarily stored in an electronic data logger located in the gaging station downstream of the plant. The data logger is programmed to read at defined intervals, converts raw signals to values, and records the measured values. As a back-up, a mechanical strip chart recorder or other device will be used to record the flow in the river. This process is automatic with no control from the operators. Since the most critical gaging stations will be polled hourly via GOES satellite or in real-time via SCADA, the need for the back-up equipment is greatly decreased. Spare parts are kept on hand so that should the system malfunction, it can be quickly replaced. In most cases it can be replaced in two days or less.

The reservoir elevation is measured by a float and real-time sensor that sends a signal to a display monitor in the control room. The display monitor provides a signal to a local computer and to Systems Operations.

2.1.2 Ramping Rate Monitoring Equipment

<u>Design and specifications</u>

The USGS gauge station downstream of the Soda plant utilizes a Sutron data logger, currently model 8200-A, to electronically measure the river stage (water depth) and record the stage measurement in electronic format. A Sutron shaft encoder, model 5600, has a wheel, with spokes around the circumference, attached to the shaft. A perforated steel tape hangs around the wheel and has a float attached to one end that floats on the water and a counter weight attached to the other end. As the float moves up and down with the change in water level, the tape rotates the wheel and shaft, which causes the encoder to generate an electrical signal that is proportional to the rotation of the shaft. This signal is fed from the encoder into the data logger where an internal program translates the signal and logs the stage data. Appendix A lists the specifications for the Sutron data logger and encoder currently in use. It is anticipated that newer models will be phased in over time or replaced by equipment to transmit stage over the Company's SCADA system.

The data logger, encoder and float tape is calibrated upon installation and checked about every 8 to 12 weeks to ensure that it is still measuring the correct stage. It is checked against a staff gauge that is permanently attached to the side of the stilling well.

A strip chart recorder is maintained and currently used as a backup, should there be a problem with the electronic data logger. The strip chart recorder also uses a float to turn the chart recorder shaft and an ink pen records the level on a moving strip of paper. The calibration of the chart recorder is also checked about every 8 to 12 weeks. As the polling frequency from the electronic data loggers increases from monthly to daily and even hourly for satellite-enabled sites or in real-time via SCADA, the need for backup loggers decreases. Hence, the strip chart recorder may be phased out or replaced by electronic data loggers if a back-up is still deemed necessary.

The reservoir elevation is measured with a Stevens Syncro stand-alone encoder. A wheel, metal tape, and float assembly turns the shaft of the encoder. The encoder has a syncro motor that produces a signal that is sent to display in the control room. The display in the control room is a Stevens programmable position monitor model 1255. It accepts the signal from the Syncro encoder and is programmed to display the reservoir elevation. The reservoir elevation reading is the reading that the operator records in the logs and reports to Systems Operations as the official elevation for the day. Appendix A lists the specifications for the Syncro encoder and the Programmable position monitor.

The Position Monitor produces a 4–20 milliamp output signal that is fed into the SCADA system and over a microwave channel to Systems Operations. This elevation data is logged in a data file at Systems Operations. The signal is also fed to an A/D converter card, which converts the signal from analog to digital data. A computer accepts and records data from the converter card.

Reliability

The river gaging station is part of the USGS network, which requires a high degree of reliability. The Sutron data logger was used by the USGS as they moved from mechanical strip chart recorders to digital data loggers. The Company followed their lead and installed the same equipment in the gauge stations that are the Company's responsibility to maintain. The Sutron data loggers have been in service since about 1995 within the Company and have proven to be very reliable.

The gauge station below the Soda plant is provided power from the local distribution circuit. A surge suppressor is installed in the circuit to eliminate surges from the distribution circuit. A small instrument transformer steps down and converts the power from 120V AC to 12V DC required by the Sutron. The Sutron has an internal battery capable of supplying power to the data logger for several days if the external power is interrupted. During external power outages, the data logger will still function and measure the river stage as programmed. The internal memory chips that store that measured data is backed up by a 3V lithium battery to keep the data safe even if the 12V battery goes dead during an extended power outage and the data logger stops functioning. The data logger is properly grounded to help protect from static charges that could harm the data logger circuit boards.

Any malfunction of equipment could cause a complete loss of stored data since the last download. As the polling frequency from the electronic data loggers increases from monthly to daily and even hourly for satellite-enabled sites or in real-time via SCADA, the need for backup loggers decreases. Hence, the strip chart recorder may be phased out or replaced by electronic data loggers if a back-up is still deemed necessary. Spare parts are kept on hand so that should the system malfunction, it can be quickly replaced. In most cases it can be replaced in two days or less.

The mechanical strip chart recorders are manufactured by Leoppold Stevens and have proved over the years to be very reliable. A stock of paper, pens, ink, and replacement clocks are taken with the hydrographer as he visits the stations every 8 to 12 weeks. He performs any necessary maintenance to keep the recorder running until the next site visit.

2.1.3 Ramping Rate Data Collection and Storage

Collection protocol

The data logged on the Sutron data logger is the water depth measured in the stilling well by the encoder and is referred to as the stage. The stage data is downloaded monthly through the Sutron internal modem by the Company hydrographer in the Salt Lake City office. After downloading the stage data for a month, it is converted to ASCII format and loaded into an Excel spreadsheet. This spreadsheet allows for a correction factor to be applied to the raw data and then uses the corrected stage to calculate the flow in the river in cubic feet per second. The spreadsheet summarizes the data to produce an average stage and flow for each day, and also displays the maximum and minimum flow for each day. The spreadsheet also displays the correction factor that was applied to the raw data for each day. The spreadsheet data is considered provisional until it is reviewed and approved by the USGS after the end of the water year (September 30).

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Shift

The raw stage data recorded by the data logger does not always reflect accurate river flow. There are a number of conditions that can distort the stage measurement. Two of the most common conditions downstream of the Soda plant happen during the summer months and during the coldest part of the winter.

During the summer months, usually starting sometime in mid-July, vegetation buildup in the river channel starts to affect the stage reading. This vegetative growth impedes the free flow of the water and backs up the water towards the plant. This condition causes a higher stage reading in the stilling well and this altered reading is measured and recorded by the encoder and data logger. The same effect on the stage readings happens in the coldest winter months when ice begins to form in the river channel and along the riverbanks, which causes the water to back up.

To find the correct stage reading (and hence the correct flow) a correction factor known as a *shift* must be calculated and then added to the measured stage. The *shift* is the difference between the current stage measurement and the stage corresponding to the measured flow from the rating table (see next section). Flow measurements are made every 8 to 12 weeks or more often if needed. Once the shift has been calculated (the results can be either a positive or negative number), it is entered into the data logger and is added to the recorded stage to compute the *provisional flow*. For the final, *published flow record*, the *shifts* measured every 8 to 12 weeks are interpolated between measurements. This produces a smoothly varying flow record and is based upon the assumption that changes to river conditions usually happen slowly over a period of several weeks or months. Abrupt changes such as a change in the channel cross-section, faulty equipment, or incorrect settings would be detectable as a run of *shifts* that are consistently of the same sign or very large. If this occurs, the equipment and gaging location is scrutinized and if no technical error is found, the rating table is updated after enough measurements are made. In the intervening period, the *shift* typically provides an accurate way to compensate for abrupt changes.

For real-time flows, the "best" *provisional flow* is the one incorporating the most recent shift. This is the data that is used to indicate compliance with license articles. The *published flow record*, which is produced by interpolating between consecutive *shifts* may indicate "after-the-fact" incidents. These are expected to be rare, but may occur. These will not be reported as they are not true incidents. This issue may arise if a stakeholder identifies a supposed "incident" after the fact. Should this occur, the necessity of relying on *provisional flow* information will be described.

<u>Rating tables</u>

An established relationship between stage and the flow in the river is called a rating table. The rating table indicates the flow in the river for each stage. It is an approximation based on previously measured flows and the associated stage. The approximation is subject to error due to the particular hydraulic conditions in the river when the measurements are made. Typically, the flow in the river is steady and uniform. However, there is no physical constraint on the relationship, which is most prominent at higher and unsteady/nonuniform flow regimes. Hysterisis of the flow-stage relationship is possible. However, the rating table is an adequate approximation with no better alternative available in the state of the science of *in-situ* flow measurement.

The stage values in the spreadsheet are tabulated to hundreds of a foot over the full range of the river flow. When someone wants to know the flow in the river for a particular stage, the correct stage (stage plus shift) is located on the rating table to see what the flow is for that stage. The current rating table for the gauge station below Soda is attached as Appendix B.

When a run of *shifts* that are very large or are consistently of the same sign occur, a new rating table is generated. The first step in creating a rating table is to plot measured flow versus the stage reading. A representative group of the most recently measured flows is plotted on a computer spreadsheet program to make a graph. A polynomial curve is fitted to the graphed points over the full range of flows. If a single polynomial, up to a fifth order, is not adequate to represent all flows within 10 percent of the measured value, a piecewise polynomial is implemented. The functional relationship is used to calculate the flow at each stage from the minimum to the maximum in increments of one-hundredth of a foot. The calculated values are placed in chart form so that it can be printed out. The actual functional relationship is used within the data logger and in spreadsheet computations.

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30) all the monthly data are summarized onto a yearly spreadsheet that shows the average flow for each day of the year. The yearly sheet also displays the monthly average flow, the monthly minimum flow, and the monthly maximum flow.

The monthly flow data spreadsheets are stored on the Company network server that is backed up each night. After approval by the USGS the data are stored on a CD ROM as well as the network server. The yearly data are submitted to and published by the USGS. A summarized monthly spreadsheet (minus the raw data) and yearly spreadsheet are printed out and stored in Company files.

The reservoir elevation files are transmitted via the SCADA system and stored on the Company-wide database, and are backed up on a regular basis.

Due to the real-time reporting requirements in the license, this procedure will be updated. Until the new procedure is verified the old procedure will continue in parallel operation. The new procedure will replace the monthly download with real-time automated data collection. The three gauges where real-time flows are required will be transmitted hourly via GOES satellite or real-time via SCADA, and the non-real-time sites will be polled via telephone modem on a regular basis ranging from once per day to hourly depending on operational requirements.

The Sutron software XConnect will be used to collect the data into a temporary database from both satellite and modem platforms. This data will be exported to a flat file every hour and imported into the Company database, where it will be available for immediate analysis. This will provide integration with other real-time SCADA system data such as reservoir elevations and will enhance management and reporting capabilities. As new technologies become available, it may become beneficial to transmit river stage directly through the SCADA system to provide real-time reporting and data storage. This would obviate the need for the Sutron data loggers and the XConnect software for these sites.

The new system will use data from the Company database instead of monthly manual modem polling. The provisional and final published flows will be stored in the Company database. The format of the data provided to the USGS will not be substantially changed.

2.1.4 Reporting to the Commission

<u>Reporting collected data</u>

Data to verify compliance with the ramp rate will be included in the annual report to the FERC. Information will also be available upon request from interested parties to verify compliance, or to investigate potential incidents.

<u>Reporting incidents</u>

The operator will monitor the ramp rate and alert Salt Lake City personnel should an incident occur. The Salt Lake City staff will be responsible to download the data, verify that the event occurred, and prepare a report. The Salt Lake City staff will also periodically review the data for any signs that an incident occurred that was not reported by the operator (e.g., an after-working-hour event).

Any suspected incident reported by plant operators will be investigated in a timely manner. Should an incident be verified, the Regional FERC office will be notified of the violation within

10 days of the verified event. A complete report of the event will be prepared and sent to the FERC within 30 days after the event is reported to the FERC Regional office.

The report will include the following information:

1. All relevant flow data will be provided to verify the incident. The data will be presented in table and graph format.
2. The report will include the results of the investigation to determine the cause, severity, and duration of the incident.
3. The report will include a description of any corrective measures that have been or will be implemented to prevent future incidents from occurring.
4. The report will include any comments or correspondence that was received from interested parties regarding the incident.

It is possible that an incident could occur during unmanned hours and the operators would not know that it occurred. However, the incident would be noted during routine review of flow data. Since these data are reviewed monthly, the incident may not be found for a month after the incident occurred. The FERC would be notified of the incident as quickly as it is verified and a report prepared as stated above.

Any incident of significant duration would trigger an alarm and require an off-duty operator to come the plant.

Unless the Company verifies an incident with data, providing data to the FERC or any agency or NGO will be done on an as-requested basis only. That is to say, data will be provided in a report should an incident occur that is verified by the Company. Suspected incidents reported by concerned parties or individuals will be investigated by the Company and data provided to the concerned party upon request. The Company will provide sufficient data to verify the suspected incident occurred. The requesting agency, NGO, or other party will need to request the data in writing. The request will need to state the specific purpose for the data, the time period desired, what specific data are needed, and the format in which to supply the data. Since the Company has a large amount of stored data and limited manpower, each request will need to be evaluated as to the time it will take to prepare the requested data. Much of the stored data is raw and may take a significant amount of time and resources in order to respond.

2.1.5 Schedule for Implementation of Monitoring

Installation of equipment

The equipment to monitor the ramp rate has been installed, tested and has been functional for about 9 years. No new equipment installation is planned in order to meet the required ramp rate.

Implementation of the ramping rate monitoring

Monitoring of the ramp rate requirement has been ongoing as part of the previous license. Modifications to the operations procedure and monitoring procedures will be accomplished upon approval of the plan.

2.2 Oneida

The new license requires that the ramping rate, on the descending arm, will be no less than 3 inches every 15 minutes as measured at a downstream location approximately 21-30 miles below the Oneida plant. This ramp rate requirement will be calibrated to an equivalent ramp rate as measured at USGS Gauge No. 10086500 just below the Oneida plant (referred to hereafter as the "Oneida gauge"). The best information available to determine the relationship in down-ramping rate was the Dobrowolski and Allred (1999) experiment and report, referred to hereafter as DA99[1]. An unsteady flow HEC-RAS (Hydrologic Engineering Center-River Analysis System) model was created using the DA99 study as a calibration event and was intended to support and extend the results of the study. However, despite good agreement in general, the rate of recession did not correlate well enough to the observed results to allow the model to be used to determine the correlation in down-ramping rates.

The DA99 experiment and report represents the most typical range of flows most experienced in the reach below the Oneida development. The recommended down-ramping limit is derived from the maximum recession rate per 15 minute period across 6 events at 2 sites - 21 (upper site) and 30 river miles (lower) downstream of Oneida development). The upper site and lower site have a similar response and appear to represent random samples of the response of the river to the down-ramping rate at Oneida, hence in regression the sites were pooled to improve the sample size available for the regression. Figure 2.1 shows the scatter plot and least-squares regression line and equation. The 95% prediction limits of the regression equation (dash-dot lines in Figure 2.1) are used to determine the down-ramping limit at the Oneida development that results in compliance with the 3" per 15 minute limit downstream. The 95% *prediction* limits are used since they take into consideration the sample size and goodness-of-fit implicitly (the adjusted R^2 for the regression is 0.65). As shown by the intersection of the 3" per 15 minute rate and the 95% *prediction* limits, we propose that **2.0 feet per 15 minutes** (the dashed line in Figure 2.1) be used as the down-ramping limit. At flows higher than those present in the experiment, the same limit would be used since the maximum recession rate reported here occurs at high flow levels where the cross-section is nearly vertical (see Figure 2.2), and nearly the same width continues further up the bank, making the same limit applicable at higher, less-frequent flows.

In order to confirm that the 2.0 feet per 15 minute limit meets the 3 inch per 15 minute limit at the designated point downstream, this may be field tested if water is available and agreement is obtained from Idaho DEQ. This verification would be a discrete event and not an on-going monitoring requirement. The Idaho DEQ 401 water quality certification indicates that the compliance point is a "designated point" between river mile (RM) 26 and 30 (as defined in DA99). Statistical analysis[2] (paired *t*-test) of the maximum downramp rate at RM 26 and RM 30 shows that there is no significant difference (alpha=0.05, two-tailed test) in the mean response at these sites to ramping at Oneida development. Hence, Idaho DEQ has indicated verbally that RM 30 will be the designated site for correlating the ramping rate with the Oneida gauge. The RM 30 site is already instrumented for other water quality monitoring purposes and provides a convenient location to measure stage for field verification of the ramping limit. However, due to the distance from the Oneida development and associated water travel time, RM 30 is *not* the compliance point for ramping. The compliance point remains the Oneida gauge.

[1] Dobrowolski, James P. and Michael D. Allred. 1999. Potential for Bank Stability Decline Due to Drastic Flow Level Change in Bear River. Department of Rangeland Resources, Watershed Science Unit, Utah State University, Logan, Utah. December 8, 1999.

[2] PacifiCorp. 2004. Technical Report to Idaho DEQ - Statistical Analysis of the Difference in Response in Bear River Ramping. Hydro Operations Analysis and Planning, PacifiCorp Hydro Resources Department, 2004.

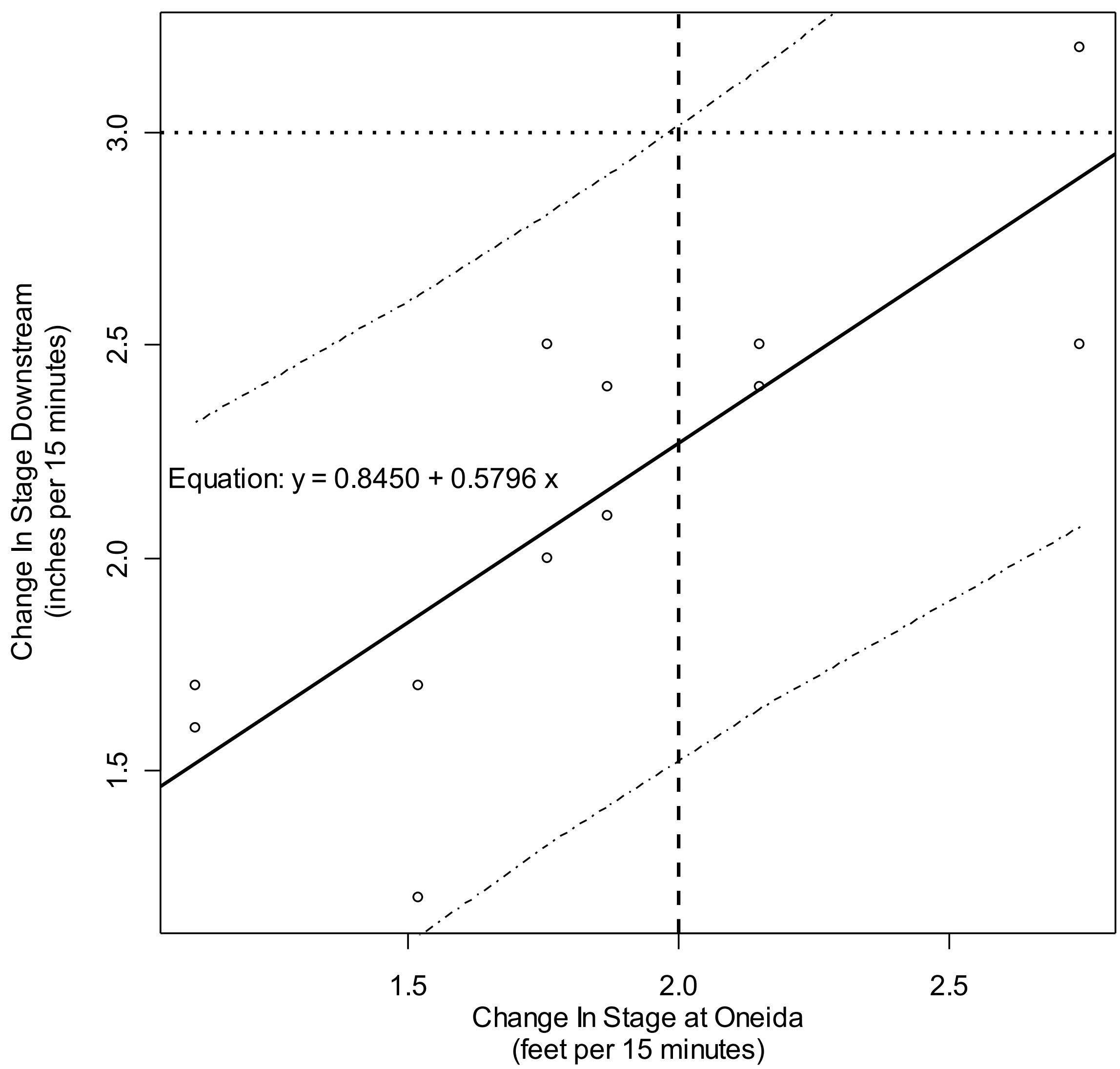

Figure 2.1. Scatter plot and least-squares regression line (heavy solid) between maximum down-ramp rate at Oneida development and maximum down-ramp rate downstream (21 and 30 miles downstream). The 95% *prediction* limits (dash-dot line) used to derive the limit are also shown. See text for explanation of other lines. The adjusted R^2 for the regression is 0.65.

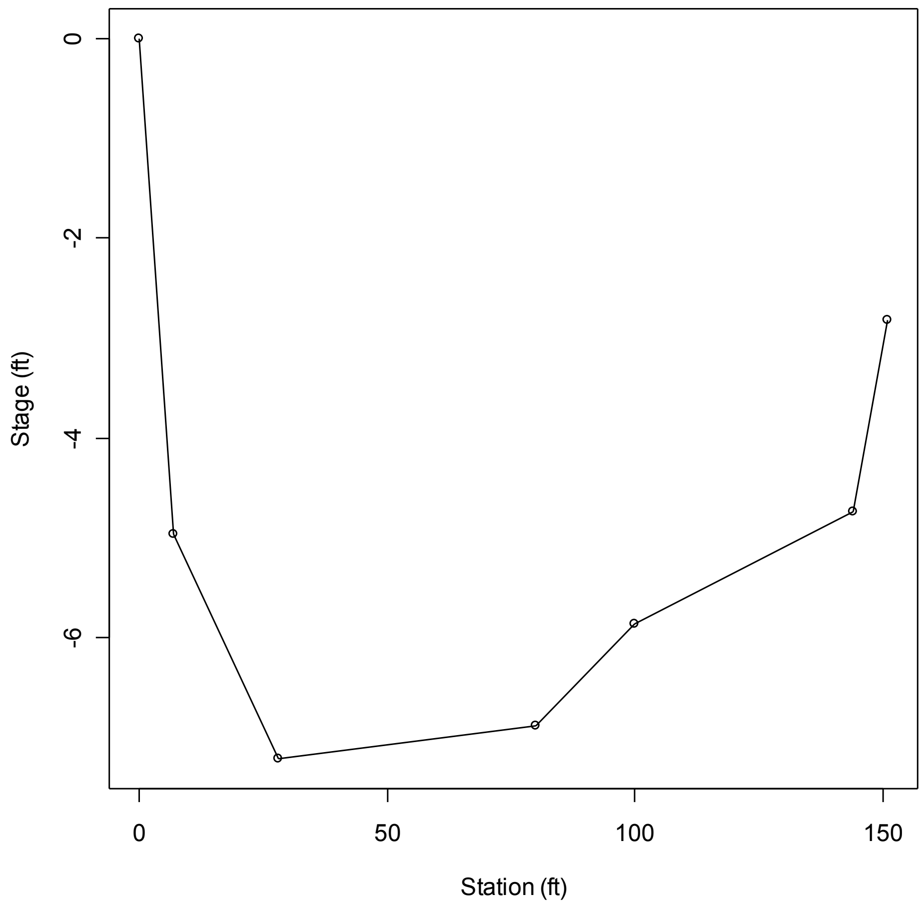

Figure 2.2. Channel cross-section at upper site (21 miles downstream of Oneida Development). (Simplified from DA99).

The Company plans to automate one of the spill gates that can be used to pass the minimum flow requirement. As part of the project a programmable controller will be installed to control the three generators and the spill gate. This controller will be programmed to control the unloading of the units to stay within the 2.0 feet per 15 minute ramp rate. When a load reduction is requested, the controller will unload the units in steps every 15 minutes until the new load level is reached.

The amount of flow that is associated with a 2.0 foot drop in the stage is not linear but is a polynomial equation. At the upper end of the flow scale, a drop of 2.0 feet in stage is a greater drop in the flow (cfs) than at the low end of the flow scale. The following table shows the relationship between stage and flow, size of the flow decrease, and generation. Maximum flow for the plant is about 3090 cfs, therefore this chart starts at maximum generation and moves down in 2 foot increments to minimum flow.

Time	**Stage**	**Total Flow**	**Decrease in Flow**
Max Gen.	6.48 ft	3090 cfs	
0 min.	4.48 ft	1398 cfs	1692 cfs
15 min.	2.48 ft	360 cfs	1038 cfs
30 min	2.14 ft	250 cfs	110 cfs

The chart shows the flow can be reduced from maximum load to minimum flow in 30 minutes. The plant is seldom generating at maximum load and will generally be passing a flow of 2000 cfs or less during irrigation season. During very high run-off events could produce flow in excess of maximum generation capacity and result in uncontrolled flow over the dam's spillway. These very high flow events are rare.

2.2.1 Ramping Rate Monitoring Methodology

Monitoring location

The stream-gaging station immediately below the Oneida plant will be used to monitor compliance with the ramping rate. PacifiCorp has the responsibility of maintaining this gauge station and providing corrected data to the USGS for final review and publishing. The stage change allowed is proposed to be 2 feet per 15-minute period.

Manned monitoring

The plant operator manually makes all changes to plant generation and flow as part of his normal responsibilities. Any changes to flow are recorded in the plant log.

Equipment for automatic monitoring

The monitoring, recording and temporary storage of data for the river is done by electronic equipment. The monitoring equipment has internal programming that controls data collection at defined intervals, converts raw signals to values, and records the measured values. In addition, a mechanical strip chart recorder is used to record the flow in the river. All recording is done automatically with no control from the operators. As noted above, since the most critical gaging stations will be polled hourly via GOES satellite or real-time via SCADA, the need for the back-up equipment is greatly decreased. Spare parts are kept on hand so that should the system malfunction, it can be quickly replaced. In most cases it can be replaced in two days or less.

2.2.2 Ramping Rate Monitoring Equipment

Design and specifications

The USGS gauge station downstream of the Oneida plant utilizes a Sutron data logger, model 8200-A, to electronically measure the river stage and record the stage measurement in electronic format. A Sutron shaft encoder, model 5600, provides the input to the data logger and is operated by a steel tape and float. Appendix A lists the specifications for the Sutron data logger and encoder currently in use. It is anticipated that newer models will be phased in over time or replaced by equipment to transmit stage over the Company's SCADA system.

The data logger, encoder, and float tape was calibrated upon installation and is checked about every 8 to 12 weeks to ensure that it is still measuring the correct stage. It is checked against a staff gauge mounted in the gauge station housing.

A strip chart recorder is used as a backup to the Sutron recorder at this station. The strip chart recorder has a float assembly to operate the recorder shaft. The calibration of the chart recorder is checked about every 8 to 12 weeks. As the polling frequency from the electronic data loggers increases from monthly to daily and even hourly for satellite-enabled sites or real-time via SCADA, the need for the back-up equipment will greatly decrease. Spare parts are kept on hand so that should the system malfunction, it can be quickly replaced. In most cases it can be replaced in two days or less.

Reliability

The gauge station below the Oneida plant is part of the USGS network of gaging stations. PacifiCorp has the responsibility of maintaining this gauge station and providing corrected data to the USGS for final review and publishing.

This gauge station receives power from the local distribution circuit and has the same protective devices as the below Soda station. It has a surge suppressor; a small AC to DC converter type step-down instrument transformer; an internal battery source; internal memory back-up lithium battery; and the metal housing is properly grounded.

Any malfunction of equipment could cause a complete loss of stored data since the last download. As the polling frequency from the electronic data loggers increases from monthly to daily and even hourly for satellite-enabled sites or real-time via SCADA, the need for backup loggers will decrease. Hence, the strip chart recorder may be phased out or replaced by electronic data loggers if a back-up is still deemed necessary. Spare parts are kept on hand so that should the system malfunction, it can be quickly replaced. In most cases it can be replaced in two days or less.

The mechanical strip chart recorder is manufactured by Leoppold Stevens and has proved over the years to be very reliable. A stock of paper, pens, ink, and replacement clocks are taken with the hydrographer as they visit the stations every 8 to 12 weeks. They perform any necessary maintenance to keep the recorder running until the next site visit.

2.2.3 Ramping Rate Data Collection and Storage

Collection protocol

The data logged on the Sutron data logger is the water depth measured in the stilling well by the encoder and is referred to as the stage. The stage data is downloaded through the Sutron internal modem by the Company hydrographer in the Salt Lake City office. After downloading the stage data for a month, it is converted to ASCII format and loaded into an Excel spreadsheet. This spreadsheet allows for a correction factor to be applied to the raw data and then uses the corrected stage to calculate the flow in the river in cubic feet per second. The spreadsheet summarizes the data to produce an average stage and flow for each day, and also displays the maximum and minimum flow for each day. The spreadsheet also displays the correction factor that was applied to the raw data for each day. The spreadsheet data is considered provisional until it is reviewed and approved by the USGS after the end of the water year (September 30).

The collection method has been updated to provide real-time flows required by the license. The real-time flows provided will incorporate the adjustment factor described below. Eventually, the real-time collected stage will be used in place of the monthly download. The data is from the same source, the data logger, but the simpler collection method will streamline the process. The monthly download method described above will continue until the new system has been verified.

Shift

The raw stage data recorded by the data logger does not always reflect accurate river flow. There are a number of conditions that can distort the stage measurement.

During the summer months, vegetation buildup in the river channel can affect the stage reading. This vegetative growth impedes the free flow of the water and backs up the water towards the plant. This condition causes a higher stage reading in the stilling well and this altered reading is measured and recorded by the encoder and data logger. The same effect on the stage readings can happen in the coldest winter months if ice begins to form in the river channel and along the riverbanks, which would cause the water to back up.

To find the correct stage reading (and hence the correct flow) a correction factor known as a *shift* must be calculated and then added to the measured stage. The *shift* is the difference between the current stage measurement and the stage corresponding to the measured flow from the rating table (see next section). Flow measurements are made every 8 to 12 weeks or more often if needed. Once the shift has been calculated (the results can be either a positive or negative number), it is entered into the data logger and is added to the recorded stage to compute the *provisional flow*. For the final, *published flow record*, the *shifts* measured every 8 to 12 weeks are interpolated between measurements. This produces a smoothly varying flow record and is based upon the assumption that changes to river conditions usually happen slowly over a period of several weeks or months. Abrupt changes such as a change in the channel cross-section, faulty equipment, or incorrect settings would be detectable as a run of *shifts* that are consistently of the same sign or very large. If this occurs, the equipment and gaging location is scrutinized and if no technical error is found, the rating table is updated after enough measurements are made. In the intervening period, the *shift* typically provides an accurate way to compensate for abrupt changes.

For real-time flows, the "best" *provisional flow* is the one incorporating the most recent shift. This is the data that is used to indicate compliance with license articles. The *published flow record*, which is produced by interpolating between consecutive *shifts* may indicate "after-the-fact" incidents. These are expected to be rare, but may occur. These will not be reported as they are not true incidents. This issue may arise if a stakeholder identifies a supposed "incident" after the fact. Should this occur, the necessity of relying on *provisional flow* information will be described.

Rating tables

An established relationship between stage and the flow in the river is called a rating table. The rating table indicates the flow in the river for each stage. It is an approximation based on previously measured flows and the associated stage. The approximation is subject to error due to the particular hydraulic conditions in the river when the measurements are made. Typically, the flow in the river is steady and uniform. However, there is no physical constraint on the relationship, which is most prominent at higher and unsteady/nonuniform flow regimes. Hysterisis is possible. However, the rating table is an adequate approximation with no better alternative available in the state of the science of *in-situ* flow measurement.

The stage values in the spreadsheet are tabulated to hundreds of a foot over the full range of the river flow. When someone wants to know the flow in the river for a particular stage, the correct stage (stage plus shift) is located on the rating table to see what the flow is for that stage. The current rating table for the gauge station below Oneida is attached as Appendix B.

When a run of *shifts* that are consistently of the same sign or very large are encountered, a new rating table is generated. The first step in creating a rating table is to plot measured flow versus the stage reading. A representative group of the most recently measured flows is plotted on a computer spreadsheet program to make a graph. A polynomial curve is fitted to the graphed points over the full range of flows. If a single polynomial, up to a fifth order, is not adequate to represent all flows within 10 percent of the measured value, a piecewise polynomial is implemented. The functional relationship is used to calculate the flow at each stage from the minimum to the maximum in increments of one-hundredth of a foot. The calculated values are placed in chart form so that it can be printed out. The actual functional relationship is used within the data logger and in spreadsheet computations.

Storage protocol

The hydrographer typically downloads the data from the Sutron data loggers during the first two weeks each month. The monthly raw data is loaded into a spreadsheet. If a shift calculation has been done since the end of the month, then the shift factor is added to the stage and provisional data are ready for use. If a shift factor has not been taken since the end of the month, then the spreadsheet is held and is not ready for use until the shift factor becomes available.

A spreadsheet for the gauge station is created for each month of the year and includes the summarized daily information as well as the raw data. At the end of the water year (September 30) all the monthly data are summarized onto a yearly spreadsheet that shows the average flow for each day of the year. The yearly sheet also displays the monthly average flow, the monthly minimum flow, and the monthly maximum flow.

The monthly flow data spreadsheets are stored on the Company network server that is backed up each night. After approval by the USGS the data are stored on a CD ROM as well as the network server. The yearly data are submitted to and published by the USGS. A summarized monthly spreadsheet (minus the raw data) and yearly spreadsheet are printed out and stored in Company files.

Due to the real-time reporting requirements in the license, this procedure will be updated. Until the new procedure is verified the old procedure will continue in parallel operation. The new procedure will replace the monthly download with real-time automated data collection. The three gauges where real-time flows are required will be transmitted hourly via GOES satellite or real-time via the Company SCADA, and the non-real-time sites will be polled via telephone modem on a regular basis ranging from once per day to hourly depending on operational requirements.

The Sutron software XConnect will be used to collect the data into a temporary database from both satellite and modem platforms. This data will be exported to a flat file every hour and imported into the Company database, where it will be available for immediate analysis. This will provide integration with other real-time SCADA system data such as reservoir elevations and will enhance management and reporting capabilities. As new technologies become available, it may become beneficial to transmit river stage directly through the SCADA system to provide real-time reporting and data storage. This would obviate the need for the Sutron data loggers and the XConnect software for these sites.

The new system will use data from the Company database instead of monthly manual modem polling. The provisional and final published flows will be stored in the Company database. The format of the data provided to the USGS will not be substantially changed. The format of the data provided to the USGS will not be substantially changed.

2.2.4 Reporting to the Commission

<u>Reporting collected data</u>

The plant operators will be the primary source of information on possible violations to the ramping rate since they will be checking the flows and the unit generation. However, the monthly spreadsheets will be modified to calculate the difference in each of the recorded stage readings. This modification will show each time a stage decrease has exceeded 2 feet per 15-minute period and bring the incidents to the attention of the staff. The staff will then be able to review the data to see if it exceeded the 2 foot per 15-minute period ramp rate.

Reviewing the monthly spreadsheets and observations of the operators should provide sufficient monitoring to expose any incidents that might possible exceed the license ramp rate. As real-time data becomes available, it may be feasible to implement a real-time alarm procedure to provide an extra level of protection against incidents.

<u>Reporting incidents</u>

The operator will monitor the ramp rate and alert Salt Lake City personnel should an incident occur. The Salt Lake City staff will be responsible to download the data, verify that the event occurred, and prepare a report. The Salt Lake City staff will also periodically review the data for any signs that an incident occurred that was not reported by the operator (e.g., an after-working-hour event).

Any suspected incident reported by plant operators will be investigated in a timely manner. Should an incident be verified, the Regional FERC office will be notified of the violation within 10 days of the verified event. A complete report of the event will be prepared and sent to the FERC within 30 days after the event is reported to the FERC Regional office.

The report will include the following information:

1. All relevant flow data will be provided to verify the incident. The data will be presented in table and graph format.
2. The report will include the results of the investigation to determine the cause, severity, and duration of the incident.
3. The report will include a description of any corrective measures that have been or will be implemented to prevent future incidents from occurring.
4. The report will include any comments or correspondence that was received from interested parties regarding the incident.

It is possible that an incident could occur during unmanned hours and the operators would not know that it occurred. However, the incident would be noted during routine review of flow data. Since these data are reviewed monthly, the incident may not be found for a month after the incident occurred. The FERC would be notified of the incident as quickly as it is verified and a report prepared as stated above.

Any incident of significant duration would trigger an alarm and require an off-duty operator to come the plant.

Unless the Company verifies an incident with data, providing data to the FERC or any agency or NGO will be done on an as-requested basis only. That is to say, data will be provided in a report should an incident occur that is verified by the Company. Suspected incidents reported by concerned parties or individuals will be investigated by the Company and data provided to the concerned party upon request. The Company will provide sufficient data to verify the suspected incident occurred. The requesting agency, NGO, or other party will need to request the data in writing. The request will need to state the specific purpose for the data, the time period desired, what specific data are needed, and the format in which to supply the data. Since the Company has a large amount of stored data and limited manpower, each request will need to be evaluated as to the time it will take to prepare the requested data. Much of the stored data is raw and may take a significant amount of time and resources in order to respond.

2.2.5 Schedule for Implementation of Monitoring

Installation of equipment

The equipment to monitor the ramp rate has been installed, tested, and has been functional for about 9 years. No new equipment installation is planned in order to meet the required ramp rate.

Implementation of the ramping rate monitoring

The actual monitoring of the ramp rate can begin soon after the approval of this operation and compliance plan since the monitoring equipment the Company plans to use is in place. The actual ramping rate can be implemented by manual operation shortly after the approval of this plan. The modifications to the operations procedure and to the monthly spreadsheet will be accomplished as soon after the approval of the plan as possible.

Appendix A
Equipment Specifications

Specifications – Model 8200-A

Dimensions	12 in. x10 in. x 6 in. enclosure, molded fiberglass polyester construction. With quick release latches. (Other enclosures available)
Weight	See Equipment Dimensions, page 145
Temperatures	-40°C to +60°C Operating
Processor	NEC V25 plus, Clock speed 5 MHz
Memory	RAM 122K (or 62,000 readings). Expandable to a total of 372K (or 190,000 Readings) in 28K Increments. Battery backed up EPROM 256K Operating System
Battery Backup	Lithium Battery storage: 2 years min. (depending on environment) Back up Life: 1 year min.
Real-Time Clock	Accuracy of 1 minute/month (GOES units have greater accuracy)
Watchdog Timer	System Reset upon microprocessor failure
Sample Intervals	1 sec. to 24 hr. in 1 second increments
Data Retrieval	RS-232 Port PCMCIA Memory Card Slot (10 sec download time)
Visual Display	16 character alphanumeric LED
Serial Sensor	Connection through RS-232 port (Unit remains programmable through port) **SDI-12** Fully supported through SDI-12 port
Communications	Up to THREE (2 internal and 1 external) of the following: Satellite Radio, LOS Radio, Telephone w/Modem and Speech Synthesis
Power Supply	Internal Battery (-0014 and -3014 models only), 6.5 aH @ 12V, operates 8210 for 90 days at 15 minute sampling. Internal charger regulator 1.25 amps max for solar panel input or DC voltage
Power	Quiescent: 600 uA
Consumption	Typical Avg: 2 mA @ 15 - minute intervals of shaft encoder sample
Digital Inputs and Outputs	Qty 20, under software control, wiring compatible with OPTO-22 equipment. Software Control of switched 12VDC power
Shaft Encoders	Switch closure w/quadrature inputs (2 max.) 3 wire + 12V (4 wire) interface to counters
Tipping Bucket	(5 max.) Input Levels: 0-5V
Rain Gauges	Switch closure
Counter Inputs	Resolution:16 bits,5 inputs available
Max. Input Freq.	32 KHz ± 0.1% w/o rollover, 1 MHz max. w/rollover

Analog Inputs	8 Standard, Resolution: 13 bits, Accuracy: ± 0.05% of full scale over temperature range, Input Range: 0-5V Standard DC Excitation Output: +5V, +12V, Pwr Consumption A/D: 30 mW active
Pressure	DC Excitation: ±5V Interface
Transducer	Differential Input Range: -5V to +100 mV

Specification for Incremental Shaft Encoder 5600-0530, 5600-0532

Specifications

ELECTRICAL

Input Voltage +5.5 to +15 VDC
Output Voltage High +5.0 VDC (CMOS), Low +0.0 VDC (CMOS)
Output Impedance 150 ohms typical
Power Consumption 0.5 mA@9ft/sec (12VDC), 1.5 mA @ 45ft/sec (12VDC)
Output Quadrature

MECHANICAL

Starting Torque 0.1 inch-ounce nominal
Size Unit 4 in. x 4 in. x 5 in.
Size Mount 6.75 in. x 4 in. x 0.125 in.
Shaft Diameter 5/16 in.

ENVIRONMENTAL

Temperature Range -40°C to +60°C
Relative Humidity 0% - 100% noncondensing
Altitude 0 - 15,000 ft

OPERATIONAL

Direction of Wheel CW and CCW
Rotational Speed Selectable 9 or 45 rev/sec

Applications

- Stilling well monitoring
- Gate position indicator
- Compatible with 8200A/8210 quadrature inputs

Measures stage (level) of rivers, streams, reservoirs, other bodies of water

- Based on low-power optical sensor circuitry, resolves one rotation of the 5/16 in. input shaft into 100 increments
- Low power (less than 1.4mA from a 12VDC supply)
- Solid state optical sensor technology
- Low starting torque (less than 0.1 ounce/inch)
- Surge protected
- For 0.01 foot resolution, input data is commonly provided by a fl oat attached to a tape that rives a standard 1-foot circumference wheel.
- For different resolutions, different circumference wheels are used.
- The shaft rotation is translated into quadrature pulses. The quadrature data is provided to a 8200A/8210 data recorder.

Stevens Programmable Position Monitors

- Exceptional Resolution
- Easy, menu driven programming
- Non-volatile storage of program parameters
- Models available to accept synchronized, 4-20 mA, or serial ASCIItransmissions

Long Service Life

- Convenience

The Stevens Programmable Position Monitors (PPM's) are sophisticated, microprocessor-based receiving instruments. The PPM is a "smart interpreter" which accepts the signal from a position transmitter, scales that signal, and then outputs it on a five-digit LED display. The PPM's can be easily programmed for scaling and offset via the front panel. Analog re-transmit and high-low alarms options are also similarly programmable. They are suitable for providing a signal to Supervisory Control and Data Acquisition (SCADA) systems. There are three models of the Programmable Position Monitor available: the Model 1255 Series, which accepts input from synchronized motor position transmitters; the Model 1511 Series, which accepts input from 4-20 mA transmitters (Stevens Position Analog Transmitter or PAT); and the Model 1256 Series, which accepts ASCII transmissions (AxSys MPU).

Stevens Model 1255 Series

The Model 1255 Series provides both the user-definable visual panel indication and auxiliary analog and digital signal outputs suitable for a variety of monitoring and control applications. The instrument is designed for monitoring changes in water level, precipitation, gate position, and other similar applications. The Stevens Model 1255 Series is a microcomputerbased synchronized receiving device, digitizing the shaft position signals from a synchronized motor transmitter. The Model 1255 Series operates from a standard 110 VAC power source. It features a fail-safe timer that automatically resets the microcomputer in the event of a power fault. The system uses non-volatile memory to retain operating status and programming parameters during power interruptions of unlimited duration. After programming, the keypad can be disabled by adding a lockout terminal connection, which discourages unauthorized changes.

The Stevens Model 1256 Series

The Stevens Model 1256 Series is a serial data monitor that accepts data from an RS-232 transmitting device. The instrument is specifically designed for use with the Stevens AxSys MPU, and GS-93/GS-98 instruments in remote monitoring of water level or gate position. It is also used with the Stevens Electro AV & Synchronized AV Systems. The Model 1256 will display a five-digit reading encoded from the AxSys unit, ranging from 0 to 999.99. The transmission can take place using just two wires, and can cover distances of several miles when the system incorporates two Stevens Direct Link Modems.

Stevens Model 1511 Series

The Stevens Model 1511 Series are designed for demanding industrial monitoring applications. The system accepts the signal from a 4-20 mA output transmitter and displays it in scaled units on its five-digit LED display. For applications where the displayed value is not simply the scaled and offset input value, the Model 1511 Series can provide nonlinear functions and corrections. The systems are extremely easy to configure and operate featuring simple menu-driven programming and setup from the unit's front panel.

Wide Range of Re-transmitting Options Available

An important feature of all Stevens Programmable Position Monitors is the range of available options for re-transmitting the displayed information. All units can be equipped with optional analog retransmit signals such as 0 to 1 mA, 0 to 2 mA, -1 to 1 mA, 4 to 20 mA, or 0 to 10 VDC. High-low relay alarm outputs are fully programmable through the front panel of the instrument. Additionally, Model 1255 and 1511 Series can also be equipped with either ASCII RS-232 or parallel binary (BCD) output signals.

Stevens' Reputation for Quality

The Stevens Programmable Position Monitors represent Stevens' continuing efforts to provide high quality products which meet customer needs at a cost-effective price. As with all Stevens products, the Stevens Programmable Position Monitors are designed to assure low maintenance and long life.

Specifications

Signal Input Model 1255 Series: Synchronized Motor
Model 1256 Series: Serial ASCII string
Model 1511 Series: 4-20 mA
Input devices Model 1255 Series: Stevens Type P Transmitter
Stevens Type PO Transmitter
Stevens Type AP Recording Transmitter
Model 1256 Series: Stevens AxSys MPU

Stevens GS-93/GS-98
Model 1511 Series: Stevens Position Analog Transmitter
Stevens Submersible Depth Transmitter
Stevens Temperature Transmitter
Operating Temperature Model 1255 Series: -20° to +65°C
Model 1256 Series; 0° to +55°C
Model 1511 Series: 0° to +55°C
Display Five Digit LED
Field programmable
Power 117 or 234 VAC, ±10%
48-62 Hz Frequency
Resolution 0.001% of full scale
Temperature Drift 0.01% per degree C
Non-linearity 0.02% of full scale maximum **(Model 1511 Series only)**
Output 0 to 1 mA, 0 to 2 mA, -1 to 1 mA, 4 to 20 mA, or 0 to 10 VDC
High-Low level alarms
Binary coded decimal (BCD) **(Model 1255 and 1511 Series only)**
ASCII RS-232 **(Model 1255 and 1511 Series only)**

Stevens Water Monitoring Systems, Inc.
5465 SW Western Avenue, Suite F, Beaverton, Oregon. 97005
***(toll-free)** 1-800-452-5272 **(tel)** 503-469-8000 **(fax)** 503-469-8100*
***website address:** www.stevenswater.com **e-mail address:** info@stevenswater.com*

Appendix B
Current Rating Tables

Bear River Below Soda
Stream Discharge Rating Table
Table created on July 1, 2004

Gauge Height in Feet - Discharges in Cubic Feet per Second (cfs)

Stage	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	46	46	46	46	46	46	46	46	46	46
0.1	46	46	46	46	46	46	46	46	46	46
0.2	46	46	46	46	46	46	46	46	46	46
0.3	46	46	46	46	46	46	46	46	46	46
0.4	46	46	46	46	46	46	46	46	46	46
0.5	46	46	46	46	46	46	46	46	46	46
0.6	46	46	46	160	161	163	165	167	170	172
0.7	175	177	180	183	186	189	192	195	199	202
0.8	206	210	213	217	221	225	230	234	238	243
0.9	247	252	257	261	266	271	276	281	286	292
1.0	297	302	308	313	319	324	330	336	341	347
1.1	353	359	365	371	377	383	389	396	402	408
1.2	414	421	427	434	440	447	453	460	467	473
1.3	480	487	494	500	507	514	521	528	535	542
1.4	549	556	563	570	577	584	591	599	606	613
1.5	620	628	635	642	649	657	664	672	679	686
1.6	694	701	709	716	724	731	739	746	754	761
1.7	769	777	784	792	799	807	815	822	830	838
1.8	846	853	861	869	877	884	892	900	908	916
1.9	924	932	940	947	955	963	971	979	987	995
2.0	1003	1011	1019	1028	1036	1044	1052	1060	1068	1076
2.1	1085	1093	1101	1109	1118	1126	1134	1143	1151	1159
2.2	1168	1176	1185	1193	1201	1210	1219	1227	1236	1244
2.3	1253	1261	1270	1279	1288	1296	1305	1314	1323	1332
2.4	1340	1349	1358	1367	1376	1385	1394	1403	1412	1421
2.5	1431	1440	1449	1458	1468	1477	1486	1496	1505	1514
2.6	1524	1533	1543	1552	1562	1572	1581	1591	1601	1611
2.7	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710
2.8	1720	1730	1741	1751	1761	1772	1782	1792	1803	1813
2.9	1824	1834	1845	1856	1866	1877	1888	1899	1910	1920
3.0	1931	1942	1953	1964	1975	1986	1998	2009	2020	2031
3.1	2042	2054	2065	2077	2088	2099	2111	2122	2134	2146
3.2	2157	2169	2181	2192	2204	2216	2228	2240	2252	2264
3.3	2276	2288	2300	2312	2324	2336	2348	2360	2372	2384
3.4	2397	2409	2421	2434	2446	2458	2471	2483	2495	2508
3.5	2520	2533	2545	2558	2570	2583	2595	2608	2620	2633
3.6	2645	2658	2671	2683	2696	2708	2721	2734	2746	2759
3.7	2771	2784	2796	2809	2822	2834	2847	2859	2872	2884
3.8	2897	2909	2921	2934	2946	2959	2971	2983	2995	3008
3.9	3020	3032	3044	3056	3068	3080	3092	3104	3116	3128
4.0	3139	3151	3163	3174	3186	3197	3208	3220	3231	3242
4.1	3253	3264	3275	3286	3296	3307	3318	3328	3338	3349
4.2	3359	3369	3379	3388	3398	3408	3417	3426	3436	3445
4.3	3454	3462	3471	3479	3488	3496	3504	3512	3520	3527
4.4	3535	3542	3549	3556	3563	3569	3575	3582	3587	3593

Note: Below stilling well stage limit of 0.63 feet stage only dam leakage of 46 cfs is reported.

Bear River Below Grace Dam

Stream Discharge Rating Table

Table created on December 21, 2004 (rating curve in use as of this date)

Gauge Height in Feet - Discharges in Cubic Feet per Second (cfs)

Stage	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
1.4	0	0	0	0	0	0	0	0	0	0
1.5	0	1	1	1	1	1	1	1	1	1
1.6	1	1	1	1	1	1	1	1	1	1
1.7		2	2	2	2	2	2	2	2	2
1.8	2	2	3	3	3	3	4	4	4	5
1.9	5	5	6	6	6	7	7	8	8	8
2.0	9	9	10	10	11	11	12	12	12	13
2.1	13	14	14	15	15	16	16	17	17	18
2.2	19	19	20	21	22	22	23	24	25	26
2.3	27	28	29	30	31	32	33	34	35	36
2.4	38	39	40	42	43	44	46	47	49	50
2.5	52	53	55	57	58	60	62	64	66	67
2.6	69	71	73	75	77	80	82	84	86	88
2.7	91	93	95	98	100	103	105	108	110	113
2.8	116	118	121	124	127	130	133	135	138	141
2.9	145	148	151	154	157	161	164	167	171	174
3.0	177	181	184	188	192	195	199	203	207	210
3.1	214	218	222	226	230	234	238	242	247	251
3.2	255	259	264	268	273	277	282	286	291	295
3.3	300	305	309	314	319	324	329	334	339	344
3.4	349	354	359	364	369	374	380	385	390	396
3.5	401	407	412	418	423	429	434	440	446	451
3.6	457	463	469	475	481	487	493	499	505	511
3.7	517	523	529	535	542	548	554	561	567	573
3.8	580	586	593	599	606	613	619	626	633	639
3.9	646	653	660	666	673	680	687	694	701	708
4.0	715	722	729	737	744	751	758	765	773	780
4.1	787	795	802	809	817	824	832	839	847	854
4.2	862	869	877	885	892	900	908	915	923	931
4.3	939	947	954	962	970	978	986	994	1002	1010
4.4	1018	1026	1034	1042	1050	1058	1067	1075	1083	1091
4.5	1099	1107	1116	1124	1132	1141	1149	1157	1165	1174
4.6	1182	1191	1199	1207	1216	1224	1233	1241	1250	1258
4.7	1267	1275	1284	1292	1301	1310	1318	1327	1336	1344
4.8	1353	1362	1370	1379	1388	1396	1405	1414	1423	1431
4.9	1440	1449	1458	1467	1475	1484	1493	1502	1511	1520
5.0	1529	1537	1546	1555	1564	1573	1582	1591	1600	1609
5.1	1618	1627	1636	1645	1654	1663	1672	1681	1690	1699
5.2	1708	1717	1726	1736	1745	1754	1763	1772	1781	1790
5.3	1799	1809	1818	1827	1836	1845	1854	1864	1873	1882
5.4	1891	1901	1910	1919	1928	1938	1947	1956	1965	1975
5.5	1984	1993	2003	2012	2021	2031	2040	2049	2059	2068
5.6	2077	2087	2096	2105	2115	2124	2134	2143	2153	2162
5.7	2172	2181	2190	2200	2209	2219	2228	2238	2248	2257
5.8	2267	2276	2286	2295	2305	2315	2324	2334	2343	2353
5.9	2363	2372	2382	2392	2402	2411	2421	2431	2441	2450
6.0	2460	2470	2480	2490	2499	2509	2519	2529	2539	2549

Bear River Below Oneida

Stream Discharge Rating Table

Table created on October 2, 1998

Gauge Height in Feet - Discharges in Cubic Feet per Second (cfs)

Stage	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	25	25	25	25	25	25	25	25	25	25
0.1	25	25	25	25	25	25	25	25	25	25
0.2	25	25	25	25	25	25	25	25	25	25
0.3	25	25	25	25	25	25	25	25	25	25
0.4	25	25	25	25	25	25	25	25	25	25
0.5	25	25	25	25	25	25	25	25	25	25
0.6	25	25	25	25	25	25	25	25	25	25
0.7	25	25	25	25	25	25	25	25	25	25
0.8	24	24	25	26	26	27	27	28	28	29
0.9	29	30	30	31	31	32	32	32	33	33
1.0	34	35	35	36	36	37	37	38	38	39
1.1	39	40	41	42	42	43	44	45	46	47
1.2	48	49	50	52	53	55	56	58	59	61
1.3	62	64	65	67	69	70	72	74	75	77
1.4	79	81	82	84	86	88	90	92	94	95
1.5	97	99	101	103	105	107	110	112	114	116
1.6	118	120	122	124	127	129	131	133	136	138
1.7	140	143	145	147	150	152	155	157	160	162
1.8	164	167	169	172	175	177	180	182	185	187
1.9	190	192	195	197	200	203	205	208	210	213
2.0	218	220	222	224	226	229	231	233	236	238
2.1	241	243	246	249	251	254	257	259	262	265
2.2	268	271	274	276	279	282	286	289	292	295
2.3	298	301	304	308	311	314	318	321	324	328
2.4	331	335	338	342	345	349	352	356	360	363
2.5	367	371	375	378	382	386	390	394	398	401
2.6	405	409	413	417	421	425	429	434	438	442
2.7	446	450	454	458	463	467	471	475	480	484
2.8	488	493	497	502	506	510	515	519	524	528
2.9	533	537	542	546	551	556	560	565	570	574
3.0	579	584	588	593	598	602	607	612	617	622
3.1	626	631	636	641	646	651	656	660	665	670
3.2	675	680	685	690	695	700	705	710	715	720
3.3	725	731	736	741	746	751	756	761	766	772
3.4	777	782	787	792	798	803	808	813	819	824
3.5	829	835	840	845	851	856	861	867	872	877
3.6	883	888	894	899	905	910	915	921	926	932
3.7	937	943	948	954	959	965	971	976	982	987
3.8	993	999	1004	1010	1015	1021	1027	1032	1038	1044
3.9	1049	1055	1061	1067	1072	1078	1084	1090	1095	1101
4.0	1107	1113	1119	1125	1130	1136	1142	1148	1154	1160
4.1	1166	1172	1177	1183	1189	1195	1201	1207	1213	1219
4.2	1225	1231	1237	1243	1249	1256	1262	1268	1274	1280
4.3	1286	1292	1298	1305	1311	1317	1323	1329	1335	1342
4.4	1348	1354	1361	1367	1373	1379	1386	1392	1398	1405
4.5	1411	1418	1424	1430	1437	1443	1450	1456	1463	1469
4.6	1476	1482	1489	1495	1502	1508	1515	1522	1528	1535
4.7	1542	1548	1555	1562	1568	1575	1582	1589	1595	1602
4.8	1609	1616	1623	1629	1636	1643	1650	1657	1664	1671
4.9	1678	1685	1692	1699	1706	1713	1720	1727	1734	1742
5.0	1749	1756	1763	1770	1777	1785	1792	1799	1807	1814
5.1	1821	1829	1836	1843	1851	1858	1866	1873	1881	1888
5.2	1896	1903	1911	1919	1926	1934	1942	1949	1957	1965
5.3	1973	1980	1988	1996	2004	2012	2020	2028	2036	2044
5.4	2052	2060	2068	2076	2084	2092	2100	2108	2116	2125
5.5	2133	2141	2150	2158	2166	2175	2183	2191	2200	2208
5.6	2217	2225	2234	2243	2251	2260	2269	2277	2286	2295
5.7	2304	2312	2321	2330	2339	2348	2357	2366	2375	2384
5.8	2393	2402	2411	2420	2430	2439	2448	2457	2467	2476
5.9	2486	2495	2504	2514	2523	2533	2543	2552	2562	2571

Bear River Below Oneida

Stream Discharge Rating Table (continued)

Table created on October 2, 1998

Gauge Height in Feet - Discharges in Cubic Feet per Second (cfs)

Stage	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
6.0	2581	2591	2601	2611	2620	2630	2640	2650	2660	2670
6.1	2680	2690	2700	2711	2721	2731	2741	2752	2762	2772
6.2	2783	2793	2804	2814	2825	2835	2846	2857	2867	2878
6.3	2889	2900	2911	2921	2932	2943	2954	2965	2977	2988
6.4	2999	3010	3021	3033	3044	3055	3067	3078	3090	3101
6.5	3113	3124	3136	3148	3159	3171	3183	3195	3207	3219
6.6	3231	3243	3255	3267	3279	3291	3304	3316	3328	3341
6.7	3353	3366	3378	3391	3403	3416	3429	3441	3454	3467
6.8	3480	3493	3506	3519	3532	3545	3558	3571	3584	3598
6.9	3611	3624	3638	3651	3665	3678	3692	3706	3719	3733
7.0	3747	3761	3775	3789	3803	3817	3831	3845	3859	3873
7.1	3888	3902	3916	3931	3945	3960	3974	3989	4004	4018
7.2	4033	4048	4063	4078	4093	4108	4123	4138	4153	4169
7.3	4184	4199	4215	4230	4245	4261	4277	4292	4308	4324
7.4	4340	4355	4371	4387	4403	4419	4436	4452	4468	4484
7.5	4501	4517	4533	4550	4566	4583	4600	4616	4633	4650
7.6	4667	4684	4701	4718	4735	4752	4769	4787	4804	4821
7.7	4839	4856	4874	4891	4909	4927	4944	4962	4980	4998
7.8	5016	5034	5052	5070	5088	5106	5125	5143	5162	5180
7.9	5198	5217	5236	5254	5273	5292	5311	5330	5349	5368
8.0	5387	5406	5425	5444	5464	5483	5502	5522	5541	5561
8.1	5581	5600	5620	5640	5660	5680	5700	5720	5740	5760
8.2	5780	5800	5821	5841	5861	5882	5902	5923	5944	5964
8.3	5985	6006	6027	6048	6069	6090	6111	6132	6153	6174
8.4	6196									

Appendix C - Ramp Limit Tables

Soda Ramping Table

Current Flow	Flow Step-up Per Hour (cfs)	Flow Step-down Per Hour (cfs)	Current Flow	Flow Step-up Per Hour (cfs)	Flow Step-down Per Hour (cfs)
46	853	46	1486	2847	521
160	869	46	1496	2847	521
161	869	46	1505	2872	535
163	884	46	1514	2884	542
165	884	46	1524	2897	549
167	900	46	1533	2897	556
170	908	46	1543	2921	563
172	916	46	1552	2934	570
175	924	46	1562	2946	577
177	932	46	1572	2946	584
180	940	46	1581	2971	591
183	947	46	1591	2983	599
186	955	46	1601	2995	606
189	963	46	1611	2995	613
192	971	46	1620	3020	620
195	979	46	1630	3032	628
199	987	46	1640	3044	635
202	995	46	1650	3044	642
206	1003	46	1660	3068	649
210	1011	46	1670	3080	657
213	1019	46	1680	3092	657
217	1028	46	1690	3092	672
221	1036	46	1700	3104	672
225	1044	46	1710	3128	686
230	1052	46	1720	3139	686
234	1060	46	1730	3151	701
238	1068	46	1741	3163	701
243	1076	46	1751	3174	716
247	1085	46	1761	3186	724
252	1093	46	1772	3197	731
257	1101	46	1782	3208	739
261	1109	46	1792	3220	746
266	1109	46	1803	3231	754
271	1126	46	1813	3242	761
276	1134	46	1824	3253	769
281	1143	46	1834	3264	777
286	1143	46	1845	3275	784
292	1159	46	1856	3286	792
297	1168	46	1866	3296	799
302	1176	46	1877	3307	807
308	1176	46	1888	3318	815
313	1193	46	1899	3328	822
319	1201	46	1910	3338	830
324	1210	46	1920	3349	838
330	1219	46	1931	3359	846
336	1227	46	1942	3369	846
341	1236	46	1953	3379	861
347	1244	46	1964	3379	861
353	1253	46	1975	3398	877
359	1261	46	1986	3408	877
365	1270	46	1998	3417	892
371	1279	46	2009	3426	892
377	1288	46	2020	3436	908
383	1288	46	2031	3445	916
389	1305	46	2042	3454	924
396	1314	46	2054	3462	932
402	1323	46	2065	3471	940
408	1323	46	2077	3479	947
414	1340	46	2088	3488	955
421	1349	46	2099	3496	963
427	1358	46	2111	3504	971
434	1358	46	2122	3512	979
440	1376	46	2134	3520	987
447	1385	46	2146	3527	995
453	1394	46	2157	3535	1003
460	1394	46	2169	3542	1011
467	1412	46	2181	3549	1019
473	1421	46	2192	3556	1028
480	1431	46	2204	3563	1036

Current Flow	Flow Step-up Per Hour (cfs)	Flow Step-down Per Hour (cfs)	Current Flow	Flow Step-up Per Hour (cfs)	Flow Step-down Per Hour (cfs)
487	1440	46	2216	3569	1044
494	1449	46	2228	3575	1044
500	1458	46	2240	3582	1060
507	1468	46	2252	3582	1068
514	1477	46	2264	3593	1076
521	1486	46	2276	3593	1076
528	1496	46	2288	3593	1093
535	1505	46	2300	3593	1101
542	1514	46	2312	3593	1109
549	1514	46	2324	3593	1109
556	1533	46	2336	3593	1126
563	1543	46	2348	3593	1134
570	1552	46	2360	3593	1143
577	1552	46	2372	3593	1143
584	1572	46	2384	3593	1159
591	1581	46	2397	3593	1168
599	1591	46	2409	3593	1176
606	1591	46	2421	3593	1176
613	1611	46	2434	3593	1193
620	1620	46	2446	3593	1201
628	1630	46	2458	3593	1210
635	1630	46	2471	3593	1219
642	1650	46	2483	3593	1227
649	1660	46	2495	3593	1236
657	1670	46	2508	3593	1244
664	1680	46	2520	3593	1253
672	1690	46	2533	3593	1253
679	1700	46	2545	3593	1270
686	1710	46	2558	3593	1279
694	1720	46	2570	3593	1288
701	1730	46	2583	3593	1288
709	1741	46	2595	3593	1305
716	1751	46	2608	3593	1314
724	1761	46	2620	3593	1323
731	1761	46	2633	3593	1323
739	1782	46	2645	3593	1340
746	1792	46	2658	3593	1349
754	1803	46	2671	3593	1358
761	1803	46	2683	3593	1358
769	1824	46	2696	3593	1376
777	1834	46	2708	3593	1385
784	1845	46	2721	3593	1394
792	1845	46	2734	3593	1394
799	1866	46	2746	3593	1412
807	1877	46	2759	3593	1421
815	1888	46	2771	3593	1431
822	1888	46	2784	3593	1440
830	1910	46	2796	3593	1449
838	1920	46	2809	3593	1458
846	1931	46	2822	3593	1468
853	1942	46	2834	3593	1477
861	1953	46	2847	3593	1477
869	1964	160	2859	3593	1496
877	1975	161	2872	3593	1505
884	1986	163	2884	3593	1514
892	1998	165	2897	3593	1514
900	2009	167	2909	3593	1533
908	2020	167	2921	3593	1543
916	2031	172	2934	3593	1552
924	2031	175	2946	3593	1552
932	2054	177	2959	3593	1572
940	2065	180	2971	3593	1581
947	2077	183	2983	3593	1591
955	2077	186	2995	3593	1591
963	2099	189	3008	3593	1611
971	2111	192	3020	3593	1620
979	2122	195	3032	3593	1630
987	2122	199	3044	3593	1630
995	2146	202	3056	3593	1650

Current Flow	Flow Step-up Per Hour (cfs)	Flow Step-down Per Hour (cfs)	Current Flow	Flow Step-up Per Hour (cfs)	Flow Step-down Per Hour (cfs)
1003	2157	206	3068	3593	1660
1011	2169	206	3080	3593	1670
1019	2169	213	3092	3593	1680
1028	2181	213	3104	3593	1690
1036	2204	221	3116	3593	1700
1044	2216	221	3128	3593	1710
1052	2228	230	3139	3593	1720
1060	2228	230	3151	3593	1720
1068	2252	238	3163	3593	1730
1076	2264	238	3174	3593	1751
1085	2276	247	3186	3593	1761
1093	2276	247	3197	3593	1761
1101	2300	257	3208	3593	1772
1109	2312	257	3220	3593	1792
1118	2324	266	3231	3593	1803
1126	2324	271	3242	3593	1803
1134	2348	276	3253	3593	1813
1143	2360	281	3264	3593	1834
1151	2372	286	3275	3593	1845
1159	2372	292	3286	3593	1845
1168	2397	297	3296	3593	1856
1176	2409	302	3307	3593	1877
1185	2421	308	3318	3593	1888
1193	2421	313	3328	3593	1888
1201	2446	319	3338	3593	1899
1210	2458	324	3349	3593	1920
1219	2471	324	3359	3593	1931
1227	2471	336	3369	3593	1942
1236	2483	336	3379	3593	1942
1244	2508	347	3388	3593	1964
1253	2520	347	3398	3593	1975
1261	2533	359	3408	3593	1986
1270	2533	359	3417	3593	1986
1279	2558	371	3426	3593	1998
1288	2570	377	3436	3593	2020
1296	2583	383	3445	3593	2031
1305	2583	389	3454	3593	2031
1314	2608	396	3462	3593	2042
1323	2620	402	3471	3593	2065
1332	2633	408	3479	3593	2077
1340	2633	414	3488	3593	2077
1349	2658	421	3496	3593	2088
1358	2671	427	3504	3593	2111
1367	2683	434	3512	3593	2122
1376	2683	440	3520	3593	2122
1385	2708	447	3527	3593	2134
1394	2721	453	3535	3593	2157
1403	2734	460	3542	3593	2169
1412	2734	467	3549	3593	2169
1421	2759	473	3556	3593	2181
1431	2771	480	3563	3593	2204
1440	2784	480	3569	3593	2216
1449	2784	494	3575	3593	2228
1458	2796	494	3582	3593	2228
1468	2822	507	3587	3593	2252
1477	2834	507	3593	3593	2264

Oneida Ramping Table

Current Flow	Next **Lower** Permissible Flow Level (cfs)	**Current** Flow	Next **Lower** Permissible Flow Level (cfs)	**Current** Flow	Next **Lower** Permissible Flow Level (cfs)	**Current** Flow	Next **Lower** Permissible Flow Level (cfs)
251	250	1154	250	2601	1119	5311	2543
254	250	1160	250	2611	1125	5330	2552
257	250	1166	250	2620	1130	5349	2562
259	250	1172	250	2630	1136	5368	2571
262	250	1177	250	2640	1142	5387	2581
265	250	1183	250	2650	1148	5406	2591
268	250	1189	251	2660	1154	5425	2601
271	250	1195	254	2670	1160	5444	2611
274	250	1201	257	2680	1166	5464	2620
276	250	1207	259	2690	1172	5483	2630
279	250	1213	262	2700	1177	5502	2640
282	250	1219	265	2711	1183	5522	2650
286	250	1225	268	2721	1189	5541	2660
289	250	1231	271	2731	1195	5561	2670
292	250	1237	274	2741	1201	5581	2680
295	250	1243	276	2752	1207	5600	2690
298	250	1249	279	2762	1213	5620	2700
301	250	1256	282	2772	1219	5640	2711
304	250	1262	286	2783	1225	5660	2721
308	250	1268	289	2793	1231	5680	2731
311	250	1274	292	2804	1237	5700	2741
314	250	1280	295	2814	1243	5720	2752
318	250	1286	298	2825	1249	5740	2762
321	250	1292	301	2835	1256	5760	2772
324	250	1298	304	2846	1262	5780	2783
328	250	1305	308	2857	1268	5800	2793
331	250	1311	311	2867	1274	5821	2804
335	250	1317	314	2878	1280	5841	2814
338	250	1323	318	2889	1286	5861	2825
342	250	1329	321	2900	1292	5882	2835
345	250	1335	324	2911	1298	5902	2846
349	250	1342	328	2921	1305	5923	2857
352	250	1348	331	2932	1311	5944	2867
356	250	1354	335	2943	1317	5964	2878
360	250	1361	338	2954	1323	5985	2889
363	250	1367	342	2965	1329	6006	2900
367	250	1373	345	2977	1335	6027	2911
371	250	1379	349	2988	1342	6048	2921
375	250	1386	352	2999	1348	6069	2932
378	250	1392	356	3010	1354	6090	2943
382	250	1398	360	3021	1361	6111	2954
386	250	1405	363	3033	1367	6132	2965
390	250	1411	367	3044	1373	6153	2977
394	250	1418	371	3055	1379	6174	2988
398	250	1424	375	3067	1386	6196	2999

Current Flow	Next **Lower** Permissible Flow Level (cfs)	**Current** Flow	Next **Lower** Permissible Flow Level (cfs)	**Current** Flow	Next **Lower** Permissible Flow Level (cfs)
401	250	1430	378	3078	1392
405	250	1437	382	3090	1398
409	250	1443	386	3101	1405
413	250	1450	390	3113	1411
417	250	1456	394	3124	1418
421	250	1463	398	3136	1424
425	250	1469	401	3148	1430
429	250	1476	405	3159	1437
434	250	1482	409	3171	1443
438	250	1489	413	3183	1450
442	250	1495	417	3195	1456
446	250	1502	421	3207	1463
450	250	1508	425	3219	1469
454	250	1515	429	3231	1476
458	250	1522	434	3243	1482
463	250	1528	438	3255	1489
467	250	1535	442	3267	1495
471	250	1542	446	3279	1502
475	250	1548	450	3291	1508
480	250	1555	454	3304	1515
484	250	1562	458	3316	1522
488	250	1568	463	3328	1528
493	250	1575	467	3341	1535
497	250	1582	471	3353	1542
502	250	1589	475	3366	1548
506	250	1595	480	3378	1555
510	250	1602	484	3391	1562
515	250	1609	488	3403	1568
519	250	1616	493	3416	1575
524	250	1623	497	3429	1582
528	250	1629	502	3441	1589
533	250	1636	506	3454	1595
537	250	1643	510	3467	1602
542	250	1650	515	3480	1609
546	250	1657	519	3493	1616
551	250	1664	524	3506	1623
556	250	1671	528	3519	1629
560	250	1678	533	3532	1636
565	250	1685	537	3545	1643
570	250	1692	542	3558	1650
574	250	1699	546	3571	1657
579	250	1706	551	3584	1664
584	250	1713	556	3598	1671
588	250	1720	560	3611	1678
593	250	1727	565	3624	1685
598	250	1734	570	3638	1692
602	250	1742	574	3651	1699
607	250	1749	579	3665	1706
612	250	1756	584	3678	1713
617	250	1763	588	3692	1720
622	250	1770	593	3706	1727
626	250	1777	598	3719	1734
631	250	1785	602	3733	1742

Current Flow	Next **Lower** Permissible Flow Level (cfs)	**Current** Flow	Next **Lower** Permissible Flow Level (cfs)	**Current** Flow	Next **Lower** Permissible Flow Level (cfs)
636	250	1792	607	3747	1749
641	250	1799	612	3761	1756
646	250	1807	617	3775	1763
651	250	1814	622	3789	1770
656	250	1821	626	3803	1777
660	250	1829	631	3817	1785
665	250	1836	636	3831	1792
670	250	1843	641	3845	1799
675	250	1851	646	3859	1807
680	250	1858	651	3873	1814
685	250	1866	656	3888	1821
690	250	1873	660	3902	1829
695	250	1881	665	3916	1836
700	250	1888	670	3931	1843
705	250	1896	675	3945	1851
710	250	1903	680	3960	1858
715	250	1911	685	3974	1866
720	250	1919	690	3989	1873
725	250	1926	695	4004	1881
731	250	1934	700	4018	1888
736	250	1942	705	4033	1896
741	250	1949	710	4048	1903
746	250	1957	715	4063	1911
751	250	1965	720	4078	1919
756	250	1973	725	4093	1926
761	250	1980	731	4108	1934
766	250	1988	736	4123	1942
772	250	1996	741	4138	1949
777	250	2004	746	4153	1957
782	250	2012	751	4169	1965
787	250	2020	756	4184	1973
792	250	2028	761	4199	1980
798	250	2036	766	4215	1988
803	250	2044	772	4230	1996
808	250	2052	777	4245	2004
813	250	2060	782	4261	2012
819	250	2068	787	4277	2020
824	250	2076	792	4292	2028
829	250	2084	798	4308	2036
835	250	2092	803	4324	2044
840	250	2100	808	4340	2052
845	250	2108	813	4355	2060
851	250	2116	819	4371	2068
856	250	2125	824	4387	2076
861	250	2133	829	4403	2084
867	250	2141	835	4419	2092
872	250	2150	840	4436	2100
877	250	2158	845	4452	2108
883	250	2166	851	4468	2116
888	250	2175	856	4484	2125
894	250	2183	861	4501	2133
899	250	2191	867	4517	2141
905	250	2200	872	4533	2150
910	250	2208	877	4550	2158
915	250	2217	883	4566	2166
921	250	2225	888	4583	2175
926	250	2234	894	4600	2183
932	250	2243	899	4616	2191
937	250	2251	905	4633	2200
943	250	2260	910	4650	2208
948	250	2269	915	4667	2217
954	250	2277	921	4684	2225
959	250	2286	926	4701	2234
965	250	2295	932	4718	2243
971	250	2304	937	4735	2251
976	250	2312	943	4752	2260
982	250	2321	948	4769	2269
987	250	2330	954	4787	2277
993	250	2339	959	4804	2286
999	250	2348	965	4821	2295
1004	250	2357	971	4839	2304
1010	250	2366	976	4856	2312
1015	250	2375	982	4874	2321
1021	250	2384	987	4891	2330
1027	250	2393	993	4909	2339