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1.0 Introduction

The El Dorado Project (Project), identified as Project No. 184 by the Federal Energy Regulatory Commission (FERC), is owned and operated by the El Dorado Irrigation District (EID). The Project includes four storage reservoirs (Silver, Caples, Aloha, and Echo), water diversions and conveyance facilities, and hydropower generating facilities. The Project is operated for hydropower generation and to deliver water for consumptive use to the EID service area in El Dorado County.

EID has filed an application for license with the FERC to continue operation of the Project. In order to streamline the relicensing process, EID is currently participating in a discussion group called the "South Fork Dialogue," along with the El Dorado County Water Agency, commercial outfitters, El Dorado National Forest and other environmental interests.

2.0 El Dorado Project Operation

The Project was first licensed in 1922 and is operated to generate hydroelectric power at the El Dorado Powerhouse, and to deliver 15,080 acre-feet of water to the EID service area annually for consumptive use. Water diverted into the El Dorado Canal consists of the natural flow of the South Fork American River, water released from storage at the project reservoirs and an inter-basin import from Echo Creek[1]. When the natural streamflow is not adequate to meet Project demands, releases are made from storage in one or more of the reservoirs. As is typical of water storage reservoirs, water is stored during the spring snowmelt season and released to meet water demands during the summer, fall, and early winter when the natural flow of the river is insufficient to meet Project demands.

3.0 Purpose of Phase I

As part of the “South Fork Dialogue,” EID contracted with HydroLogics, Inc to prepare a model design for Project 184. When completed the model will be used by EID and the other participants to evaluate alternative project operational rules.

While every water resources system is unique and requires an individualized approach, HydroLogics has developed a general approach for developing an understanding of the client’s problem and designing the analytical tools to help perform the analysis required by decision makers. In Phase I, the scope of work to develop a model design which recognizes the needs of EID and the other participants to Project 184 FERC relicensing process includes:

- Interview El Dorado Irrigation District (District) and other participants to identify performance measures
- Review available data

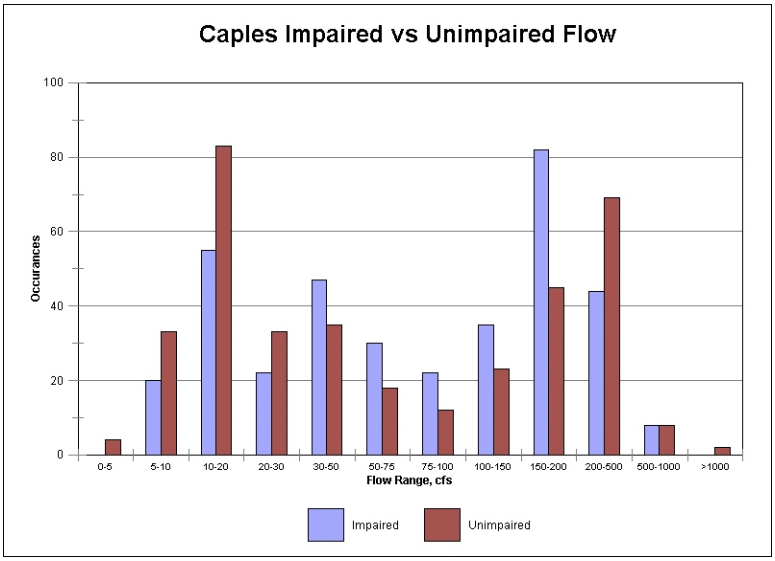
[1] Echo Creek is tributary to the upper Truckee River.

- Create a preliminary schematic of the system to be modeled
- Recommend modeling time step
- Prepare scope of work, schedule and cost estimate for model development

3.1 Performance Measures

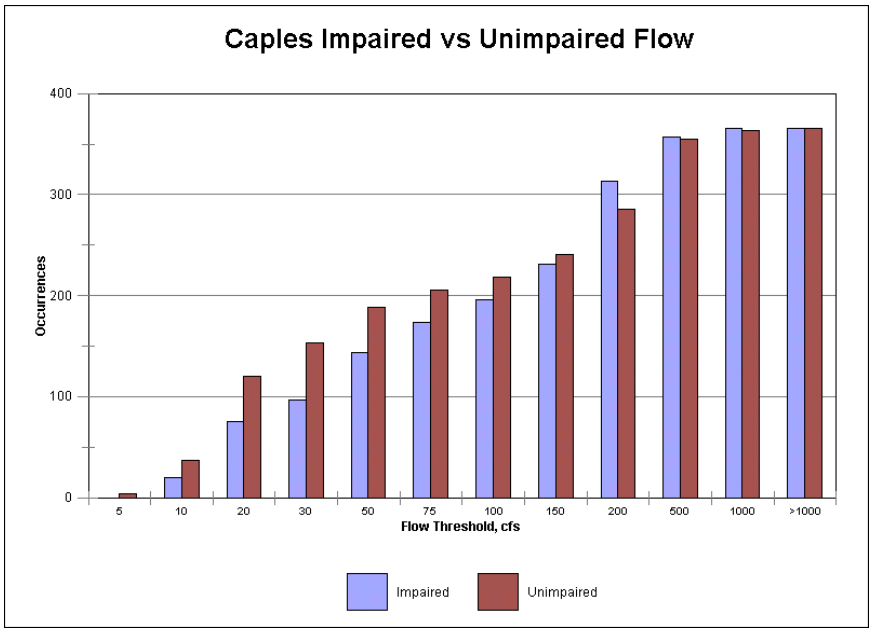
Performance measures are the displays produced by analytical tools which allow the water managers and collaborative participants to determine whether one alternative management strategy is better or worse than another. Typically, performance measures are the reasons for the model. In Phase I, HydroLogics has developed a set of performance measures which hopefully address the issues expressed by the following interested entities:

- El Dorado Irrigation District
- USDA Forest Service
- California Department of Fish and Game
- California State Water Resources Control Board
- Alpine County
- Amador County
- National Park Service
- El Dorado County Water Agency
- Chris Shutes
- El Dorado County Citizens for Water
- Trout Unlimited
- Friends of the River



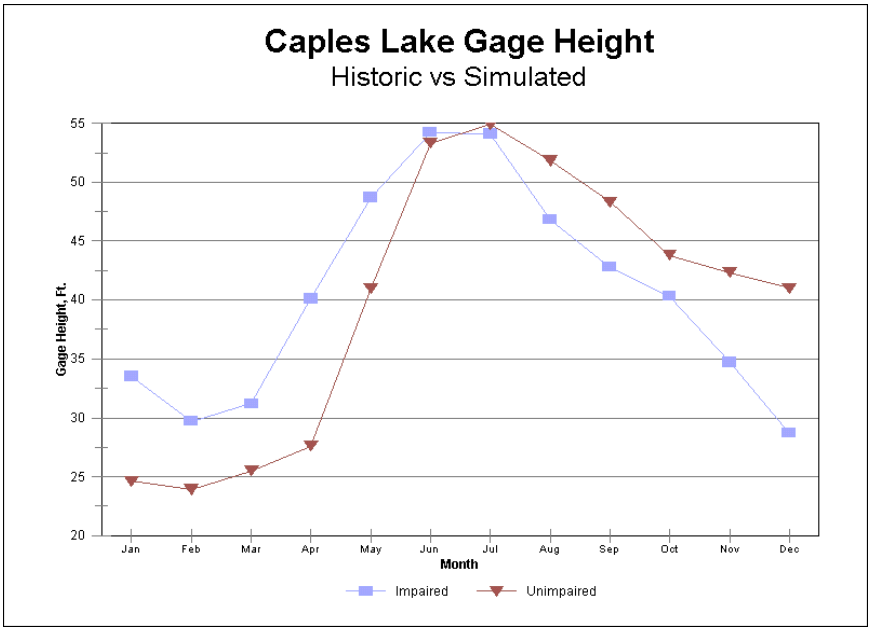
Performance measure help evaluate the impacts of changes in operating polices, changes in water allocations and potential new facilities. Most often the development of performance

measures involve the use of a simulation model. These models produce time series estimates of system performance, that is, output which traces how the water resources system might change month by month or day by day for a relatively long period of time. The model will produce average flow information for every time period in every arc (stream reach) in the model. It is important to build the model so that sensitive stream reaches are represented. The model will also produce storage information for every time period for every reservoir in the model. The "hydrologic state variables" (storages and flows) from these models are the basis for most other performance measures, and may serve as input to many other analytical tools.



The graph above displays the number of occurrences in which flows were less than a threshold value.

The severity, frequency and duration of stressful events, including low flows or high temperatures for biological organisms, water delivery reductions for water users, reduced hydro- generation and low recreation season reservoir levels is often very important. It is often not easy to distinguish severity, frequency or duration by simply looking at a table or a graph representing time series. Therefore, the performance measures displayed here and in Appendix A, include graphics specifically targeted at highlighting these aspects of system performance. While the performance measures shown above



The graph above displays the difference between the gage height at Caples Lake when comparing the historic operation to a future operating alternative.

and in Appendix A are presented for specific locations, they are only examples of the numerous performance measures which can be prepared for each node and arc.

It is likely that other performance measures will be developed as the District and collaborative participants become familiar with the model capabilities.

Daily information is necessary to evaluate the impacts due to daily operations. These impacts may not effect water supply or generation, but may be critical to native species. Drastic changes in stream flows or temperatures for only a few hours may have devastating effects on fisheries.

3.2 Available Data

The model will require three types of creditable data to produce a reliable simulation of the Project 184 operation. Those data are:

- A physical description of the facilities to be modeled.
- Basin hydrologic data
- Operating rules, instream flow criteria, demands and other guidelines which govern the operation of the facilities

Required data is dictated in part by the desired performance measures. This could dictate the location of nodes and the time step used for the hydrology.

3.2.1 Description of the Facilities to be Modeled

Much of the facilities description data are readily available and are not in dispute. New storage-area-elevation information was developed by Sea Surveyors for Caples Lake, Silver Lake, Echo Lake and Forebay Lake. The table below shows the reservoir characteristics as reported in the El Dorado Hydroelectric Project Manual published by Pacific Gas and Electric Company, or reported in data files from the Resource Insights EID Project 184 EID CD #1 dated Dec. 2000.

Reservoir	Storage, Area, Elevation Source	Capacity	Outlet Works Maximum
Echo Lake	Sea Surveyors	1,890 AF	32 cfs
Lake Aloha	U.S.G.S.	5,063 AF	461 cfs
Caples Lake	Sea Surveyors	21,581 AF	150 cfs
Silver Lake	Sea Surveyors	8,590 AF	110 cfs
Forebay	Sea Surveyors	472 AF	163 cfs

The El Dorado Canal is 115,790 feet long and can carry 156 cfs from the South Fork of the American River. Water from the creeks along the canal can be diverted into the canal. The following table shows the creek where water can be diverted and the corresponding diversion capacity at those creeks.

Creek	Diversion Capacity
Alder Creek	15 cfs
Bull Creek	10 cfs
Ogilby Canyon	10 cfs
Esmeralda Creek	10 cfs

Note: Bill Slightam, hydrographer for EID, has made a verbal agreement with the Fish and Wildlife Service, California Department of Fish and Game, and the Forest Service to divert no more than 70% of the streamflow.

There are some data which will be model time step dependant. If it is decided that the model should operate on a daily timestep, we will need rating curves for both the outlet works and the spillway at each Dam. If, however, it is determined that the necessary information can be obtained with a model using a longer timestep of a week or a month, outlet rating curves and spillway curves will not be required.

There is also the issue of travel time if we are going to use a daily timestep. Travel times or the time it takes water to move from one point in the basin to another, can be an important factor in understanding operations on a daily time step. Time of travel was not considered in the derivation the basin daily unimpaired flow, so it might not be necessary to be concerned about travel time in the model.

3.2.2 Basin Hydrologic Data

Some of the participants have indicated that a daily simulation will be necessary to provide them with a the information they need to evaluate the impacts to geomorphology and aquatic habitat in the study area. Monthly data are generally adequate to assess water supply and generation impacts. The available basin hydrologic data exists from three sources. Those sources are:

- Project 184 Related Gaging Stations
- Newly installed gages
- Project 184 simulated flow locations

These data sources are descibed in detail below including where possible, the source of the data, the period of record, a description of the location of the records, and time step.

The USGS and PG&E have maintained several gages in the basin since the project was initially constructed in the early 1900's. A list of this gages is presented in the table below. Data from these gages have been published in USGS Water Supply Papers and are generally available as daily average flow.

Project 184 Related Gaging Stations

Gaging Station	County	Source	Period of Record	Description
Echo Lake Conduit Nr Phillips Ca	El Dorado	USGS 11434500	Aug 1923 - Sep 1996	Daily average flow
Pyramid C Nr Phillips Ca	El Dorado	USGS 11435000	Oct 1960 - Sep 1970	Daily average flow (3.73 mi^2)
Pyramid C A Twin Bridges Ca	El Dorado	USGS 11435100	Oct 1970 - Sep 1996	Daily average flow (8.76 mi^2)
SF American R A Kyburz Ca	El Dorado	USGS 11435500	Oct 1993 - Sep 1924	Daily average flow (73.2 mi^2)
Silver Lk Outlet Nr Kirkwood Ca	Amador	USGS 11436000	Oct 1922 - Sep 1996	Daily average flow (15.2 mi^2)
Silver Lk Leakage No 1 Nr Kirkwood Ca	Amador	USGS 11436500	Oct 1986 - Sep 1996	Daily average flow
Caples C Release Bl Caples Dam Nr Kirkwood Ca	Alpine	USGS 11436999	Sep 1970 - Sep 1971, Oct 1977 - Sep 1996	Daily average flow (13.5 mi^2)
Caples Lk Outlet Nr Kirkwood Ca	Alpine	USGS 1143700	Oct 1922 - Sep 1996	Daily average flow (13.5 mi^2)
Caples Lk Spillway Nr Kirkwood Ca	Alpine	USGS 11437500	Oct 1977 - Sep 1992	Daily average flow
Silver Fork Of Sf American R Nr Kyburz Ca	El Dorado	USGS 11438000	Oct 1924 - Sep 1944	Daily average flow (107 mi^2)
El Dorado Cn Nr Kyburz Ca	El Dorado	USGS 11439000	Oct 1922 - Sep 1957, Oct 1966 - Sep 1977, Oct 1975 - Sep 1992, Oct 1993 - Sep 1996	Daily average flow
SF American R Nr Kyburz (River Only) Ca	El Dorado	USGS 11439500	Oct 1922 - Sep 1996	Daily average flow (not including El Dorado Canal, 193 mi^2)
SF American R Nr Kyburz Total Flow Ca	El Dorado	USGS 11439501	Oct 1922 - Sep 1996	Daily average flow (combined flow of river and El Dorado Canal, 193 mi^2)
Alder C Pipline Nr Whitehall Ca	El Dorado	USGS 11439950	Oct 1975 - Sep 1982	Daily average flow
Alder C Nr Whitehall Ca (Creek Only) Ca	El Dorado	USGS 11439999	Oct 1975 - Sep 1981	Daily average flow (22.1 mi^2)
Alder C Nr Whitehall Total Flow Ca	El Dorado	USGS 11440000	Oct 1922 - Sep 1981	Daily average flow (22.1 mi^2)
Plum C Nr Riverton Ca	El Dorado	USGS 11440500	Oct 1922 - Sep 1939	Daily average flow (7.32 mi^2)
Picket Pen C Nr Kyburz Ca	El Dorado	USGS 11440850	Feb 1962 - Sep 1968	Daily average flow (0.49 mi^2)
SF American R Bl Silver C Nr Pollock Pines Ca	El Dorado	USGS 11442500	Oct 1969 - Oct 1993	Daily average flow (449 mi^2)
American R Flume Nr Camino Ca	El Dorado	USGS 11443000	Oct 1922 - Sep 1957	Daily average flow (501 mi^2)
Slab C Res Nr Camino Ca	El Dorado	USGS 11443450	Oct 1981 - Jul 1984, Oct 1988 - Sep 1993	Daily average flow (493 mi^2)
SF American R Nr Camino Ca	El Dorado	USGS 11443500	Oct 1922 - Sep 1996	Daily average flow (493 mi^2)
SF American R Nr Camino + American R Flume Ca	El Dorado	USGS 11443501	Oct 1922 - Dec 1964	Daily average flow (493 mi^2)
SF American R Nr Placerville Ca	El Dorado	USGS 11444500	Oct 1911 - Sep 1920, Aug 1964 - Sep 1996	Daily average flow (598 mi^2)
SF American R A Coloma Ca	El Dorado	USGS 11445000	Oct 1929 - Sep 1941	Daily average flow (631 mi^2)
SF American R Nr Lotus Ca	El Dorado	USGS 11445500	Oct 1951 - Sep 1996	Daily average flow (673 mi^2)
Caples Lake Storage	Alpine	USGS 11436950	Oct 1985 - Sep 1996	Daily average flow
		PG&E Records	Oct 1921 - Sep 1985	Daily average flow. Hand written daily logs from 1925-32.
Silver Lake Storage	Amador	USGS 11435900	Oct 1985 - Sep 1996	Daily average flow
		PG&E Records	Oct 1918 - Sep 1985	Daily average flow. Intermittent hand written daily logs from 1925-32. Winter months have no or few measurements from 1925-84.
Lake Aloha Storage	El Dorado	PG&E Records	Oct 1921 - Sep 1996	Sparse and hand written daily data.
Echo Lake Storage	El Dorado	PG&E Records	Oct 1924 - Sep 1932, Oct 1952 - Sep 66	May-Aug draw down. Not complete
EID delivery at Forebay	El Dorado	PG&E Records	Oct 1919 - Sep 1996	Daily average flow 1954 - 96. Monthly data from 1919 - 53.

Newly installed gages

As part of EID's effort to provide the data required to evaluate project impacts, several new

Group	EID Station ID	Location
Relicensing 15 Min.	A-6-A	Caples Creek 0.4 mi. upstream
Relicensing 15 Min.	A-7	Caples Wing Dam Spill
Relicensing 15 Min.	A-9-A	Silver Cr. Downstream of Caples Conf.
Relicensing 15 Min.	A-10	Mill Cr. above diversion
Relicensing 15 Min.	A-10-A	So. Fk. Am. River above Silver Fk.
Relicensing 15 Min.	A-24-A	Oyster Creek downstream Hwy 88
Relicensing Weekly	T-1	Esmeralda Cr. above Hwy 50
Relicensing Weekly	T-2	Esmeralda above diversion
Relicensing Weekly	T-3	Esmeralda Cr. below canal
Relicensing Weekly	T-4	Ogilby Cr. above confl.
Relicensing Weekly	T-5	Ogilby diversion flume
Relicensing Weekly	T-6	Ogilby Cr. above diversion
Relicensing Weekly	T-7	Bull Cr. above confl.
Relicensing Weekly	T-8	Bull Cr. above canal
Relicensing Weekly	T-9	No Name Creek above canal
Relicensing Weekly	T-10	Carpenter Creek above canal
Relicensing Weekly	T-11	Strawberry Cr. 0.5 mi above confl.
Relicensing Weekly	T-12	So. Fk Am. River above Pyramid Creek
Relicensing Weekly	T-13	So. Fk Am. River above Echo Conduit
Relicensing Weekly	T-14	Long Canyon Cr. near confl.
Relicensing Weekly	T-15	Sherman Canyon Cr. near confl.
Relicensing Weekly	T-16	Mill Cr. aove confl.
Relicensing Weekly	T-17	Bull Cr. diversion flume
Relicensing Weekly	T-18	Mill Cr. above canal

gages have been installed in the basin in the last three years. Two types of gages were installed, Gages A-6-A, A-7, A-9-A, A-10, A-10-A, and A-24 record data several times a day and the data is retrieved once a month. This type of data will be very useful for modeling purposes. The daily time step may also be used to determine operating rules that can be used on a real time basis. The data from gages T-1 through T-18 are staff gages that are read once a week and the readings represent flows only at the time the gages were read. These data may not be useful for modeling purposes unless we can establish a relationship between these gages and a continuous recording gage. Some of the data collected in the last three years at the recently installed gages can be used to calibrate the model and provide information that could be useful in determining environmental impacts on a daily scale.

Project 184 simulated flow locations

Participants are interested in investigating the impacts of Project 184 operations in location where historic flow data are nonexistent. Previous consultants have developed synthetic daily flow data for these locations. The simulated flow data are derived based on the South Fork American River at Kyburz gage, the Blackwood Creek gage, drainage areas and precipitation factors. The Blackwood Creek gage is located in the Tahoe Basin and was used to disaggregate the monthly data into daily data. Simulation flow locations, historic records and simulation records are listed in the tables below. All of the unimpaired records can be traced back to the South Fork American River at Kyburz. Where no gage data exists, areal relationships and precipitation factors were used to derive records.

FERC Final Flow Data derived by Borcalli and Associates

STA	Simulated Flow Locations	Origins (Historic Record)	Simulation Record
1	Streamflow below Silver Lake	11436000 (10/01/1922 - 09/30/1996)	1972-1996
2	Streamflow below Caples Lake	11437000 (10/01/1922 - 09/30/1992)	1972-1996
3	Silver Fork at Caples Creek	Derived	1972-1996
4	Caples Creek at Silver Fork	Derived	1972-1996
5	Silver Fork at China Flat	Derived	1972-1996
6	Streamflow of Echo Creek below Echo Lake	Derived	1972-1996
7	Pyramid Creek below Lake Aloha	11435100 (10/01/1970 - 09/30/1996)	1972-1996
9	South Fork American at Aspen Creek	Derived	1972-1996
14	Silver Fork at South Fork American	11438000 (10/01/1924 - 09/30/1944)	1972-1996
15	South Fork American near Kyburz	11439500 (10/01/1922 - 09/30/1996)	1972-1996

The monthly unimpaired flow records at locations 1, 2, 7, and 15 are good, but the daily records suffer from a lack of daily storage records from 1972 through 1994 and from the lack of consideration of travel time in the calculation of the accretions from the reservoirs to the diversion dam at Kyburz.

Additional Flow Data derived by Borcalli and Associates

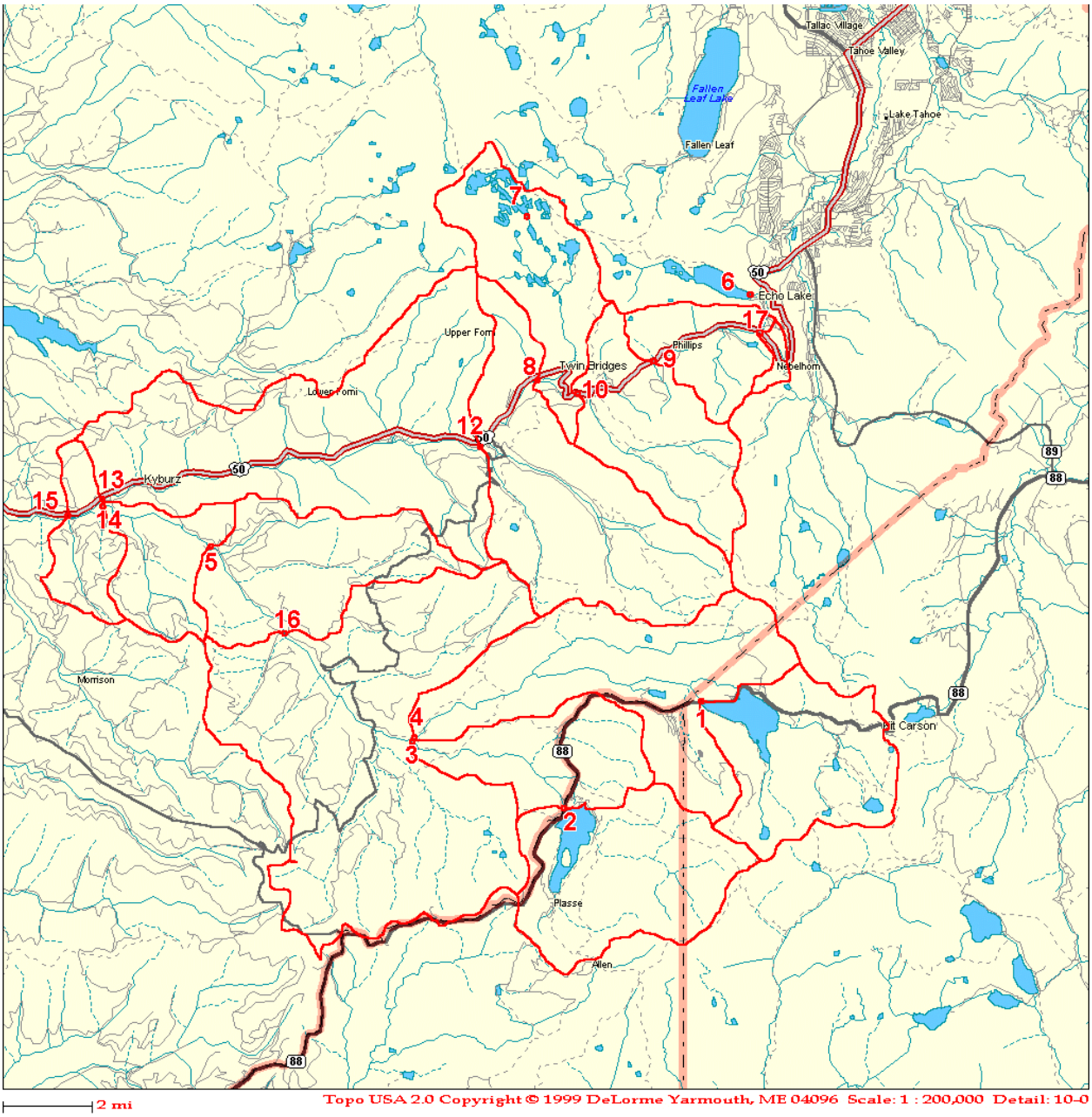
STA	Simulated Flow Locations	Origins (Historic Record)	Simulation Record
10	South Fork American at Camp Sacramento	Derived	1972-1996
12	South Fork American at Strawberry Creek	Derived	1972-1996
13	South Fork American at Silver Fork	Derived	1972-1996
16	Silver Fork at Girard Creek	Derived	1972-1996
17	South Fork American at Echo Conduit	Derived	1972-1996

All of the Water Year 1972 - 1996 unimpaired data sets were derived using the intermittent reservoir storage data from Caples Lake, Silver Lake, Lake Aloha and the stream flow data from 3 or 4 gages in the basin. Those data were supplemented with information from Blackwood Creek in the Lake Tahoe basin. Only two of the above locations have any actual measured stream flow data at that location for the October 1, 1971 - September 30, 1996 period. Those two locations are number 7 (Pyramid Creek near Twin Bridges) and number 15 (S. F. American River near Kyburz.) It is clear that the daily record generated for the above 17 sites is not an accurate estimate of the flows that actually occurred during the October 1, 1971 - September 30, 1996 period. While the synthetic record which has been generated may not be the **actual** flows that occurred in any particular stream reach historically, the synthetic record represents flows which **could** occur at those locations and may be useful in understanding the **incremental impacts** of changes of proposed operational plans.

The development of the performance measures of the process participants will be critical in assessing the usefulness of the synthetic data. How useful the synthetic record might be will be highly dependant on how well it represents the **range** of flows that could be experienced in the stream reaches being studied. The quality of the record in that regard must still be determined. The usefulness of the synthetic record is also dependant on what we might want to do with those data and what conclusions we want to draw from the model results.

Simulation Data Station Location Map

The station numbers in the tables above correspond to the numbered locations on the map.



The data collected in the last three years at the recently installed gages, can be used to calibrate the model and provide information that could be useful in determining environmental impacts on a daily scale. The daily time step can also be used to determine operating rules that can be used on a real time basis.

The monthly data developed for the 1972-1996 period can be used for planning studies. The twenty-five years is the shortest time-period allowed for the FERC planning studies. The larger time-step gives information about how the system can respond to various hydrologic conditions. Typically, a monthly model gives information about supply reliability, but doesn't give details about day to day operations.

Much of the data has been manufactured rather than measured. In general, the data development has been well documented and there has been a large effort to estimate flows using various techniques where no measurements exist. The techniques used probably give acceptable volumes of flow over a monthly timestep, but also probably underestimate the peak flows and duration of those peak flows. For long term water supply studies, this data is likely acceptable, but for environmental impacts, it may not be acceptable. Interested parties are particularly concerned about the inflows to Echo Lake and the unimpaired flow of the South Fork American River at Kyburz.

3.2.3 Operating Rules, Criteria and Guidelines

There are several sources that contain operating rules or water rights that may dictate the operation of Project 184. The sources we have reviewed include:

- The operating manual for the El Dorado Hydrelectric Project written by Pacific Gas and Electric Company
- Decision 1635
- Order Taking Final Action On Petitions for Reconsideration of Decision 1635.

We are aware of FERC license 184, but do not have the document and have not reviewed the license. Included in this report are only the items that can be modeled.

El Dorado Hydroelectric Project

The El Dorado Hydroelectric Project contains information about the historic operating rules used by P.G. and E. The rules are written for each facility as follows:

Echo Lake: Flashboards are allowed 4/2 through 11/15 each year. The draft on the lake is not started until after Labor Day for recreation purposes. P.G. and E. only have rights to the top six feet of the lake. The storage values listed (1,890 AF) is the total water available to P.G. and E. There is still water available to the Tahoe Basin at zero acre feet to P.G. and E. If the lake is going to spill, water is drafted to the South Fork of the American River providing it can be utilized at El Dorado Power House. If not, the water must be spilled to the Upper Truckee River for use in the Tahoe Basin.

Echo Lake Canal: Carries 32 cfs from Echo Lake to South Fork American River

Lake Aloha: No specific instructions

Caples Lake: Flashboards allowed 4/2 through 9/30 each year. Normal end of year carry-over will be 6,000 acre feet. The lake will continue to be drafted after the end of the year until the level is down to the minimum pool by the time the following spring run-off has started.

Silver Lake: Flashboards and Radial allowed closed 4/2 through 10/31 each year. Normal end of year carry-over will be 1,000 acre feet. The lake will continue to be drafted after the end of the year until the level is down to the minimum pool by the time the following spring run-off has started.

General Reservoir Operations

All flashboards are removed and spill gates opened by November 1 on all reservoirs except Echo Lake (November 15). Flashboards are installed and spill gates closed as soon as rin-off sonditions permit, but no earlier than April 2 each year.

During Spring run-off and while the El Dorado Headdam is spilling, all releases from these reservoirs are considered either fish reqirements or regulated spill, regardless of wether the water is being released through the draft gate or via the spill channel.

As soon as spill at the El Dorado Headdam stops and release is down to the fish requirement, draft on the Forest Service lakes (American, Lake of the Woods, Ropi, and Toem) will commence to maintain approximately 150 cfs in the El Dorado Canal.

Water released for fish purposes below the El Dorado Headdam will be maintained at minimum specified releases. This flow is augmented between July 1 and Ocotber 14 by an additional 1 to 2.5 cfs releases for Forest Service use downstream of El Dorado Headdam. This additional water is maintained by releases from P.G. and E. reservoirs to replace the water P.G. and E. used from the Forest Service Lakes.

Draft on Lake Aloha will start when the Forest Service Lakes are empty. Any additioanl water needed to maintain approximately 150 cfs at the headdam in the El Dorado Canal will come from Caples Lake.

Echo and Silver Lakes are left as full as possible and are not drafted until after Labor Day. At this time, depending on remaining storage, management decides the amount of water to maintain in the El Dorado Canal. These two lakes are drafted while Caples Lake draft is increased. Some water is kept in reserve for release during snow and freezing conditions. This is done to keep anchor ice from building up in the bottom if the canal and to keep the canal from filling with snow.

El Dorado Headdam: The El Dorado Headdam sluice gate is opened to maintain the desired releases down the South Fork American River as measured at A-12. If the fishwater release at gage A-12 drops below the requirement, the canal intake gates are closed to increase the releases out of the headdam.

El Dorado Canal: The Company has diversion rights to a total of 156 cfs at the intake of the canal. Small amounts of water from various small streams and springs which intercept the route of the canal, are diverted into the canal. During

the dry season, the canal can hold 170 cfs at the intake. However, during the wet season it is usually cut back , depending on the weather, to accomodate the run-off from the various small streams that intercept the canal.

Alder Creek Feeder: This feeder carries up to 15 cfs from Alder Creek to the El Dorado Canal. From October 1 to June 15 of the succeeding year, P.G. and E. has the right to divert up to 15 cfs from Alder Creek and put it into the canal.

El Dorado Forebay: Two foot flashboards installed all year. One foot additional boards installed 4/2 through 10/31 each year. P.G. and E. can be called upon to deliver up to 15,000 acre feet for a caledar year and a maximum of 40 cfs to the El Dorado Irrigation District Canal at the forebay, depending on forebay elevation.

3787.0' = 5 cfs	3790.0' = 20 cfs
3788.0'= 10 cfs	3791.0' = 30 cfs
3789.0' = 15 cfs	3792.0' = 40 cfs

El Dorado forebay is not to be spilled due to a serious erosion problem. Forebay storage can be controlled by diverting water out of the El Dorado Canal at Spillway 47C just above the forebay.

Decision 1635

Decision 1635 contains references to FERC License 184, amended in 1984 by revising "Exhibit S", which relates to fishery protection requirements. Article 34 of that document contains the following requirements for the protection and enhancement of fishery resources:

- Minimum Streamflow Releases
  a. A continuous minimum flow of 2.0 cfs and 5.0 cfs from Silver Lake and Caples Lake, respectively, or the inflow to the respective reservoirs, whichever is less.
  b. A continuous minimum flow release of 2.0 cfs from Lake Aloha, or the inflow to the reservoir, whichever is less.
  c. The following continuous minimum flows from the El Dorado Diversion Dam near Kyburz:

Bypass Period	Minimum Flow (Normal Year)	Minimum Flow (Dry Year)
11/01 to 08/31	50 cfs	18 cfs
09/01 to 09/30	38 cfs	10 cfs
10/01 to 10/31	43 cfs	15 cfs

A normal water-year is defined as any year when the South Fork American River annual runoff, at the inflow to Folsom Reservoir, as forecasted on April 1 and corrected on May 1 by the California Department of Water Resources, is greater than 50 percent of the 50-year average. All other years are defined as dry.

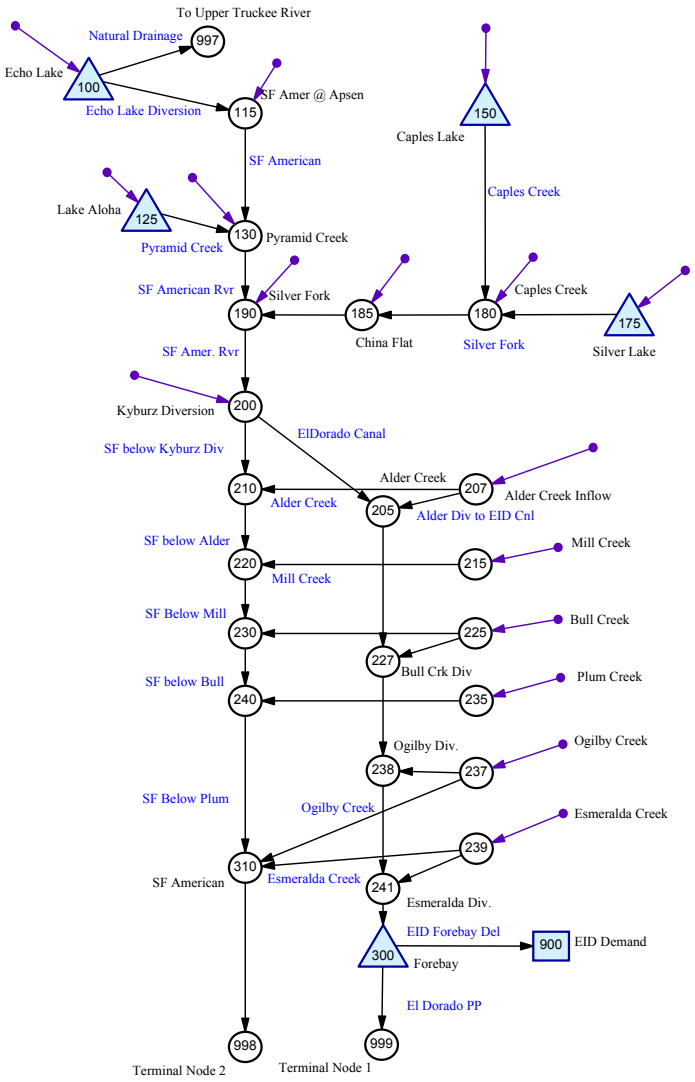
- Reservoir Storage Volume

  The minimum pool in Caples Lake shall be maintained at 2000 sf. (93, PG&E, 2, Order Amending License and Approving Revised Exhibit S, 4-6.)

3.3 *Preliminary schematics*

Preliminary schematics have been prepared for both a monthly model and a daily model. The schematics are different for a few reasons. The models will be built to answer different questions. The longer period, monthly model will be used to assess water supply and generation. The daily model will be used to get a handle on potential operating rules and the daily impacts to natural resources. Some of the gages on Caples Creek and on Silver Fork can only provide data for the last three years. That period is not long enough to provide any meaningful information to develop water supply or generation strategies because is does not contain the variety of hydrologic conditions that can occur in the watershed. In addition, FERC requires that a minimum of twenty-five years of data be used for relicensing studies. Gages have recently been placed in key areas of environmental concern. Some of these gages are staff gages placed at Mill Creek, Bull Creek, Ogilby Creek, and Esmeralda Creek. These particular gages are read weekly and will only generate dated at the time the gage is read with no information available between readings. In both the monthly and daily timestep schematics, the creeks are represented in the schematics, but development of reasonable hydrology from the weekly staff gage readings is not possible.

Monthly Timestep Schematic

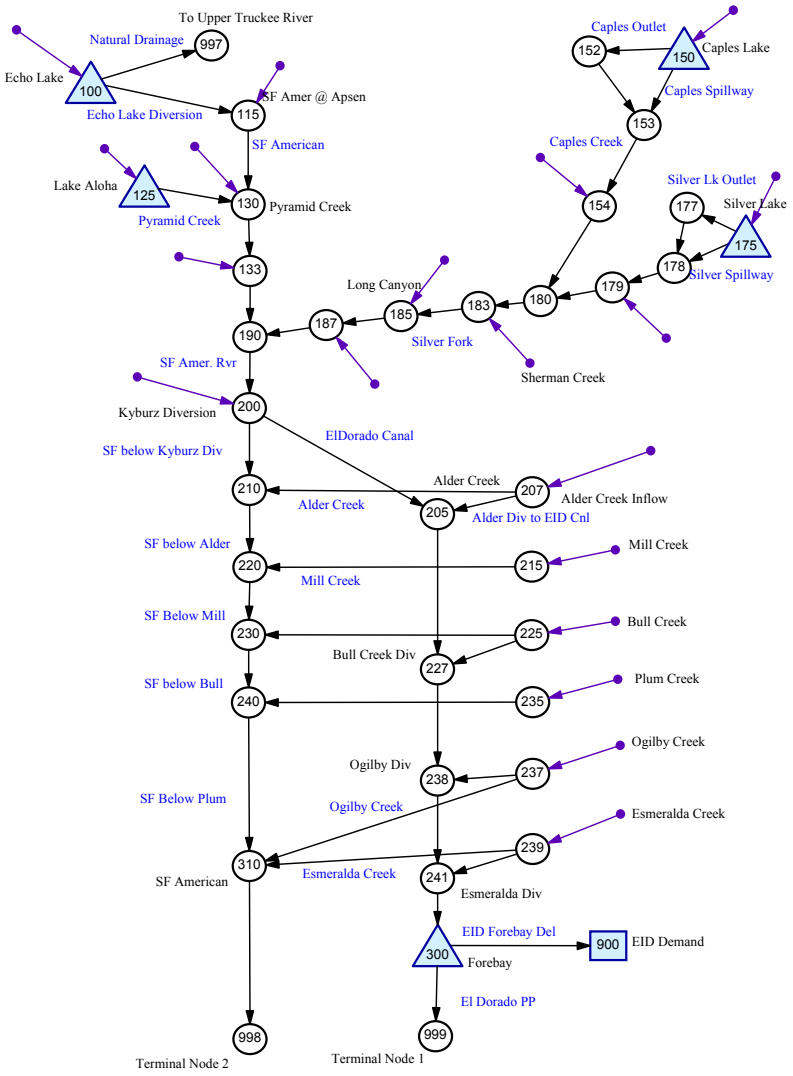


The longer period, monthly models will be used to assess water supply and generation. The daily model will be used to get a handle on potential operating rules and the daily impacts to natural resources.

For example, for water supply and generation studies, it is not necessary to separate the spillway from the outlet works when modeling the releases from Silver Lake. However, if the evaluation of the impacts to a meadow downstream of the outlet works is required, the flow through those outlet works on a daily basis might be important. In addition, when modeling on a daily basis,

travel times will likely need to be considered. For example, if the goal is to have a certain flow at the Kyburz diversion point, a coordinated operation of the upstream reservoirs may be required. If the effects of a release at Caples Lake takes 18 hours to reach Kyburz, releases from closer reservoirs may be needed while water from the upstream reservoir is traveling downstream. The schematic for a daily model may require the use of special travel time reservoirs which will simulate travel times by holding water in the reservoirs for a specified amount of time and then released when appropriate. The difference between the monthly schematic and the daily schematic is dictated by data and specifically in the Silver Lake, Caples Lake, and Silver Fork areas. The daily model will contain more detailed information about Silver Lake and Caples Lake operations.

Daily Timestep Schematic



3.4 Recommended Modeling Timestep(s)

Based on the interviews of the participants and the available data, two timesteps will be necessary to address the concerns of the participants. The two necessary timesteps are monthly and daily. The FERC relicensing process requires a minimum of 25 years of monthly data. The monthly data can be used to answer water supply reliability and generation questions, but would not be good for answering questions about daily operations or impacts to environmentally sensitive areas on a daily basis. The available daily data is comprised of the monthly data disaggregated to daily data and the newly installed gages near Caples Lake, Silver Lake and Silver Fork of the American River. This period of record for the newly installed gages is for the last three years. This means that the model can be run on a daily time step with the proposed daily schematic, on page 18, for a three year period or can be run with the proposed monthly

schematic, page 17, using daily data for the 1972 through 1996 period. The data from the recently installed gages doesn't encompass the range of hydrologic conditions that can occur within the basin, but is representative of recent operations. The daily data can be used to calibrate a daily model.

4.0 Phase II - Scope of work, Schedule and Cost estimate for model development

A major part of the Project 184 model construction will be the preparation of the hydrology required to drive the model. HydroLogics, Inc. and district representatives have identified the data, thoroughly reviewed existing hydrologic data and determined what steps must be taken to provide the data necessary to produce the performance measures desired by the District and by the Project 184 collaborative participants. An initial step in Phase II, will be to generate the desired data using statistical methods where necessary. It is anticipated that there will be four major tasks to be completed in Phase II.

- Generation of hydrologic data. Hydrologics is proposing that two versions of the Project 184 model be constructed. One version of the model will be used to look at the biological and geomorphology aspects of the project area . This version will use a daily time step and will be run for a three year period. The second version of the Project 184 model will be set up to primarily to examine the impact of operational changes on water supply and energy generation. Hydrologics will prepare daily and monthly data sets to drive the operation of the system.

  The daily data set can be developed for the daily time step schematic shown on page 18 using available data collected in recent years (Water Years 1998-2001) by the USGS and EID. Actual daily data are not available for all points of interests. Where recording gages are available, the daily records will be used to generate the required data. However, gages T-1 through T-18 are staff gages which are read once a week and the readings represent flows only at the time the gages were read. Hydrologics will use data from these staff gages, along with data from recording gages in the basin, to develop a three year daily record for the tributaries of interest. Where there are tributaries of interest, with neither recording gages or staff gages, Hydrologics will work with the District, collaborative participants and other consults to determine the best way to represent runoff from these tributaries in the data set.

  Monthly data for many points in the basin for the period from October 1, 1972 - September 30, 1996 were previously developed by other District consultants. This information will be used to the extent possible. HydroLogics will review all monthly data sets with the district and the collaborative participants for acceptability. Of particular concern to the collaborative participants are the inflows to Echo Lake and the unimpaired flow of the South Fork American River at Kyburz. If it is clear that the previously developed data must be revised or if additional monthly data must be developed to support the monthly time step version of the Project 184 model, Hydrologics will work with the District, collaborative participants and other District consultants to insure that the developed data are a reason representation of the flows which might be expected at the point of interest in the South Fork American River Basin.

  The development of both hydrology data sets will be done on a time and materials basis and will be begin concurrently with the construction of the model.

- Model Construction - Construction will be done based on the Phase I report. The model will be constructed to generate all the outputs required to produce the performance measures identified in Phase I or in subsequent meetings with the District and the collaborative participants. We will work with the District to accurately describe all Project 184 physical characteristics, operational constraints, operation rules and project objectives. The completion of the model will be dependant on the completion of the hydrology data sets needed to drive the operation. A hydrologic data set will be needed to test the model. Assuming the availability of such a data set, the models could be completed in about eight weeks at a cost of $50,000. This price includes the cost of the OASIS, XA and Vedit licenses. The OASIS and Vedit licences which are included in attachments to this proposal for signature. No signed document is required for the XA licence.
- Analysis - Following the development of the model and the base study simulation, we anticipate that some analysis of alternatives will be necessary to fulfill the FERC relicensing requirements. Typically, we can develop and analyze an initial alternative for $5000. Each subsequent analysis will be performed for $3,000.
- Training - Training sessions are a valuable part of our services. The sessions are designed to inform the users about the way the model and post processors work. In addition, the training can be used to demonstrate the flexibility and usefulness of the model, specifically addressing the Operations Control Language (OCL) commands and LP formulation. We would suggest a 2 or 3 day training session for district representatives with a limit of about 12 attendees per session. Such a training session would be provided at a cost of $15,000.

APPENDIX A

Examples

Of

Performance Measures