US Army Corps
of Engineers®
Portland District

Volunteer Training Manual

Bonneville Lock and Dam

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The Visitor Centers

Welcome!
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Yes, it's happened here: Visitors were locked in the theater, two computers caught on fire, 25 people were trapped in an elevator which started to slide down the shaft, and someone hung the Corps flag up up-side down.

Welcome to Bonneville!

As you get settled into your RV site, you may be wondering how to find local amenities such as food, laundry services, gas, etc.

Cascade Locks, Oregon is 4 miles east on I-84. What's there???

Grocery store
Three restaurants
A drive-in (great ice cream cones and greasy fries!)
Three gas stations
Propane available at the Chevron Station
Post office (Set up your mail service here.)

Stevenson, Washington is located 4 miles east of the dam on Hwy. 14. What's there??

Grocery store (you'll be paying sales tax in Washington)
A few restaurants
Three gas stations
Two banks
Post office
Library
Laundromat
Bakery
Drug Store
Propane is available at the Stevenson Texaco Gas Station.
And a few other amenities that you can explore

Skamania Lodge is a resort just west of Stevenson. Go check it out by wandering around the facilities.

If you are not familiar with these two communities, take some time and go explore. Visitors to Bonneville Dam will be asking about the local towns and it's easier to remember what's there when you've seen it first hand! Your card key and car tag gives you access across the dam so you don't have to pay to cross the Bridge of the Gods. ($1.00 toll bridge that links Cascade Locks and Hwy 14.)

If there are other amenities or recreation areas you are looking for, ask a staff member or take a look at the brochures we have for the public at the visitor centers.

Project Gates. How do I make those *&%$* gates open?? Depending on which direction you approach a gate from, it will automatically open when your vehicle trips a sensor, or you have to wave your card key at a receptacle to open the gate. Some card key receptacles look like a vertical gray pad, others are hidden inside brick columns. You will be taken on a tour of the project as part of your training. That would be a good time to make a mental note of how to make each of the gates operate.

Who works here?

Go around and say “hi” to your fellow co-workers. You can write their names below:

Park Rangers:

STEP (Student temp employment program):

Co-op, temporary, and seasonal rangers:

Volunteers:

What about the “other” people?

There are 5 other staff types that hover around the visitor center. All official workers will have a colored photo ID card clipped to their shirt. If they don’t, get suspicious.

Bookstore staff: The bookstores are run by a non-profit organization called the Northwest Interpretive Association (NWIA).

Rangers: The "other" rangers run outdoor areas such as the fishing accesses, lake, and project roads. They handle problems such as fires, lost dogs, keys locked in cars, and jump starting cars.

Fish counters: These dedicated heroes count fish all day without going insane. They take breaks the last ten minutes of each hour, so you might see them walking around. They work for the Washington State Department of Fish and Wildlife.

Grounds crews: These people keep all of our landscaping trimmed and green. They are always planting something around the visitor center. They are contractors hired by the Corps. You can recognize them by their muddy boots.

Housekeeping crew: These people come out at night to clean our visitor centers. It's OK to leave for home while they are in the building. They are also contractors hired by the Corps.

Project staff: From time to time, you might see mechanics, computer technicians, operators, fish biologists, carpenters, painters, etc. wandering through the visitor center. These are other Corps employees that work on the project. Say “hi” because you will see them at meetings, parties, etc.

Contractors: These are people hired by the Corps to do special jobs such as install AV equipment and exhibits, maintain elevators, construction, etc. All of them must have a white visitor ID badge and a brown visitor parking permit in their vehicles.

Visitor Centers

You are working at the Bonneville Lock and Dam Regional Visitor Center. This visitor center is the flagship of the Corps so working here is sort of like working at Yellowstone for the Park Service. The Bradford Island Visitor Center always ranks in the top 10 most popular attractions in Oregon, with over half a million visitors a year! The Bonneville Lock and Dam Regional Visitor Center actually includes several areas:

Oregon side:

BIVC - (Biv-ick) Bradford Island Visitor Center
PH I - Powerhouse one visitor gallery
Navlock - New navigation lock visitor buildings

Washington side:

VOB - Visitor Orientation Building
FVB - Fish viewing building
PH II - Powerhouse two visitor galleries
Ft. Cascades Historic Area

Phone numbers:

BIVC	541-374-8820
BIVC (TDD)	541-374-4501
VOB	509-427-4281
Project office	541-374-8442
Rangers	541-374-8344

Mailing address:

Visitor Center
U.S. Army Corps of Engineers
Bonneville Lock and Dam
Cascade Locks, OR 97014

Desk Duties

Most of the things you must do at the desk are best learned "hands-on". This check list will help if you forget how to do something. At the desk you are responsible for:

- Welcoming and informing visitors (first and most important)
- Answering the telephones
- Making PA announcements
- Listening to the base station radio
- Dealing with emergencies

Welcoming and Informing Visitors

There are many resources at the desk to help you keep your image of omniscience (possession of universal or complete knowledge):

- Brochures - become familiar with them, restock continuously
- Handouts - same as above
- Foreign language brochures
- Desk Copy Maps and Publications - become familiar with them
- Binder with campground, hotel, restaurant, etc. information - Thumb through it so you know what is in there.
- Public and Corps phone book, phone manual, and number listings
- The Official Bonneville Trivia Book - Look here first for answers to visitors' questions.

There are also some resources that are important to you when you are working at the information desk:

- The desk clipboard has lots of information:
  - Daily schedule
  - Monthly schedule
  - Statistics sheet (scheduled programs, hourly programs, AV's given and number of buses are recorded here).
  - Emergency SOPS - Contains step by step instructions on what to do in an emergency.
- Computer - Blackboards, e-mail, fish counts, word processors, etc. Due to the high cost of security clearances, volunteers do not have access to Corps computers.

Phones

Every phone should have a Bonneville telephone directory sheet near it with all our phone numbers. Look up these common numbers and write them down (go back to page 6 to review what the abbreviations mean):

BIVC desk:

BIVC office:

BIVC outside line:

BIVC bookstore:

PH I Control room (emergency):

BIVC elevators:

VOB/PHII/FVB elevators:

VOB desk:

VOB office:

VOB outside line:

VOB lunchroom:

VOB bookstore:

Rangers:

How do you anwer? Please answer the outside line by saying, “Bonneville Dam Visitor Center, this is (your name)”. Answer inside lines by saying, “Visitor Center, (your name) speaking”.

Phone functions:

Forward - When you are away from a phone, this feature will "forward" your calls to another phone. So when a call comes in, it will make someone else's phone ring. Push forward (The indicator blinks), dial the number you would like the calls to go to and push forward again (The indicator is steady).

Hold - To put someone on hold, push the HOLD button and hang up. Notice that the phone line on hold will have a flashing indicator.

Conference - This feature allows you to talk to three or more people at once or transfer a call to another phone. While talking to someone, push the conference button (This places the person on hold and gives you a dial tone). Dial another number. When that person answers, push the conference button and all three people can talk to each other. Keep doing this to add more people to the conversation.

To transfer a call, start a three way conversation and hang up. The remaining two people will still be connected. Here’s how to do it: While talking to person A, push conference and dial person B. When person B answers, say “I’m conferencing a call from person A to you”. Push conference, verify that everyone is connected, “Are we all here?” then hang up.

Phone messages

Phone messages are taken on the yellow phone message pads. Be sure to fill in all the blanks such as: your name, the date, your weight (just kidding!), the time, etc. There is nothing so frustrating as getting a message you can't figure out and not knowing who took it or when. Also, be sure that the person gets the message either in their mailbox or in person. These are matters of common courtesy.

PA System - Oregon side

Announcements - Push in the MIC1 button and speak into the holes labeled CONSOLE MIC. Or, use the handset. All of the announcements you will make are printed on cards and hung on a hook near the unit. In an emergency, push the red button instead of MIC1 to call all rooms.

Communicating to Staff - Call buttons are located throughout the building. When pushed, they make a "beep" and light up a red light on the PA control board. The switches on the board are labeled as to which room they allow you to communicate with. The red lights above each switch shows which room you've been "beeped" from. When you wish to speak to the person "beeping" you, flip the appropriate switch down to hear them. Push the green button and speak into the speaker on the control board to respond.

Switches - Turning the switches up will allow those rooms to hear your announcements (yellow), switches in the middle position are off (blue), and switches in the downward position allow you to hear into and talk to that room. Please keep the switches set according to the colored label when not using them.

PA System - Washington side

This system is a little more complex than the one at BIVC, so a more detailed instruction book has been written. Make sure you read the Washington Intercom System user's manual at the VOB desk. It's fun to read and you will never be able to operate the PA system without it!

Alarms - Two things you MUST know about the Washington PA system are the emergency pull switches and the alarms. Throughout the visitor center are panic switches that visitors can pull in an emergency. The console at the desk will flash “Help” and a number. Read the user manual so you know what to do when this happens. Also, the laserdisc computer and the artifact cases in the FVB are hooked up to an alarm. Make sure you know what it sounds like and how to deactivate it. Again, instructions are in the user manual.

Radios

We have 2-way radios for communication. You should always wear one when roving away from the visitor center. The natural resource section (visitor center and outdoor rangers) and the daytime security guards use channel 2 and the rest of the project uses channel 1.

What to say - We use names and numbers on the radio. All the staff have radio numbers. When calling someone, hold down the transmitting button, wait a second or two, then say "(Their number and name) this is (your name)". Make sure the microphone is a few inches away from your mouth and you speak slowly and clearly. Remember that everyone on the project, visitors standing next to a ranger with a radio, and people with ham radios can hear your conversation so keep it professional. When the conversation is over, the person originating the call says, "(your number and/or name) clear".

The desk radio (base station)- The radio at the desk should always be turned on and at a level that you can hear. It is always scanning all the channels, but will automatically transmit on channel 1. A call to the visitor desk will be addressed to "BIVC desk" or "VOB desk". To call out on the radio, hold the microphone one foot from your mouth and press the switch that has a lightning bolt on it. It is important to pay attention to the radio in case of an emergency.

Emergencies - If you need lots of rangers around you in a hurry, use the number 200 or say "code 200" and state your location. Everyone in the building will come running. If you hear the number 200 on the radio, drop everything and run to that location. Here's some examples:

- A visitor is threatening you and you need help: "This is 200. I'm busy with a visitor at the desk, so I'll be late for my movie." The second sentence is a distraction for the visitor.
- Medical emergency: "This is 115. We have a code 200 medical by the fish ladder."

Computers

Do you like computers? Several essential visitor center operations are on computers. The good news is that you don't have to be a computer genius to operate them. Due to the high cost of security clearances, volunteers do not get access to Corps computers.

Fish count and weather reports - These are idiot-proof programs that print out the daily fish counts and weather conditions (In the winter, the fish count is replaced with road conditions).

Blackboards - Since everyone works different days and shifts, communications between people get difficult. The blackboard is a place where the staff can leave notes to

about what is going on. **A staff member will e-mail new blackboard entries to all volunteers once a week.

For computer geeks - Our systems are Pentium or newer PC's running Windows XP. All computers are on a network (the LAN). We have e-mail at the dam, to the district, and internet access. Major software includes: Microsoft office (Excel, Word, and Powerpoint).

TDD

At the BIVC desk, we have a telecommunications device for the deaf (TDD). If line 4501 rings at the desk, you will see a flashing strobe coming from the TDD. Instructions are on the TDD machine.

Emergencies

When staffing the information desk, you may be the critical link in the response chain. Please notify the Sr. Staff member on duty of all emergencies or security situations. If they are not readily available, call the control room and notify them (x2223). They will contact the Rangers, BERT (Bonneville Emergency Response Team), and an ambulance if needed. After contacting the control room, do make sure the VC Sr. staff is aware of the situation. And remember, IF YOU ARE IN DANGER, GET TO SAFETY! Heroism only works in movies.

Emergency bags - In each office are two bags used for emergencies. The red one is for when someone falls into the fish ladder. The white one is for general emergencies but is geared towards road emergencies. It contains blankets, gloves, flares, etc.

Personal Emergencies - What do you do if you need help when you are at your RV site? **Call the control room at x2223!** The control room operators are trained to dispatch the local fire, ambulance, and police as needed. They also will get someone out to open the front gate after hours, and make sure the swing bridge is not swung!

Bookstore Duties

OPENING:

- Turn on display lights.
- Get the green tagged key set from (BIVC): under the desk next to the red file cabinet, or the FVB storage room, in a small bowl in the right side cabinet.
- At BIVC, get the cash drawer from the bottom drawer of the red file cabinet. At the FVB, it's in the left cabinet in the storage room
- Opening/closing daily record sheet is in the three ring binder on the shelf under the register. Count money in both cash register tray ($150.00 at BIVC and $100.00at FVB) and the change bag ($50.50). Keep that day's record sheet in the register under the cash tray.
- Check to see that the bookstore is cleaned up and stocked. Check under the cabinets for stock as well as the stockroom on the 3rd floor BIVC or storage room FVB.
- The above routine must be complete when the Visitor Center opens at 9am.

BE FRIENDLY AND DO WHAT YOU CAN TO PLEASE THE VISITOR (CUSTOMER).
Please, no more than two volunteers/employees working in the bookstore at one time.

Mastercard/Visa Process

1. Swipe card.
2. Press "enter" button.
3. Key in $ amount and press "enter".
4. Have customer sign first copy.
5. Press "enter" again for customer copy of receipt.
6. Put signed copy in register.

Register Sale Process:

1. Enter PLU#
2. Press "PLU" key for each item
3. Press "subtotal"
4. Enter amount of cash received.
5. Press either "Cash", "check", or "credit card" depending on what you are given.
6. Register will tell you how much change, if any, to give customer.

Multiple items:

1. Enter quantity of item (ie. 2, 3, 4, etc.)
2. Press "x/time"
3. Enter PLU#
4. Press "PLU" key
5. Press "subtotal"
6. Enter amount of cash received.
7. Press "Cash" ", "check", or "credit card" depending on what you are given.
8. Register will tell you how much change, if any, to give customer.

Sale discount:

1. Enter PLU#
2. Press "PLU" key
3. Press "subtotal"
4. Enter amount of Discount (15, 30, etc.)
5. Press "sale discount"
6. Press "subtotal"
7. Enter amount of cash received from customer
8. Press "Cash" , "check", or "credit card" depending on what you are given.
9. Register will tell you how much change, if any, to give customer.

**Lana and/or Ginny will spend time training each volunteer on the register and credit card machine and other aspects of Bookstore procedures.

CLOSING:

- Start closing when the building is closed and you don't have any more customers.
- Run Z report on the register: Place the "z" key in the register, turn to "z" and press "Daily Report" key. Tear off the tape when it finishes printing.
- Close out the Visa/MC machine:
    - Press red "report" button, then "1" for detail.
    - Let print, and tear off, then…
    - Press the "settle" button and key in the password (0000) and press the "enter button.
    - Follow what the machine asks you to do.
    - It will say "accepted" when completed.
- Using "Z" tape, record checks and travelers checks (travelers checks are to be regarded the same as cash when ringing up in cash register, but are listed separately on the Daily Record sheet.
- Remove amount of cash sales (including travelers checks). This will be your cash deposit.
- Count remaining cash in till. If under or over $150.00 (BIVC) or $100.00 (FVB), make adjustments from the cash deposit, showing amount over or under where indicated on the Daily Record sheet.
- Put complete deposit and Daily Record sheet in red envelope found in the top drawer.
- Count money in the change bag and record on Daily Record sheet.
- The cash deposit (red envelope), till, and change bag all go (BIVC) bottom drawer of the red file cabinet, or at the FVB, the storage room.
- Make sure the bookstore is cleaned up, especially if you are not working the next day.
- Leave the door open (BIVC store), so the night janitors can clean the area.
- If you have any questions, call Ginny at 541-490-6259 or 509-427-5977 if you are working on the Washington side.
- Remember this is a fun job, so be happy!

NOTE: Complete operators guides for the cash register and the visa machine are in the file box under the register. Use the cash register guide to get familiar with how to replace the register tape.

Fish Viewing Building Procedures

When you work on the Washington side, you will be responsible for opening and closing the building as well as the bookstore located inside. You will be the ruler of the roost, King for the Day and Emperor of all you can see (inside the building at least!).

Opening the Fish Viewing Building:

1. Volunteers working at the FVB (Fish Viewing Building) should park in the upper level of the parking lot, allowing the lower level for visitors. The "Reserved" parking space is for the Fish Counter.
2. Unlock gate to FVB and leave wide open.
3. Use your key to enter the building.
4. Unlock the green door to break room on the bookstore level. Keep this door shut but not necessarily latched during the day. Break room lights will come on automatically upon entry.
5. Obtain the key located in the small bowl in cabinet to the right, which is kept unlocked. With this key, unlock left cabinet, take cash drawer, change bag, donation box and hand held radio to the cash register. Radio should always be on channel two. Turn radio "on" and volume up.
6. In the break room, turn on the wall switch located to the right of the storage cabinets in the corner. This powers displays in the museum area.
7. In the museum, turn on video screens by placing the wooden pencil in the hole on the back of the video cabinet (after turning on the switch in the break room, see #6 above). If the screen does not light up, repeat the process. Once turned on, tap the icon on the lower screen twice to finish activating the program.
8. Turn on the "Fish Facts" display on the wall behind the store wall. The light switch is located at the left hand baseboard below the display.
9. Turn on the fish wheel by opening the cabinet door. The latch can be unscrewed by hand or by using the hex key found in the cash register drawer. Reach in and turn on the switch to the right. Close cabinet door and tightening down the screw.
10. At 9:00am, take the hex key from the cash drawer and unlock three sets of exterior double doors, one at the store level and two at the upper entrance level. The hex key fits in the holes to the left and right of the door push bars. Hex key turned clockwise will lock the bars in the open/depressed position. To lock the doors, upon closing at 5:00pm, turn the hex key counter clockwise and release the push bar. (Push in on the push bar while turning the hex key.) Return the hex key to the cash register drawer.
11. The First Aid Kit is on a hook beneath the store counter.

During the Day:

1. All sales paid for by personal check and credit/debit card should be verified by a photo ID. Only Visa/Mastercard is accepted. Discover or American Express is not. Out of state checks are acceptable. Personal checks should be accepted and

verified with a driver's license. Write the driver's license number on the face of the check.
2. Visitor surveys are to be completed as provided by the Ranger.
3. Note items to be restocked so they can be brought over the following day. Call BIVC (Bradford Island Visitor Center) store to have items set aside and bagged. Notify the next day's FVB volunteers that the bag will be delivered to their RV site (by whoever is working at the BIVC store) or that they can pick up the bag at BIVC the next morning.
4. Advise Lana Kidner, NWIA Manager, by early Thursday afternoon, or Ginny Porter by early Saturday afternoon if the change bag needs smaller denominations, if they are available. If they are not, get change from the cash box at BIVC (kept in Lana's desk on the 2nd floor).
5. On warm days, prop open upper level doors to the exterior to allow fresh air in the vestibule/lobby area. There is no air conditioning on that level.
6. If two volunteers are available at the FVB, one may occupy the Visitor Orientation Building (VOB) desk while the ranger is on a tour or at lunch. In addition, one volunteer may rove in the FVB at the fish windows to answer questions or outside to pick up trash.
7. If only one volunteer is present and you need to leave the store for a few minutes, turn the register to "off" and take the key with you. Upon your return, insert the "reg" key in the register to "on" position.
8. Empty water leak pails as needed and especially at closing.

Building Closing:

1. Ensure all visitors have exited the building. At 5:00pm lock the three sets of exterior doors using the hex key (see #9, Opening Procedure). Close and latch parking lot entrance gate to FVB. Return the hex key to the cash register drawer.
2. Be sure to turn off the video display at the cabinet using the pencil. Also, turn off the "Fish Facts" display and the fish wheel. Then, in the break room, turn off the wall switch, which powers the display area. Turn off the video display before turning off the break room wall switch, otherwise this will damage the video computer.
3. Turn off the hand held radio and place it in the charger in the break room next to the microwave.
4. If you used the coffee pot, unplug it at night.
5. Check cash register counter and displays to see if neat and ready for next day's opening.
6. Turn off bookstore lights, i.e., the wall switch, fluorescents and under counter. Unplug counter lamp. Remove CD's and turnoff radio/CD player using the switch at the top lift of the radio. Alternatively, unplug it.
7. Upon exiting the outside doors, push/pull to ensure they are locked and latched. Also push the "button" on the outside of the door to make sure the door is locked.
8. After exiting the parking lot gate, close it and be sure it is latched before leaving.

Customer Service

Customer Service
Finding Answers
People with Disabilities

From our suggestion box: “You should be able to swim with the fish! Make it a family thing - put some clothes on the fish. My son was in awe of all the nakedness. Clean it up a bit!” - B. Larson

After turning down several visitors requesting tours, Robin turned to see Kevin Costner asking for a tour.

Little girl: “This is a hospital” Mother: “No, it’s Bonneville Dam” Little girl: “Then why is there a wheelchair here?”

Customer Service

Our goal is to be the best interpretive center in the world. As a result, we are always looking for ways to improve our facilities and service.

The service we give is what keeps the Corps from replacing us with contract workers or shutting down the visitor centers. YOU make the difference between a memorable or mediocre experience for the visitors. Always be on the lookout for any thing you can do to help someone, even if it is small. For example:

- Xerox a page of information for a visitor from our library files.
- Offer to lock the pile of lunches for your school group in the VOB Xerox room so the kids won't have to carry them.
- If the roses at the desk or in the bathroom have wilted, cut some fresh ones.
- We have even hosed down a 500 pound pig on a hot day to keep him from overheating!

Remember that there are two types of customers here at Bonneville:

1. External customers - the visitors
2. Internal customers include anyone you work with such as: co-workers, other people on the project, people in the downtown office, contractors, etc.

People tend to forget internal customers because they focus on external customers. Remember, a happy co-worker will make it easier for you to help visitors. By the way, you are an internal customer because you are reading this training manual. Did this manual serve your needs and answer your questions? If not, we need your input so we can make it better for the next employee. Here are some ways to help your internal customers:

- We work as a team and help one another.
- We all try to do more than "our share."
- We don't discuss others unless we have something positive to say.
- We remember customers include our coworkers!
- We return phone calls, mail, and messages as soon as possible.

Here's a list of things you can do to serve our external customers:

- We greet every visitor and make them feel welcome.
- We keep the facility looking good, well equipped and in good repair.
- We take extra steps to assist visitors.
- We smile and show enthusiasm.
- We only give out accurate information.
- We find answers to questions if we do not know the answer.
- We leave people with a good impression.
- We tell both sides of an issue and let the visitors make up their minds.
- We don't argue with visitors. Even if you win, you lose.

- We keep learning and keep up-to-date.
- We behave professionally.
- We have fun and enjoy our work.

Finding Answers

As a Bonneville Volunteer, you are expected to know the answer to everything *including* things unrelated to the dam! Part of our customer service is to provide answers to those questions, no matter how weird. What do you do when you don't know the answer to a question?

You say, "I don't know, *but I can find out*."

Your next step:

- Look in brochures, binders, and info sheets we have at the desk.
- Look in the *Official Bonneville Trivia book.* There is one at each information desk and the library. This is a great way to start your information search because most answers are here.
- Ask another staff member.

Now that you've found the answer, give it to the visitor.

If you can't find the answer before the visitor leaves, and they really want an answer, offer to have the answer sent to them in the mail, or e-mailed to them. Get the pertinent information from them to do this (name, address), and pass all this on to a Sr. Staff member and we can take it from there.

People with Disabilities

This job brings you in contact with a large segment of the population. In a few months, you will meet more people with disabilities than most people do in a lifetime. Some are obvious, such as a missing limb or a person in a wheelchair. Others are invisible such as hearing impairments or people with certain mental disorders. How do you deal with these people?

First, a few basic rules:

- Despite the disability, remember that these people are "normal" just like you, with the same interests, needs, feelings, and fears. They have families, friends, hobbies, and homes just like you.
- Don't stare at or pretend to ignore the disability.
- Treat them exactly like you would to anyone else. There's no need to be extra polite or helpful just because of a disability.

- Don't be afraid of using terms such as see, look, listen, hear, walk, or hold. For example, "If you want to see the generators, walk over to the powerhouse." These words are part of everyday conversation and people with disabilities understand that.

Crippled, handicapped, handicapable, disabled... All these terms were acceptable at one time, but things keep changing. What's the latest "politically correct" way to refer to these people? "A person with a _____ impairment". For example, instead of a blind person it's: A person with a vision impairment. This terminology is used because these people are "persons" first and the disability comes second. It's a reminder of the basic rules stated above.

Here's a sampler of some types of people you may encounter:

Hearing impairments - This is the most common disability you will encounter and it is also invisible. You may not encounter many deaf visitors, but many older visitors are hearing impaired and won't tell you. That's why we offer assisted listening devices as much as possible (see The Visitor Centers chapter). When talking to someone, speak slowly and clearly, and make sure they can see your face (for lip reading). Some people may have hearing-ear dogs, which come in all sizes and shapes. These dogs are allowed in the building.

Sight impairments - Most blind people have some vision. A woman with vision impairments asked me if I could identify a tree she saw along the road. Unsuccessfully, I tried to describe a diagram in a plant ID book to her. I then handed her the book, which she held two inches from her eyes. Her question was answered! Strategies you can use: Carry objects or simple diagrams that you can pass around, emphasize touch, smell, and sound while roving, and mention hazards such as stairs as you approach them. Seeing-eye dogs are allowed in the visitor center. People with glass eyes may seem unnerving because both of their eyes are looking in different directions. When you talk to them, make eye contact with the eye that's looking at you.

Mobility impairments - This category includes walkers, strollers, wheelchairs, canes, and people that can't walk distances. Think ramps and elevators! Give directions through the facilities using accessible routes. When talking to someone in a wheelchair, squat down so you meet eye to eye. Do not touch a person's wheel chair unless you have permission. This is part of their personal space. We also have a wheelchair for people to use (You need to take their driver's license and lock it in the key box when loaning the wheelchair).

Mental impairments - These run the gamut from mental retardation to phobias. Common phobias include fear of heights (the VOB skywalk), elevators, and escalators. With mentally retarded adults, don't treat them like children. You may be surprised at their abilities!

Resources

Communications: More than Sounds - Video by the Smithsonian Institution
Interpreting for Park Visitors - By William Lewis. Read Chapter 7.

Stuff we talk about

List of stuff you are required to know
Explanations of this stuff

“Where is the Columbia River Gorge?’
Heard by fish counter: “When you hear a click, she lets a fish through.”
“Where is the nuclear part of the dam?”
“Does this dam go all the way across the river?”

List of stuff you're supposed to know about

When visitors come in the front door, they expect the person at the information desk to be a wealth of knowledge. We don't expect you to memorize it all today, but over the first few weeks you are here, become familiar with the following information. Most of this material will be covered during one-on-one or group training at the visitor center.

Corps of Engineers

- Missions of the Corps
- Missions of the Corps at Bonneville Dam
- What does the Portland District do?
- History of the Corps

Hydropower

- How this dam and others helped to develop the river and the region
- The dam's contribution during W.W.II (Shipbuilding yards and aluminum plants)
- How electricity is produced
- How we operate the dam

Navigation

- The role of our lock on the Columbia/Snake waterway
- How a lock works
- The history and strategic role of the Ft. Cascades site for trade

Recreation

- The role of the Corps in providing recreation.
- Things in the region to see and do, including routes, mileage, and freeway exits.

Resource Management

- Understand current fish issues.
- The purpose and function of the fish ladders.
- The purpose and function of the Fish Bypass System.
- Know the anadromous fish life cycle.
- Understand the fish counts and how fish are counted.
- Understand the role of barging and the spill program.
- Be able to identify fish.
- Canada Goose program
- Barrett's Penstemon program

- Ranger's ARPA inspections and VOB archaeology dig

Geology

- Climate in the gorge
- Formation of gorge

Bonneville Power Administration

- History and how it relates to dam.
- The BPA grid and reservoir control center.
- Relation of Bonneville Dam to the BPA.
- Pacific Intertie and our connection with California.

History

- Lewis and Clark
- Oregon Trail

Study Guide

This manual only provides a *brief* overview of each topic. To help you out, there is a study guide in the Appendix of this manual. Use it as a review, self-test, or to help take notes as you go along.

Since this training manual is a brief overview, at the end of each section is a list of resources you can use to learn more. These items have our "Seal of Approval", meaning that we've used them in the past and find them valuable.

U.S. Army Corps of Engineers

What is the Corps?

The U.S. Army Corps of Engineers is a branch of the Army. It is divided into two parts: military works (which builds military bases, airfields, etc.) and civil works (Dams, levees, etc.). We work for the civil works side which is civilian. Our duties include dredging rivers, building locks, and maintaining harbors which makes us sort of like the highway department for rivers. The civil works part of the Corps has 900 officers and 39,000 civilians working all over the world.

Missions of the Corps

Civil Works

- Navigation - Dredge and maintain harbors and rivers, build and operate navigation locks.
- Flood Control - Build and maintain dams and levees.
- Hydropower - Operate powerplants at our dams.

Military Programs

Build ranges, training facilities, barracks, dining halls, hospitals, workplaces, recreation centers, commissaries, and exchanges for Army and Air Force families.

Environmental Mission

We've established a permit program to regulate the deposit of dredge and fill materials in waters and wetlands. We preserve and protect wetlands and natural resources. Our projects are guided by a program called ERGO (Environmental Review Guide for Operations). It insures that our operations are in compliance with environmental regulations that regulate such things as air emissions, hazardous materials, pesticides, wastewater, and natural, cultural, and historic resources.

Work for other federal agencies

The Corps is hired by other government agencies for projects like: Sewage treatment plant construction, cleaning up hazardous and toxic waste, designing and building launch facilities for the Space Shuttle, and restoring natural water flows to the Everglades.

Other

- Recreation - Maintain campgrounds, boat ramps, swimming areas, visitor centers, etc.
- Disaster response - Assist in disasters such as floods, hurricanes, earthquakes, war damage, and volcanic eruptions.

What are the Corps missions at Bonneville Dam?

1. Hydropower - Both powerhouses
2. Navigation - Lock and navigation channels
3. Recreation - Visitor centers, fishing areas, campgrounds around the lake, and the lake itself.
4. Resource Management - Helping fish pass the dams, monitoring Canada Geese, protecting archaeological sites, protecting endangered plants.

The Portland District

What do lakes, locks, trains, whale watching, dams, and volcanoes have in common? They are all reasons visitors come to Portland District projects. What do realtors, chemists, telephone repair persons, and geologists have in common? They are just a few of the many people who work in the Portland District.

The Portland District of the Corps of Engineers is involved in dredging, hydropower production, navigation, recreation, flood control, fish and wildlife management, toxic waste cleanup, as well as disaster relief assistance in the region and around the world.

North of Portland, the Corps manages the Sediment Retention Structure on the Toutle River. This structure was built to help reduce sedimentation in the lower reaches of the Columbia River and Toutle River by allowing silt to collect behind the Dam. The Corps provided expertise and equipment to aid in the recovery of flooded homesites, farmland and impassable rivers resulting from the May 18, 1980 eruption of Mt. St. Helens. Today, visitors can picnic and observe elk and other wildlife along the interpretive trail at the retention structure.

West of Portland visitors can enjoy safe boating, fishing, clamming and other seaside activities thanks to the Corps harbor, jetty and bay maintenance work. The Coastal Harbors project stretches from Astoria, Oregon south to Brookings. Work includes maintenance on 22 jetties, 9 navigation channels, breakwaters, 12 small boat basins. Most of this work is accomplished by our expert dredging crews. The two most common types of dredging vessels used on the Portland District are hoppers and pipelines. Both use a vacuum type action and suck sediment from the navigation channel, marinas, sandbars, etc. The dredge captains and crew members are well respected throughout the nation. During the Exxon Valdez oil spill, one of our dredges pioneered a technique of vacuuming oil off the surface of the ocean. They often assist states as far away as Louisiana. We even built two of the original light houses along the coast!

South of Portland in the Willamette Valley, are several other projects. One of the most interesting is Willamette Falls Locks. Unlike the new lock at Bonneville, which is a single lift lock, the Willamette Falls Lock uses a series of 4 locks to move vessels through a total lift of 41 feet. The Willamette River is free flowing through the center of the project, allowing maximum usage of the river for both wildlife and people. There is a visitor center and viewing area for visitors to learn more about the locks.

Traveling South on I-5, visitors can enjoy lakeside recreation at one of the ten Willamette Valley lake projects operated by the Corps. Some of the campsites are managed by the U.S. Forest Service in cooperation with the Corps. Most campsites require a user fee and reservations are highly recommended.

From Portland traveling East up the Columbia are the three hydro-electric projects operated by the Portland District. Bonneville Dam and Lake Bonneville provides many recreational activities for visitors to enjoy. (There's more about this later on.)

Up river from Bonneville is The Dalles Dam. The lake behind The Dalles is called Celilo Lake. Recreational activities include: fishing, windsurfing, visitor center, fish viewing, and a neat train ride around the project. The navigation lock lifts vessels 90 feet and the 22 generators in the powerhouse put out 1.8 million kilowatts, almost double Bonneville's output. A common question asked about this area is about the traditional Native American fishing grounds called Celilo Falls. When the Dam was completed 1957, this 10,000 year old fishing area was submerged.

Upriver from The Dalles Dam is John Day Lock and Dam. The Lake behind the dam is called Lake Umatilla. Recreation activities are similar (minus the train!) to those mentioned at The Dalles. Unlike the lower two dams, John Day provides much needed irrigation to many farmers and ranchers. In addition this dam also provides flood control. The navigation lock raises ship 113 feet, making it the largest single lift lock in the free world. The 16 generators in the powerhouse put out more than double that of Bonneville at 2.16 million kW.

History of the Corps

How did we get started?

During the Revolutionary War, when Americans were making their stand against British tyranny, Congress appointed George Washington as the Commander-in-Chief of the Army they had just established. On June 14, 1775, Washington requested Congress to authorize a 65 year old ex-British Colonel by the name of Richard Gridley and a resident of Boston, Massachusetts as the new Chief of Engineers. That night at midnight, with British ships of war preparing to attack Boston Harbor, Gridley and his men built a well-designed earthwork fortification that withstood British cannon fire during the Battle of Bunker Hill the next day.

After the Revolution, the Corps was dissolved, but its engineers were continually called on to design and construct frontier fortifications. In 1794, Congress again established a Corps of Artillerists and Engineers at the request of President Washington to build fortifications along the Atlantic seaboard to protect the American coastline during a period of war in Europe. Stephen Rochefontaine was Washington's selection for a Chief Engineer, and it was he who established West Point in 1802 as a school for military engineers, which was forerunner of today's U.S. Army Military Academy. The Corps'

engineers built forts and batteries that proved themselves during the War of 1812 with Britain and none of them fell in battle.

Exploring the West

After the Lewis and Clark expedition completed their journey across the continent, the Corps was assigned the task of surveying and mapping the new territories more extensively. West Point educated topographical engineers obtained scientific and geographical data needed to open the west for settlement. One of these engineers was Captain Benjamin L.E. Bonneville, for whom Bonneville Dam is named.

Accomplishments

As the new nation moved westward, a lot of major tasks needed to be accomplished. Since the Corps was the only large engineering organization around, Congress gave the task to them. The Corps cleared snags from the Ohio and Mississippi Rivers, worked on Great Lakes harbors and lighthouses, began early road, canal and railroad surveys, and later improved and maintained the famous Cumberland Gap National Road.

The Corps accomplishments included: surveying for the Transcontinental Railroad, developing inland waterways, construction of the Washington Monument and the Library of Congress, surveying and mapping Yellowstone and the construction of the Panama Canal.

In 1927, the Engineers found themselves in a new kind of battle--the flood fight. In one of the greatest floods in American history, the Mississippi and Ohio Rivers overflowed their banks from Illinois to the Gulf of Mexico causing 200 people to lose their lives. Congress then authorized work on a 2,200 mile levee system that is still working today and has protected the lower Mississippi Valley from even greater floods than the one in 1927.

During the Great Depression the Corps was responsible for a number of water management and navigation projects that used PWA (Public Works Administration) money to build and improve American waterways, including the construction of Bonneville Dam.

During World War II, Army engineers became totally responsible for most military construction for the Armed Forces because of the many years of experience the Corps had in organizing and building projects through its civil works program. A local example was the construction of the Hanford Engineering Works.

The Corps Today

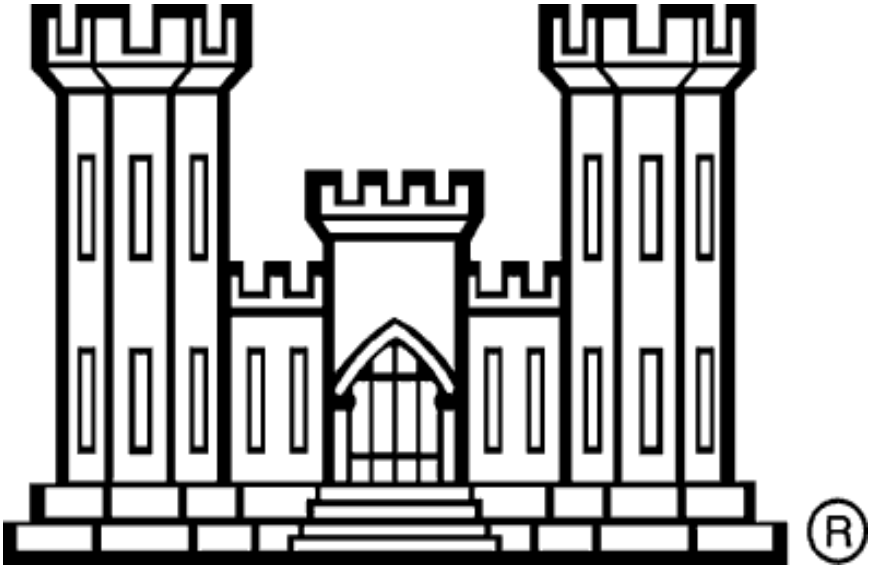
Today the Corps is the largest engineering organization in the world, and is proud of its heritage. With two roles, one military and the other in civil works, it supports our armed forces and retains responsibility for the development of our nation’s waterways and water resources.

The Corps Castle: Our Insignia

The turreted castle is a symbol of fortification and architecture, and was often used in medieval times in a coat of arms symbolizing a noble's success in breaching or defending a fortification. Our gold castle is without embellishment or decoration and was officially adopted in 1839 by General Totten, Chief of Engineers. It is said to be a rendition of the original main entrance at West Point.

Resources

History of the U.S. Army Corps of Engineers - An interesting and detailed book
Corps of Engineers - Video by Willie Allen
Public Affairs Office of the Portland District - Their job is to tell people about the Corps



Hydropower

What kind of dam is Bonneville?

Bonneville is a low head, run of the river, gravity dam:

Low head - Water falls 60 feet past our dam. In a "normal" dam, water falls 200-400 feet.

Run of the river - A "normal" dam stores water in a calm lake. As the season goes by, the water level in the lake drops until the winter rains come. At Bonneville, upstream dams store the water. Over the season, they gradually release the water to keep our lake full at all times so barges have enough deep water. Since we are always generating power, there is always water flowing in to and out of our lake. In fact, our "lake" is really more like a river.

Gravity dam - There are three types of dams: *Earth* dams are just big piles of dirt pounded into place (The SRS at Mt. St. Helens). *Arch* dams are huge, curved dams wedged into narrow canyons. As the water pushes against the dam, the arch shape transfers the pressure into the canyon walls (Hoover Dam). A *gravity* dam relies on sheer weight to hold it in place. If a section of the dam collapses for some reason, the rest of the dam would remain in place (held by gravity) as the water rushes by.

Reservoir Control Center

How does Bonneville Dam fit into the big picture? Bonneville is the first of 14 dams on the Columbia. There are also several more dams on the Snake and smaller rivers. Most of these dams are multipurpose dams which means they serve several functions. You already know the four missions at this dam. Compare that to Grand Coulee Dam which is used for irrigation, flood control, hydropower, and recreation.

Since the dams share the same river, they work together to accomplish their missions. For example, the storage dams upstream can hold back flood waters so Bonneville doesn't have to. They can release water as needed to keep our lake full so barges have deep water in the channels and at their docks. But, there's a problem with this setup. A lot of the dams are run by other agencies with their own needs and rules. What happens if the Bureau of Reclamation decides to generate a lot of power at Grand Coulee at the same time the Corps decides to shut our generators off? Grab a life jacket, because our dam can't hold that extra water!

Fortunately, we've solved this problem. The Corps runs the Reservoir Control Center located in our office in downtown Portland. We tell all the dams on the river how much water to release or how much power to generate. Our decisions are based on several factors: electrical demand, irrigation needs, stream flow, snow pack, season, navigation needs, fish passage needs, recreational needs, weather forecasts, and good old fashioned guesswork. By having one agency control the river, we can use the water more

efficiently and maybe even keep BIVC from being washed into the river because the Dalles Dam decided to produce more power!

Earthquakes and the dam

Bonneville is designed to survive incredible forces; mainly the millions of tons of pressure from the water in Lake Bonneville. The piers on the spillway have to survive the pressure from the lake and the pressure from water rushing through an open spillway gate on either side. These forces are equal to or greater than the forces from an earthquake.

What will happen? The windows will be shattered. Concrete will crack and pieces of concrete will fall off the structure. The generators might be ruined because the shafts might be moved an inch or two out of alignment if the dam shifts. The skybridge at the VOB will probably fall to the ground since it is just sitting between the two buildings. The dam would be damaged, but it is doubtful that it would collapse.

History of the dam

In 1925, Congress directed the Corps of Engineers to study the potential of the Columbia River for the following benefits: irrigation, hydropower, flood control, and navigation. In 1926, the Corps produced a document, the 308 Report, which recommended eight sites along the Columbia where dams could be built. Since there were few farms, industries, or people in the Northwest, it didn't make sense to build the dams at this time.

When the Depression hit, 80% of the lumber mills closed in the Northwest by 1932. Thousands of people were out of work. When Franklin Delano Roosevelt (FDR) came to the Northwest campaigning for election, he promised that if elected, the first federal project to be built would be a dam called Bonneville on the Columbia.

FDR was elected, and in September 1933, Federal Works Project #28 was authorized. Bonneville Dam was under construction! Thousands of people were grateful that they could work for $.50 an hour ($5 in 1996 dollars) or $1.00 an hour if you had a skill. Housing was short so workers slept in cars or on wooden shelves. The boomtown of North Bonneville sprouted up to serve the workers. So much happened during this time period that it would take pages to explain. Make sure you look at some of the resources listed at the end of this section to learn more.

When the dam was completed in 1938, it was called "The Dam of Doubt" or "Roosevelt's White Elephant". There were few customers in the Northwest who could use our power and industries weren't interested in Oregon because there wasn't a market for their products. The powerhouse had a capacity for six generators, but only two were installed because of this limited demand. Even worse, few boats traveled up the Columbia through our locks. The biggest problem was that no one could afford to build power lines to the dam. The Bonneville Power Administration (Explained later) solved

this problem by building power lines to the towns. Our first customer was Cascade Locks.

World War II

Just two years later, World War II began with the German invasion of Poland. As campaigns were tearing across Europe and Asia, the United States watched and prepared for the likelihood that it would soon be drawn into the conflict. The government approved the funds to install four more generators (Units 3-6) in Powerhouse I as part of a military-industrial buildup. Two years later we, too, were at war when the Japanese launched their attacks in the Pacific.

Bonneville Dam had a direct link to the victory of the Allied nations in the war. The Northwest was an ideal place to build new factories because of the abundance of inexpensive hydropower.

Aluminum is the main component of military aircraft, however, it requires a vast amount of electricity to make. (Consider this: PH I can produce 500 MW. The aluminum plant in Troutdale uses 250-400 MW of power!) The government built three aluminum plants near Portland, and these were leased out to aluminum companies. The plant in Troutdale was one of these plants and it even has it's own power line from our dam. Over the course of the war these plants produced enough metal to construct 50,000 warplanes. In Seattle, the Boeing Aircraft Company put the aluminum to use in their B-17 and B-29 bombers. These two aircraft types carried the bulk of the bomb loads to Japan and Germany. They bombed industries that supplied axis armies.

On the waterfronts of Portland and Vancouver were the Kaiser Shipyards that built Liberty and Victory ships. These cargo ships were assembled using electric arc welders, which sped up construction by a matter of weeks. For an extended period, Kaiser was able to launch a ship a day. These ships were put to sea carrying troops and supplies all over the world. Kaiser also received another benefit from the dam; over 1,000 Kaiser employees were men who gained experience building Bonneville Dam.

Bonneville's most unique customer was a mysterious industry located in a desolate and remote part of Washington. Hanford Engineering Works was a top secret facility creating plutonium for the world's first nuclear weapons. These weapons were as generally believed to be responsible for ending the war.

In a few short years, Bonneville Dam was overwhelmed by the demand for electricity. Our generators were running at 110% of capacity. In 1943, the powerhouse was extended by cutting away part of Bradford Island. Four additional generators were installed (Units 7-10), bringing the total to ten. A retaining wall that used to protect the shoreline is now a fin sticking out from behind the dam.

Railroad cars were in short supply, so the materials from the Northwest had to be shipped out by different means of transportation. Fortunately the recently completed Bonneville

navigation lock was ready to handle the drastic increase in river traffic. Tons of ammunition and other materials passed through our lock for the war effort.

Since Bonneville was such a prime source of power, it was given strong defenses against possible enemy attack. The dam is a large target and one that is difficult to hide, but the Army Corps approached the task in several ways. First, they painted the spillway, powerhouse, and surrounding buildings camouflage. Guard shacks called "pill boxes" (one is on display outside of BIVC) were placed throughout the project. A .50 caliber machine gun was posted inside the powerhouse, aimed at the main entrance. We also experimented with smoke screens to hide the project from bombers. The Coast Guard patrolled the river searching for enemy submarines.

The Baby Boom

After the war, industries converted to peacetime use. People bought homes and started families. New jobs brought money, so people started buying stuff...lots of stuff. Electrical demand skyrocketed. We couldn't build dams fast enough. Throughout the 50's, 60's, and 70's dams sprouted up along the Columbia (All the ones suggested in the 308 report) and Snake Rivers.

Powerhouse II

The Columbia River drains a watershed the size of France, most of which is behind Bonneville. The dam needed a huge spillway to pass water because we had no way to store it. As dams were built on the Columbia, more excess water could be stored. The idea was to store snow melt in the spring and release it during the winter to generate power. By controlling the river flow with upstream dams, we wouldn't have to waste water by dumping excess over the spillway.

A problem arose in the late 1960's. When upstream dams were generating power, Bonneville had to dump water over the spillway even when our generators were running. This was a waste of power. The solution was to build another powerhouse at Bonneville; the last federal powerhouse to be built on the Columbia.

How do you build a dam when there's no place to put it? We decided to dig a new river channel just north of the spillway where the town of North Bonneville stood. The government purchased the land at fair market value and demolished the town. The second step was to survey the area for archaeological sites. One was found (near the west tip of Cascade Island) and excavated. We found artifacts such as whiskey bottles, uniform buttons, fossils, and Indian artifacts; some of which can be seen in the FVB display area. The third step was to dig a big hole in the ground and build the powerhouse. The final step was to dig a new river channel to bring water to the powerhouse. What do you do with all the dirt you dig up? We piled it on top of Hamilton Island in a big mound.

A big problem was the town. Imagine spending a lifetime to pay off your home and as

you are enjoying your retirement, the government decides to build a dam and destroy your town. This created controversy and lawsuits, but eventually a solution was found. The Corps built a new town west of the construction site, provided interim housing for the residents until their new homes could be built, and gave residents a discounted rate for property in the new town.

Recent History

The Northwest enjoyed the cheapest electrical rates in the nation. Then in 2001 came deregulation in California, greed and a drought, which resulted in a huge jump in electricity rates. Where northwest consumers used to pay around 5 cents per kWH, now here are the current rates:

- National average: 8.87 cents per kilowatt hour (kWH)
- BPA wholesale rate: 2.95 cents per kWH
- A Portland electric bill: 8.04 cents per kWH

Every region in the U.S. gets their power from different sources. The central states and east coast generate most of their power from coal which is very expensive. Texas and California use oil, so their electricity is cheaper. Here's where our power comes from:

- Hydropower 68%
- Coal (Centralia, WA, Boardman, OR, and MT) 12%
- Nuclear (WPPSS1 at Hanford) 3%
- Imports (We buy from Canada and California) 8%
- Combustion turbines (Basically, a jet engine that burns natural gas.) 4%

Since most of Northwest power comes from hydro, the cheapest power source, our rates were the lowest in the nation.

Today

We are still paying for the higher rates that were locked in from a few years ago. The BPA must compete on the open market along with all the other utilities, so rates go up and down as the market fluctuates.

The future

We can't build any more dams, but the population keeps growing in the Northwest. How will the Bonneville Power Administration supply our energy needs in the future? They've come up with a 4-step plan that will be followed in numerical order:

1. Conservation - Saving power is equivalent to adding more generators to the system. Adding insulation to buildings and replacing inefficient equipment (Such as using fluorescent bulbs instead of incandescent) are ways to accomplish this goal.
2. Small scale energy plants - Use byproducts from industry to generate power. For

example, a sawmill can burn sawdust to generate electricity.

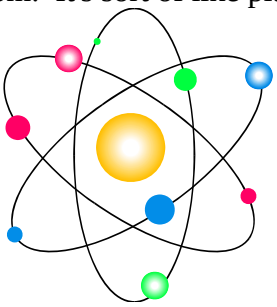
3. Alternative energy - Use solar, wind, and geothermal plants.
4. Large power plants - As a last resort, build large coal, oil, or nuclear plants.

A Historic Place

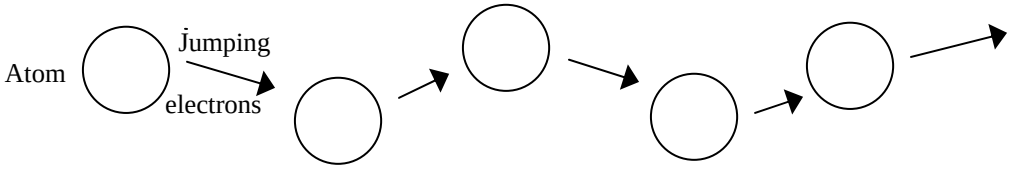
Because of its significance to the Northwest, Bonneville Dam is registered with the National Park Service as a National Historic Landmark. The areas include the spillway, old lock, Powerhouse I, Auditorium, Project Office, and the landscaping. Our job is to try to preserve these areas as much as possible so future generations can see Bonneville as it was. For example, we can't paint the project office pink, put vinyl siding on the auditorium, or tear out the rhododendrons at the project entrance. Another example is the architecture of the new lock had to fit in with the rest of the project. Notice the street lights fixtures and the "wrought iron" look of the front gate. By the way, the only part of our historic district that is open to the general public is the PH I display gallery.

Electricity

Atoms - Everything in the universe is made up of incredibly small particles called atoms. Atoms themselves are made up of three main parts: protons, neutrons, and electrons. Protons and neutrons are warm and friendly so they cuddle together in the center of the atom. This is called the nucleus. The electrons are more aloof, so they circle around the nucleus of the atom. It's sort of like planets circling the sun:



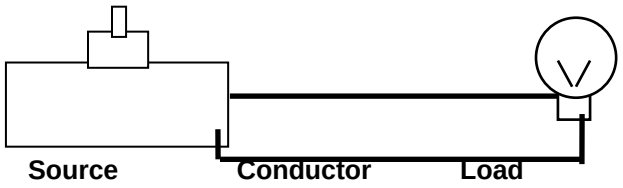
Wires are made out of atoms, just like everything else in the universe. Usually, they are made out of aluminum and copper atoms. Metal atoms are unique because the electrons can fall off easily. In fact, you can make the electrons in a wire jump from atom to atom. This flow of electrons down a wire is called electricity. Materials with "loose" electrons that can carry an electrical current (water, metal, etc.) are called CONDUCTORS.



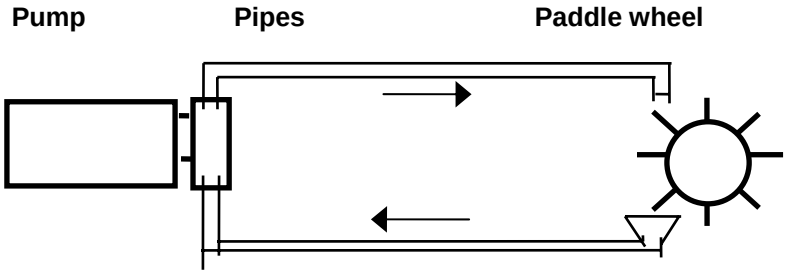
Wait! How come electricity can flow down a wire, but it can't flow through glass or wood? Aren't they made out of atoms? Well, yes, but those materials are made from

selfish, greedy atoms that hold on to their electrons tightly. The electrons can't jump from atom to atom. As a result, these materials are called INSULATORS because they block the flow of electrons.

Circuits - How does Bonneville Dam and light bulbs fit in with moving electrons? Well, you already know that a conductor is a copper wire. A generator, or SOURCE, is what gets the electrons moving down the wire. We'll explain this in more detail later. The light bulb, which uses the electricity, is called the LOAD. These three parts make up a CIRCUIT like the one illustrated:

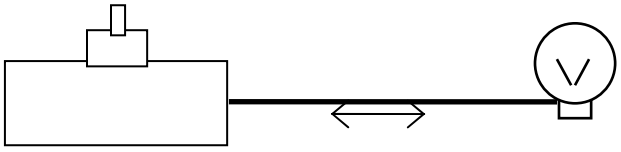


Notice the second wire going from the light bulb back to the generator. Why is it there? A circuit is like a pipe full of water. The water represents electrons, the generator is a pump, and the load is a paddle wheel. The generator pumps the water through the pipe which turns the paddle wheel. The second pipe returns the water back to the pump. Without the second pipe, the pump would soon run out of water.



So, in a circuit, the electrons are always there. All a generator does is get the electrons moving down the wire (flow of electricity). The energy of their movement is what powers the light bulb, just like the flow of water is what turns the paddlewheel. No electrons get “used” up; instead they are returned to the generator by the second wire.

Types of electricity - Electricity comes in two flavors: Direct current (DC) or Alternating current (AC). In the circuit we learned about, the electricity flowed down one wire to the load, and back to the generator in a second wire. This one-way current flow is called direct current or DC. In the circuit pictured below, the current flows to and from the generator in the same wire:



This type of electricity is alternating current because the electricity alternates direction.

DC current is mainly used in battery powered or low voltage devices such as cars, computers, radios, or flashlights. AC current is what comes out of your wall outlet. It powers vacuum cleaners, salad shooters, and anything that you plug in to the wall outlet. The power system in the United States is an AC system. The generators here at the dam and the power lines in the Northwest are all AC systems (Except for one DC power line that will be discussed later.)

Electrical terms - A lot of visitors will ask you questions about "how much" when talking about electricity. As a result you need to know a few electrical terms.

VOLTAGE - Think of this as the electrical "pressure" in a wire. Imagine two pipes of equal diameter, but one is squirting farther than the other. That pipe has higher pressure or "voltage".

AMPERAGE - Think of this as the "gallons per minute" measurement of electricity. For example, a garden hose and storm drain can be at the same pressure, but the storm drain delivers more gallons per minute because it is a larger pipe.

WATTAGE - This is the important measurement. When you multiply AMPS and VOLTS (volume x pressure) you get WATTS (total amount of power). For example, a 100 watt light bulb will put out more light than a 50 watt bulb because it uses more power. Since both of these bulbs use 120 volts, voltage won't tell you which light will be brighter. So when talking about an "amount" of electricity it's safest to use watts.

1000 watts (W) = 1 kilowatt (KW)
1000 kilowatts (KW) = 1 megawatt (MW)

Bonneville Dam produces 1,000,000,000 W or 1,000,000 KW or 1,000 MW of electricity.

Hydropower

Here's how we make electricity at Bonneville Dam:

1. The lake behind the dam is 60 feet higher than the river in front of the dam. This distance is called the HEAD of the dam. As this water falls under the force of gravity to the river, it can do work.

2. Water enters the dam from the lake through the SCROLL CASE. This is a large chamber that houses the TURBINE. The turbine looks like a giant boat propeller. The water spins the turbine blades as it rushes over the turbine blades.

Mr. Science note: We use a special type of turbine called a KAPLAN ADJUSTABLE TURBINE. While most dams use a paddle wheel type of turbine, ours looks like a propeller. The blades can swivel up or down depending on the head, making the turbine more efficient at different water levels. At Bonneville Dam, the water can fall anywhere from 50 to 70 feet depending on lake and river levels.

3. The turbine spins a SHAFT, which spins the ROTOR in the GENERATOR. (a ROtor ROtates) The rotor is a giant wheel that has powerful magnets on its outer edge. These magnets are ELECTROMAGNETS which are powerful magnets powered by electricity.

4. The rotor spins inside coils of copper wire. These are called the STATOR. (The STAtor is STAtionary) As the magnets on the rotor pass by the copper wires in the stator, electricity is produced.

Mr. Science note: How is the electricity "made" in the stator? Remember that a conductor, such as copper, has loose electrons inside of it? To make a flow of electricity, all you have to do is to get those electrons moving. A law of physics says that when you pass a magnet by a wire, electrons move down the wire. No one really understands why this happens.

5. The generator produces 13,800 volts of electricity. If this was sent down a transmission wire, the wire would heat up and the electricity would be lost. To solve this problem, we use TRANSFORMERS to transform the voltage to 230,000 volts. This way, less electricity gets burned up as it travels down the power lines.

6. The electricity travels onto power lines that cover the Northwest. When the electricity gets to a town (Goldendale, for example), the local utility sends the power through several transformers to reduce the voltage. When it reaches your home, a final transformer (usually up on a utility pole) reduces the voltage to 120 volts.

Electric power produced by dams is called HYDROELECTRIC or HYDRO power. Hydropower is clean because we do not pollute the environment. It is inexpensive because the fuel we use (water) is free. Hydropower is also good for the environment since water is renewable. As you might guess, the water flowing down the Columbia can be used again and again to generate power at a number of dams. This water remains unchanged by the power generating process. A glass of water that has gone through a powerhouse to produce electricity looks the same as a glass of water that has not.

The Bonneville Power Administration

The problem in the 1930's was not an electricity shortage. Private companies would sell power to anyone that wanted it if they built their own power lines. For small towns, that was too expensive. The Bonneville Power Administration (BPA) was established to solve this problem in 1938. (The BPA was under the Department of Interior when it was established, then was transferred to the Department of Energy, where it stands today.) They had two missions:

1. Build power lines to deliver the electricity from Bonneville and Grand Coulee Dams to towns all over the Northwest. This network of power lines is called the grid.
2. Market the power. The BPA pioneered "postage stamp" electrical rates. For example, if you mail letters to your neighbor and a friend in New York, the postage on each will be 32 cents. The BPA did the same with it's electrical rates; no matter how close or far from the dam you lived, you paid the same rates. The purpose was to encourage the distribution of power over the largest possible area.

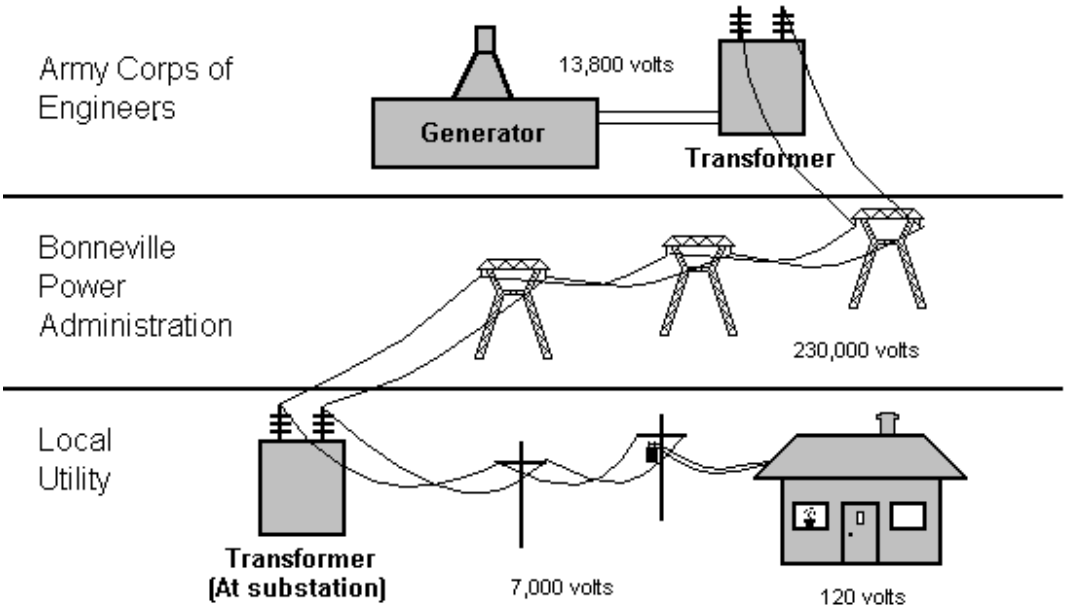
When Bonneville Dam was built, electrical rates dropped from 1½ cents to ½ cent per kilowatt hour. (Converted into 1995 dollars that's 15 cents to 5 cents per kWH) Electrical demand skyrocketed, and for the next 50 years, we couldn't build dams fast enough to meet demand.

Pacific Intertie - One solution to supplying the demand was building the Pacific Intertie to California. In the summer, electrical demand peaks in California because of air conditioning. In the winter, demand peaks in the Northwest for heating. So, in the spring, why not send our surplus power to California and in the winter, buy surplus power from them? To transfer this power, there are three power lines connecting the Northwest to California. Two of the power lines are standard AC power lines. The third is a 1,000,000 volt DC power line.

The DC power line is unique in that there are only a few in the world. It turns out that it's more efficient to use DC to transmit power long distances, and after about 400 miles it's also cheaper than AC. The hitch? You need to build an expensive converter station at each end to convert AC into DC. Our converter stations are in The Dalles (on the hill above the dam) and in Sylmar, CA (just north of Los Angeles). They use large, computer chip like devices called thyristors to convert the power.

The grid - A network of power lines is called a grid. The BPA grid basically covers Oregon, Washington, and Idaho and is controlled from the Dittmer Control Center in Vancouver, WA. People will ask you if Bonneville Dam supplies Portland. Once our power enters the power lines, it gets mixed up with the power from other power plants so we really don't know where it goes other than it is used in the Northwest. Since Portland gets 60% of its power from the BPA and Bonneville Dam is close to the city, most of our power *probably* goes to Portland. Another neat trivia item for you: The Corps gives our power away for free....to the BPA. They sell the power to utilities, and the money raised

is used to pay off the construction and maintenance of the grid and federal dams. Here's how Bonneville, the BPA and the customers fit together:



Resources

Ranger Dave: In Search of Electricity - A great video on electricity and hydropower
Waterpower in the Wilderness - Good book on the construction of the dam
Power in the Pacific NW - Detailed history of the BPA
Columbia: River of Many Returns - A video explaining how dams work together in the NW
River of Power - A video explaining the history of dam in the Northwest
Celilo, Northern Terminal of the Pacific Intertie - Book about the Intertie; sort of technical
History of Bonneville - Great side show about the building of the dam.
The Bonneville Dream - Fun, gossipy book about daily life at the dam in the 30's and 40's.

Navigation

History of navigation on the Columbia

The Columbia Gorge is the only near sea level passage through the Cascade Mountain Range. It is an ideal route because there is no snow, there are no hills to climb, and the river provides a "highway" so no roads or trails need to be built. As a result, Indians from all over the region came to the Gorge and used it as a transportation route.

In the early 1800's, Lewis and Clark paddled down this convenient passage through the mountains. In the 1840's, settlers began to travel the Oregon Trail. The trail itself ended at The Dalles. There, the settlers would chop down trees, tie the logs together to make a raft, and load their wagons on. Part of this journey to Oregon City was peaceful, as the rafts drifted past towering mountains, delicate waterfalls, and scented fir forests. However, getting through the Cascades Rapids was a harrowing ride if you dared it.

750 years ago, a massive landslide formed a 5-mile long set of rapids that stretched from what is now the town of Cascade Locks to just below our dam. These rapids created a major barrier to river traffic, ripping apart rafts, flipping canoes, and sinking boats. The best solution was to "portage" the rapids (Unload your cargo, walk around the rapids, and reload your stuff into another boat downstream).

This site was strategic, because whoever controlled the rapids controlled transportation on the river. By September of 1855, the U.S. Army had moved into the area and established three forts along the rapids to protect the only route for transportation of supplies. The largest fort was Fort Cascades, at the downstream side of the rapids. As more settlers came to the area, conflicts with the Indians rose, so the Army also had to play a peacemaker role.

The War in the Gorge

By November the Army had moved in and built a Blockhouse, posting ten soldiers and one corporal there. On March 26, 1856, the natives attacked the settlements at the Cascades. The settlers defended their land for most of the day, then evacuated on a wharf-boat and a schooner to Ft. Vancouver. The soldiers in the blockhouse were trapped, and were forced to await reinforcements. Arriving the next day, the Army sent Lt. Philip Sheridan and a contingent of soldiers from Ft. Vancouver. The natives had destroyed most of the government property and burned all the buildings. Sheridan and his men were not in a favorable position to advance on the enemy from their boat. A landing party did manage to set foot on shore and advance before meeting resistance. The battle ended up as a stalemate.

That evening, Lt. Sheridan devised his plan to bring his troops to victory. While the artillery barrage continued from the boat, the Lieutenant sent some of his men across the river to Bradford Island. In a second stage, he and the rest of his men followed. Upon their arrival, they found and captured several native women who were seeking refuge

from the battle. Finding the current too strong to paddle the boats, they towed them from the shore. Once they reached the eastern tip of the island the men climbed aboard and began their silent descent upon the enemy. They floated downstream just above the natives, and beached. Now, the advantage was theirs. They could attack the natives from a favorable position, surprising the enemy from an unknown location. Sheridan's plan was a success. They were able to rescue the blockhouse, and soon reinforcements arrived from the Dalles. By March 28, the U.S. Army had regained control of the Ft. Cascades.

By the summer of 1859, Fort Cascades finally achieved the appearance of a military post. Between 1856 and 1861 the Army had between 50 and 60 soldiers stationed there. In 1860 the Fort received it's last inspection. When the Civil War started in 1861, federal forces gradually abandoned the forts along the Columbia and headed east.

The Cascade Locks

By 1870, it was realized that navigation locks would be superior to the Military Portage Road in moving cargo past the rapids. This would save time and allow an increase in shipping from Astoria to Celilo Falls. In 1876 Congress appropriated $90,000 to begin the construction of a navigation lock near Whiskey Flats, Oregon (The town has been renamed Cascade Locks). The work moved slowly. The contract time limit ran out in 1879, but it was extended. The government soon bought the contractor's equipment, and took over construction with hired help. The work continued for 12 years. It was now 1892, and the firm Day & Day was granted a contract to finish the job. Finally on November 5, 1896, the locks were ready, 20 years after their beginning.

Nine years later, Cascade Locks passed 1,417 boats, carrying a total of 133,070 passengers. The Columbia now confirmed it's role as a highway for ships. The Cascade Locks would continue this mission until the construction of the Bonneville Dam in 1933. When the water of Bonneville Lake took its position, it flooded over the once treacherous Cascade rapids, and the Cascade Locks as well. Bonneville Dam would now be the gateway to the Columbia River.

Traffic Jam on the Columbia

As the years went by, seven dams with locks were built on the Columbia and Snake Rivers allowing passage up to Lewiston, Idaho. As cities and farms grew, so did river traffic. To stay competitive, barge operators custom built their barges so they could cram as many as possible into a lock at one time. Most of the locks on the river were 86 feet wide and 675 feet long, so the barge operators developed a tow consisting of five barges and one tug that fit snugly into this space, with only *inches* to spare!

Unfortunately, the first lock on the river, which was also the busiest, was also the smallest. Bonneville's lock was 76 feet wide and 500 feet long. As a result, a barge tow would have to be taken apart at one side of the dam, barges moved two at a time through the lock, then reassembled on the other side. This process took up to six hours and involved five lockages for the tug! With 12-15 barges passing Bonneville per day, you can imagine the traffic jams. To add to the problem, there were treacherous currents at

the upstream entrance to the lock. Barges were loosing control and crashing into the guide wall all the time.

In 1992, the new lock was completed. It's size is comparable to locks upstream, so the barge tows don't have to be disassembled before going through. Now it only takes a barge tow 20 minutes instead of six hours to pass the dam. Also, even though the new lock is bigger, a lot of water is saved because a tug doesn't have to be locked through five times to move its barges past the dam. What about sailing into the lock? The designers built a hydraulic model of the dam and studied the currents running past the new lock. During construction, parts of Bradford Island were blasted away, underwater berms were built, and a new guide wall was constructed to redirect the currents. Now the river guides barges safely in to the lock.

Our lock and the inland waterway

The river has been used for transportation for centuries. Why do we still use it now, considering that we have trains, freeways, and airplanes to ship goods? Consider a few statistics:

1. If you have one ton of cargo and one gallon of fuel, you can transport your cargo: 59 miles by truck, 202 miles by rail, and 514 miles by barge.
2. One barge tow can carry as much as 538 trucks. Think of the reduction in traffic and pollution!
3. The barge industry moves 12% of the nation's freight using 2% of the nation's fuel.

Because barges are so efficient, they are a great way to carry bulk cargo such as grain or petroleum products. But waterfalls, rapids, and seasonal water flows create problems for navigation. Dams solve this problem by flooding the rapids and waterfalls with deep, calm lakes. Navigation locks move ships and barges past the dams.

There are eight dams with locks on the lower Columbia and Snake Rivers. Their lakes and locks create a passage known as the Columbia/Snake Inland Waterway. Think of it like a highway for ships. Just like highways are paid for by gasoline taxes, barges pay a tax on the fuel they use. This money goes into the Inland Waterway Trust Fund with can be used to fund navigation improvements on rivers.

The Columbia/Snake Inland Waterway stretches 465 miles from the Pacific Ocean to Lewiston, Idaho. The depth of the channel averages from 40 feet (Ocean to Portland) to 14 feet near Lewiston. Since our lock is the first on the river, we are the busiest. 12-15 barges travel through Bonneville's lock per day. This amount of river traffic is equivalent to 8,076 trucks or 21 trains, so the river's busier than you think!

Cargoes on the Columbia - With farms and forests upstream from the dam and a major port and industries downstream, it's easy to remember which cargoes go where on the river. Barges headed upstream carry supplies such as gasoline, jet fuel, diesel, ammonia (used as fertilizer), and manufactured goods. Downstream cargoes include wheat, corn,

wood chips (used by paper mills), and rafts of logs.

Here's something to think about if you were a barge operator: If you carry wheat downstream, you now have an empty barge to haul back upstream. Why not carry another cargo to make this trip profitable? Barge companies on the Columbia have developed a double-hulled barge that can carry petroleum products in the outer hull for the upstream trip and wheat on the inner hull for the downstream trip. The barge is never empty!

How a lock works

A lock is basically an elevator for boats. It consists of these parts:

A. Upstream Doors
B. Upstream Valve
C. Diffuser
D. Water Pipes
E. Downstream Doors
F. Downstream Valve

1. The first step in locking a boat upstream is to open the DOWNSTREAM DOORS (E). The boat sails in and ties up to a FLOATING MOORING BITT. These mooring bitts are attached to large flotation tanks that travel in slots along the lock wall. If the boats didn't tie up, they would drift around in the lock as it filled. Once the boats are safely inside, the doors close.

2. Next, large TAINTER VALVES (B) open. Water will fall from the force of gravity through the water pipes (D) into the DIFFUSER (C). The diffuser is a series of concrete chambers with dozens of 3x4 foot openings in them. Because the water is forced out of several small openings, there is less turbulence in the lock when it fills. Without a diffuser, a large geyser would appear when the upstream valves were opened and small boats might be capsized.

3. As the water rises in the lock, the floating mooring bitts rise with the boats attached.

4. Once the lock is filled, the UPSTREAM DOORS (A) open, and the boat sails out.

To lock a boat downstream, the procedure is reversed. After the boat sails in and ties up, the downstream valves (F) open and water drains out of the lock into the river.

Resources

Waterpower in the Wilderness - Good book on the construction of the dam
Videos and exhibits at the navigation lock - How the lock works and history
Sagebrush Sailors - Video on history of tug operators on the Columbia.
Ft. Cascades brochure - Information on the Ft. Cascades site.

Recreation

Role of the Corps in Recreation

Near the headwaters of the Russian River in California, the Corps built Mendocino Dam to control floods. The climate is hot and the lake is inviting. This puddle of a lake is surrounded on three sides by several campgrounds, day use areas, concession stands, two boat ramps, and a swimming area all operated and maintained by Corps rangers. This area is used for camping, swimming, fishing, water skiing, sunbathing, Frisbee throwing, hiking, hunting, and many other activities.

A wonderful side effect of building a dam is that it creates incredible recreation opportunities. Lake Mendocino is a typical example of a Corps lake: The dam is forgotten, the visitor center is ten by ten feet square, the day use areas are HUGE, and the campgrounds are well maintained (they even have free showers!). For those that love the outdoors, Corps projects are a wonderful place to recreate. As you can see, Bonneville is very unusual for a Corps project in that our visitor centers and dam are the main attractions.

How many people come to our projects? In 2004, 358 million people used Corps facilities nationwide! That's second only to the Forest Service. Another factor to consider is money. When people visit Bonneville Dam or our recreation areas, they buy chips, gas, beer, food, and other items from local stores. This money adds up when you consider three million people visit each year. Our research shows that each person visiting our recreation areas, on the average, spends $90 in the local economy!

As you can see, recreation is a major industry. Also, consider the fact that after W.W.II, Americans started having more leisure time. 80% of our projects are within a one hour drive from metropolitan areas so they are ideally located for recreation. That is why the Corps takes recreation seriously and has hired Park Rangers. Our jobs are to maintain campgrounds and boat ramps, patrol lakes, promote water safety, provide security, empty garbage, collect fees, give interpretive programs, and develop recreation programs.

Recreation at Bonneville

There are a variety of recreation opportunities at Bonneville Lock and Dam. People visit the project and pool to recreate in different ways. Some only come to see the fish in our underwater windows. Some only come to take advantage of our fishing access. Still others never grace the entryway to the project and go straight to the windsurfing access points on our pool (some consider our lake to be the best in the world for windsurfing). But for whatever reason they come, they do come, and we need to provide them with a safe and clean place to recreate in, whether it be in the visitor buildings, or on the tip of Bradford Island. In addition to visitor facilities and fish and windsurfing access, we also provide a boat ramp, a picnic shelter, and a beautiful, historical hiking trail.

The public can reserve and use the picnic shelter and parts of the Auditorium for group gatherings. This is done through the resource ranger office and for a fee.

Not only do we supply recreation ourselves, but there are other agencies in the gorge that do to. We give out information about those recreation areas as well. Be prepared to answer questions about camping, hiking and fishing throughout the gorge. By the way, we do not sell fishing licenses here. Most sporting goods stores do.

Local attractions

What's there to do in this part of the Gorge? A lot. Here is a list of local attractions:

- Columbia Gorge Interpretive Center - Stevenson - Good museum about the Gorge.
- Beacon Rock - N. Bonneville - Steep 1-mile trail to the top. Good views.
- Cascade Locks - Food, gas, stores, and the park near the old locks has a visitor center and small history museum.
- Scenic Highway - Exit 35 off I-84 - Eight waterfalls including Multnomah Falls, Crown Point, and lots of hiking trails.
- Eagle Creek trail - Exit 41 off I-84 - Popular hiking trail. Hike two miles one-way and see Punch Bowl Falls, 3 miles up is High Bridge, and 7 miles up is Tunnel Falls.
- Wahclella Falls - Exit 40 off I-84 - Stunning 2 mile loop hike includes a waterfall and lava tube.
- Historic Highway State Trail – Exit 40 off I-84 – Four mile walk to Cascade Locks along paved old scenic highway. Only accessible to foot traffic and bikes.
- Bonneville Fish Hatchery and Ft. Cascades Trail - Don't forget the stuff on our project!
- The Pacific Crest Trail crosses the Bridge of the Gods. There is an equestrian access trail head across the highway from the VOB.

Other attractions a little farther away include: Mt. St. Helens, Maryhill Museum and Stonehenge, The Discovery Center in The Dalles, Mt. Hood Loop, and a variety of things in Portland.

Resources

Project brochure - Shows all fishing areas we manage.
State fishing regulation brochure (At the information desk) Get familiar with it!!
Forest Service maps of the Gorge, Mt. Hood and Gifford Pinchot National Forests.
Campground listings in the black binder at each information desk.

Resource management

Fish

Know your fish issues! The declining salmon runs make for a hot topic in the news. Visitors are always asking questions about this issue; some are hostile and others are concerned. There is the perception that the dams are responsible for the salmon decline and the Corps has done nothing to help. How do you deal with this issue?

- Give out accurate information - Know the issues! So much new information comes out that you need to constantly keep up on your knowledge.
- Tell the truth - Dams DO kill fish. We are a part of the problem! But also...
- Reveal the complete picture - Dams kill fish, so the Corps is working hard to find solutions. Explain our successes and our failures. The important message is not that we have the answer to the problems (no one has) but we are working hard on solutions.

Identifying fish

Seven types of fish pass our fish ladders. Look at our exhibits and read the *Fish Identification Booklet* to get the information you need to fill out the following sections.

Chinook

Identifying features:

When their migration peaks: APR MAY JUN JUL AUG SEP OCT

Interesting facts about this fish:

Coho

Identifying features:

When their migration peaks: APR MAY JUN JUL AUG SEP OCT

Interesting facts about this fish:

Steelhead

Identifying features:

When their migration peaks: APR MAY JUN JUL AUG SEP OCT

Interesting facts about this fish:

Sockeye

Identifying features:

When their migration peaks: APR MAY JUN JUL AUG SEP OCT

Interesting facts about this fish:

Shad

Identifying features:

When their migration peaks: APR MAY JUN JUL AUG SEP OCT

Interesting facts about this fish:

Lamprey

Identifying features:

When their migration peaks: APR MAY JUN JUL AUG SEP OCT

Interesting facts about this fish:

Sturgeon

Identifying features:

When their migration peaks: Sturgeon don't have a "run". The ones behind the dam usually just stay there. The ones downstream can migrate to the ocean.

Interesting facts about this fish:

Northern Pikeminnow (used to be called Squawfish)

Identifying features:

When their migration peaks: Northern Pikeminnow don't migrate. So there!

Interesting facts about this fish:
- The term "Squaw" is offensive to Indians, so consider using the term Northern Pikeminnow

The life cycle of the salmon

Most people know about the famous salmon migration. This amazing journey fills you with awe as these majestic creatures surpass incredible obstacles to reach their spawning grounds. Or, as one visitor put it, "If you could only have sex once in your life, isn't it worth the effort?"

With the exception of the Northern Pikeminnow and Sturgeon trapped behind the dam, all the fish listed in the last section migrate from salt water to fresh water to lay their eggs. The scientific term for these type of fish is anadromous (an-ADD-dro-mus). Let's take a closer look at their life cycle:

1. Anadromous fish lay their eggs in the gravel of clear, shallow streams that feed the Columbia (Except for shad and sturgeon which lay their eggs in the Columbia). The gravel protects the eggs from predators and the water brings oxygen and carries away waste products.

2. After 2-3 months pass, the eggs hatch and the alevins (fish with yolk sacs attached) swim to protected areas in the stream to feed. When the yolk sacs are absorbed, these fish are known as fry. (Lamprey will swim downstream to where the bottom's muddy. They will spend the next six years in the mud, eating algae before migrating to the ocean.)

3. About 6-8 months later, summer has arrived and the snow is melting off the Cascades. This surge of water washes the young fish, called smolts or fingerlings, down to the ocean. The fingerlings travel at night to avoid predators. As they travel, they undergo smoltification; a process where their body chemistry changes to adapt to salt water.

4. Once in the ocean, the fingerlings eat...and eat...and eat. The reason why these fish evolved such a complex life cycle is that there is more food in the ocean. Salmon will eat anything that's smaller then they are such as plankton or smaller fish. In 3-5 years, a

Chinook salmon may grow from a 3-inch fingerling to a 4 foot long adult! Lamprey are parasites that only spend a year in the ocean. They feed by attaching to other fish with their sucker mouth and sucking body fluids.

5. Once they have grown, the fish will enter the Columbia and swim to their home stream. How do they find their way back? To find their way upstream, all a fish has to do is swim against the current. To find their home stream, all they have to do is smell the water. Each stream has a unique geology and vegetation that imparts a chemical "odor" to the water that the fish can detect. To get past rapids and waterfalls, salmon can jump up to 10 feet. Lamprey attach to rocks with their sucker mouths and jerk their bodies to climb waterfalls.

6. Once at home, the fish will dig a nest, called a redd, in the gravel. After the female releases eggs and the male releases milt, they cover the nest with gravel. Shad and sturgeon, which spawn in the Columbia, just spray their eggs out and let them sink to the bottom (This is called broadcast spawning). After spawning, the fish die. Their bodies provide food for other animals and nutrients for the streams. The exceptions to this are Steelhead, Shad, and Sturgeon, which can spawn many times.

Fish issues

Pick up any Northwest newspaper, and you will probably see an article about the declining salmon. Over the last 150 years, the salmon population has been declining as more people and cities appear in the area. If nothing is done, the salmon could become extinct.

Fish issues will be a challenging topic for you to discuss for several reasons:

- This is a politically charged subject. People have strong opinions, some have their lifestyle at stake (Indians, fishermen), and some people are looking to blame others (especially the Corps) for the problems.
- Biologists don't fully understand the salmon ecological system. Many complex factors need to be researched, such as studying the effects of a farmer in Idaho turning on an irrigation pump to a fisherman off the coast of Japan. As a result, the biologists can't offer all the answers or solutions to the problem.
- Dams do kill fish, which puts the Corps in a bind. People are demanding that we solve the problems, but it's difficult for biologists to come up with solutions guaranteed to work. As a result, the solutions we have implemented at the dams are controversial.

In the early 1800's, before the settlers arrived, there were lots of salmon in the Columbia River. Back then, we had no fish counters so we can only make educated guesses at the fish populations. The estimates range from 7-18 million fish traveling up the river each year.

The problems started when settlers built canneries and started harvesting the fish. Salmon were pulled from the river in such huge numbers, that by 1883 there was evidence that the runs were starting to shrink. In the early 1900's the concern became great enough that hatcheries were built to supplement the fish runs. A good example was the Bonneville Hatchery, built in 1909. Another problem were fish wheels. These giant wheels, powered

by the river's current literally scooped the fish out of the water. They were so efficient that they were outlawed on the river by the 1930's. The overfishing was so great that by 1928, the fall run of the Chinook Salmon was greater than the once large spring and summer runs. Most of the fish were gone.

The impacts continued with dams, growth of cities, farming, logging, and other factors. In the last ten years, the fish count has averaged about 1 to 1.5 million fish per year. Even worse, over 60-80% of those fish are hatchery fish. One problem with hatchery fish is that they have less genetic variety than natural fish. Genetic variety helps a fish population cope with natural disasters in the environment such as climate changes or diseases. Hundreds of fish runs are already extinct and many are close to extinction.

What's causing the problems?

- Dams - Dams flood out spawning grounds, turbines kill fish, and lakes are great habitats for predators. Dams without ladders destroy all salmon populations upstream (50% of the Columbia Basin salmon habitat has been destroyed from this.), and dams slow river flow (Salmon rely on spring floods to wash them to the ocean. If they are slowed down, they may still be in fresh water as their bodies convert to salt water life; a fatal problem.)
- Overfishing - There are thousands of fishing vessels from all over the world plying the Pacific. Some have nets that are miles long and factory ships can process hundreds of tons of fish.
- Irrigation - Fingerlings get sucked into irrigation pumps, irrigation reduces water flows for fish, pumps can cause small streams to flow backwards, confusing fingerlings, and some fish spawn in irrigation ditches which dry up later.
- Logging - Soil erodes off of hillsides, silting up spawning beds. Removing protective shade trees along streams hurts fingerlings.
- Chemicals - Fertilizers, pesticides, fire retardants, herbicides, and oil wash off of farms, streets, and forests into streams. Also effluent from industries pours into rivers.
- Ranching - Cows trample eggs in streams and stir up silt which smothers eggs.
- Natural causes - Floods, fires, droughts, and El Niño's take their toll on fish. (El Niño's are wacky changes in ocean currents which affect weather all over the world. When the currents change, the salmon food supply is reduced off the coast.)

As you can see, there are many factors impacting fish. The good news is that the people involved are doing things to help. For example, when loggers clear cut, they leave a 300 foot band of trees between the cut and streams. Eroded soil is trapped by this buffer zone, and the trees shade the streams. Ranchers put up fences to keep cows out of streams. What are we doing at Bonneville to minimize our impacts on the fish?

Salmon passage systems at Bonneville

Getting fish upstream - If you were on the first floor of a six story building, how would you get to the top? You'd probably take the stairs or an elevator. Adult salmon returning to spawn need to climb six stories to get past the dam. Like you, they can take the stairs or the elevators!

Fish Elevators - No one had ever built a fish passage system for a dam as large as Bonneville. Fish biologists argued whether fish ladders or a new technology, fish elevators, would work. The Corps decided to install both at Bonneville. Unfortunately, the fish elevators didn't work so we stopped using them (Apparently, only the sturgeon seemed to use them.)

A fish elevator (a.k.a. - fish lock or fish lift) worked like a navigation lock. A door would open and fish would swim into a chamber. Then the door closes, the chamber fills with water, and the fish swim out the top. To encourage the fish to enter the elevator, "attraction" water was released through holes the bottom of the chamber. To encourage the fish to exit, a screen was raised to shove fish out. There is a diagram of a fish elevator on BIVC4. There are six fish elevators on the project (Pairs on each end of the spillway and on the south end of PH I).

Fish ladders - Fish ladders are basically a stairway for fish and are very effective at helping adult salmon pass the dam. They consist of five parts:

1. Collection channel - Salmon swim against the strongest current to find their way upstream. How can they find the fish ladder when its puny flow is overwhelmed by the turbine outflow? Well, they don't! The salmon head straight towards the turbine outlets. Since this flow is very strong, salmon swim just above it to save energy. As a result, they swim through a slot into a fish collection channel located right above the turbine outlets. Once inside, they are protected from the turbine flow and head straight towards the ladders.

2. Stairway section - This section is a quarter-mile long and consists of 60 pools each one foot higher than the next. It's designed to simulate a set of rapids. The purpose of the walls (weirs) is to slow the water down and create resting pools for the fish. Visitors expect to see salmon jump but the fish would rather swim from pool through two foot openings (orifices) cut through the weirs.

3. Resting pool - At the top of the ladder is a resting pool. A fence in this pool guides all the fish into the counting station.

4. Counting station - This narrow slot forces the fish up against the fish counting window where dedicated people count fish for research purposes. The far wall of this slot consists of a moveable wall, called a crowder, which can be moved closer when the water is cloudy making it easier to see fish. Fish counters work from March to November, 8 hours a day, and get a ten minute break each hour. (The counters multiply the number of fish that passed during the last hour by a numerical factor to account for any fish they miss during their break.) Why do we use people? A machine isn't sophisticated enough to gather the information we need. A counter has to record: The type of fish, the size, whether it's a hatchery fish or not, claw marks, bite marks, missing scales, fungus, brands, tags, and net marks. (No wonder they need the breaks!) We've been counting since 1938.

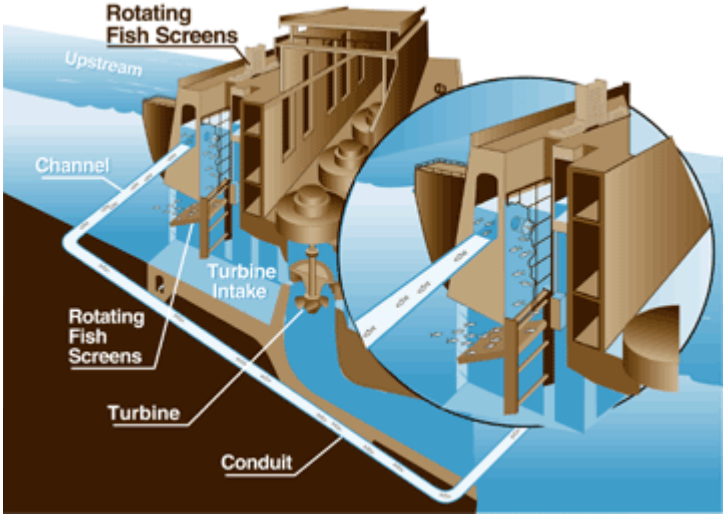
5. Flow control section - The water level in the lake varies from hour to hour. The fish ladder needs a constant flow. If we didn't do anything to compensate for the lake levels, the

ladder could run dry or turn into a water slide. The flow control section has a series of valves that automatically adjust how much water enters the ladders. The result is a constant flow of water over the weirs. Fish need to swim through this section and if the lake level is high, they might have to climb an additional few feet. To slow the water down and create resting areas, this part of the ladder zig-zags. This is where the visitor viewing windows are located. In 2005 and 2006 PIT tag (Passive Integrated Transponder) detectors were installed in this section of both the Washington and Oregon fish ladders. PIT tags are inserted into the abdominal cavity of some fingerlings in hatcheries before they are released. What a PIT tag does is act like a bar code on the fish. When it is detected, it's like scanning an item at the grocery store, so we can get the information from the PIT tag, without handling the fish. Using this information, we can track the fish as fingerlings going downstream, and now also going back upstream. Eventually, all fish ladders will have PIT tag detectors.

Getting fish downstream

Fingerlings ride the river's current down to the ocean. Since much of the water that passes the dam goes through our turbines, many fingerlings have to face the turbine. Studies done in the 1930's indicated that turbines wouldn't harm fingerlings, so not much was done. We installed "mini" fish ladders that had a several foot drop between each step to pass fingerlings by the powerhouse. They didn't work that well.

In the 1970's, we discovered that 5 - 15% of the fingerlings were being killed passing through the turbines. The fish weren't getting chopped up (The fish can pass between the blades). Instead, they were being killed by pressures called cavitation; fish in front of the blade get crushed and fish behind the blade explode. 15% may not seem like a lot, but consider that many fish getting killed as they pass 8 dams! It adds up.



Fingerling Bypass System
To solve this problem, we installed fish screens. These are large screens that are lowered into the turbine intakes. Screens block the upper 1/3 of the intake. Extended screen prototypes cover the upper ½ of the intake. The screens rotate to keep debris from building up and the motion helps to guide fish. As fingerlings enter the intakes, they sense the

screens with their lateral lines and swim upwards. As they travel up, they see floodlights and instinctively swim towards them. The floodlights attract fish to an orifice, which sucks the fish into a pipe. The pipe leads around the dam and originally dumped the fish just downstream from the powerhouse. But there were problems. Some fish swam under the screens into the turbines, and predators, such as gulls and Northern Pikeminnow, ate fingerlings as they shot out of the bypass pipe dazed and confused. Some fingerlings at PH II were not swimming down to the screens, so we installed turbine intake extensions (TIE's) to break up the water flow, guiding the fish down. Special computer controllers run the turbines in such a way to minimize salmon mortality (A side effect of this is that it increases generator efficiency!).

New Tunnel and Outfall

In 1999, we completed a 2-mile tunnel down the Washington shore to carry fingerlings from the 2nd Powerhouse fingerling bypass system to a safer release site downstream. A juvenile monitoring facility was completed in March 2000 to study fish conditions and survival. The tunnel and new exit (outfall) releases fingerlings into the fast moving current downstream from the project, reducing the number of fish getting nabbed by predators. Because of the turbine improvements being done on PH1 (see information below), PH1 will not be tied into the tunnel and outfall. Fingerling survival is higher through the new turbines than through the fingerling bypass system at PH1.

PH1 Turbine Improvements

Under the ongoing Bonneville Major Rehabilitation project, six generators are being rebuilt and 10 sets of turbine runners will be replaced. When all of the turbines and generators at the First Powerhouse are completely rehabilitated, power generation will be increased enough to provide electricity for nearly 16,000 more homes in an average year. (That's about an 8% increase in efficiency). The new turbines, called Minimum Gap Runners (MGR), also increase the survival of fingerlings passing through them (average of 96% survival). These new runners minimize or eliminate the gaps that occur between the runner blades and the runner hub, and between the blades and the discharge ring (outer casing around the turbine). Fish can get caught in these gaps and be killed or injured. In the minimum gap runner, the blades are longer and fit into milled notches in the hub, eliminating gaps at those points. In addition, a more nearly spherical-shaped discharge ring would further reduce gaps at the periphery of the blades.

Turbine Minimum Gap Runner (MGR) Tests

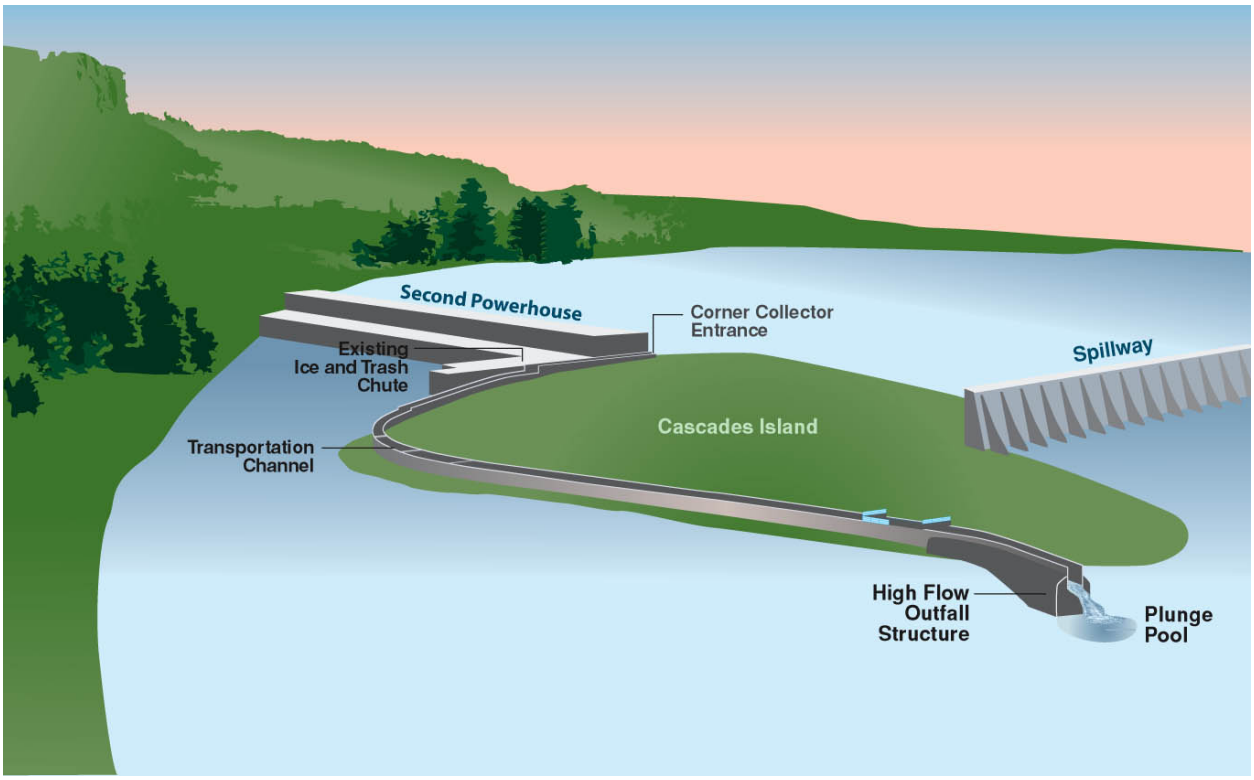
Quality assurance/quality control tests were conducted in 1999 on the first unit modified with an MGR (unit 6) and an existing turbine (unit 5). Also in 1999, biologists released juvenile salmon at different locations in both turbines so fish could pass through both turbines at specific spots – the hub gap, the tip gap and at mid-blade. The turbines also were operated at different power outputs and efficiency levels, to determine which operating conditions are better for fish passage.

Test results show injury rates were low for both units at Bonneville, with the MGR showing about one-half the injury rate of a traditional turbine, plus a better survival rate. At the turbine hub, survival rates are between 97 and 100 % in both the MGR and traditional turbines. At mid-blade, there was from 95 – 97% survival in both turbines. The most

significant difference was at the blade tip. The survival rate was 90.8 – 95.6% from the traditional turbine, compared to 93.8 - 97.5% through the MGR. The biological tests strongly show that survival rates are "release point sensitive". The tests are specific to Bonneville Dam and are not an accurate indication of possible survival at other Columbia-Snake River dams.

PHII Corner Collector

The latest improvement for juvenile salmon passage at Bonneville Dam is the PHII Corner Collector. "What's that?", you ask? Well, let's start at the beginning. Our fisheries biologists discovered that 40% of the juvenile salmon going downstream at PHII were traveling through the ice and trash chute. This is a channel of water that travels from the north to the south along the upstream face of the powerhouse, then loops around the south end of the building and dumps into the tailrace (downstream side of the powerhouse). That dump into the tailrace wasn't too good for the young fish, so we have modified the ice and trash chute into a surface flow bypass system, or corner collector. The new corner collector guides 50-60% of the juvenile salmon around PHII and send them out a safer 500 foot long outfall channel below the powerhouse. Fish travel at 50 ft/sec. or about 34 miles/hr. Studies have shown the survival rate is 97%! There is also an antenna in the flume that reads PIT tagged fish every 1/3 of a second.



Barging

Another solution we've come up with to get fish around turbines is barging. Fingerlings are

collected at McNary dam, placed on barges or trucks, transported past the next three dams, and dumped into the river just west of Bonneville. At the north end of PH I, at the Bradford Island Fishing Area, you will see a pipe dumping water into the river. That's where the trucks release their fingerlings here at the dam. The Corps believes this program is effective. There are problems with diseases and stress because the fish are being handled so much.

Spill program

Because juvenile fish survival is high through and around the powerhouses at Bonneville Dam, we are not using the spill program very much.

However, in the spring and summer months, other dams on the Columbia open their spillway gates to help move fingerlings. There are two benefits to this:

1. Salmon mortality through the spillway is only 2%. If we dump enough water, the fingerlings will be drawn away from the powerhouses and travel through the spillway.
2. Dams have stopped the spring floods. We store this extra water to generate power the next winter. Salmon need the spring floods to get them to the ocean before their bodies change to salt water life. By opening the spillways, we create an artificial spring "flood" which moves water faster through our lakes.

The good news is that the spill program seems to work. From April through August, spillway gates dump about 75,000 cubic feet per second (cfs) during the day and 120,000 cfs at night.

But, there are problems. By spilling water, we increase the level of nitrogen gas dissolved in the river. This nitrogen gets into the bloodstream of the fish, and as they go through the next spillway, pressure changes cause this nitrogen to bubble out (like opening a can of pop). This disease, nitrogen gas bubble disease, is similar to the bends that divers get. It's fatal to salmon. Fortunately, we can monitor nitrogen levels in the lakes and adjust the spillway flow accordingly to reduce this problem. The other problem is that the more water we dump over the spillways, the less power we can generate the next winter. This raises electrical rates.

Lamprey fish ladder bypass

Fisheries biologists found that up to 20% of lamprey moving up the Bradford Island fish ladder were moving into the auxillary water channel. This channel runs parallel to the flow control section and has no direct exit to the fore bay (area above the dam). These fish would have to return to the ladder or climb up a vertical wall to pass the dam. A bypass structure was designed and built in 2004 that allows the lamprey an escape route out of the auxillary water channel and back into the river above the fish ladder. This will increase the number of lamprey passing the dam and should help increase the survival of lamprey migrating up the Columbia River.

Lamprey also have a hard time entering the fish ladders. Researchers built and installed a prototype entrance collector at a main entrance to the Washington shore fish ladder in 2005. More testing will be done in 2006/07 to see how well it works.

Sea Lion Predation at Bonneville Dam

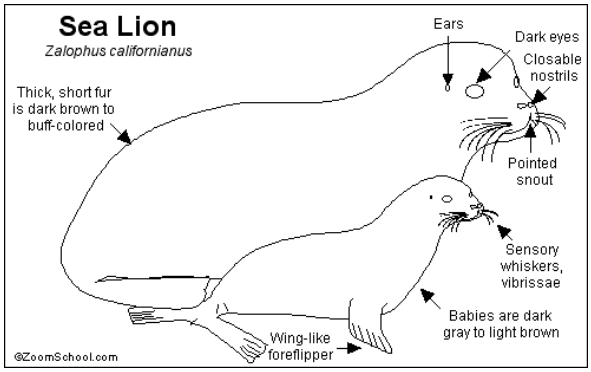
Sea lions and seals (also known as pinnipeds) have historically fed on spring run salmon on the Columbia, but because the spring runs have been low over the last 50 years, there were not many showing up here. That all changed in 2001, when we had a record breaking spring run of salmon. Sea lions are smart creatures, so when they saw the salmon swim by out at the coast, about 6 of them (California sea lions) followed them on up the river to Bonneville. They stayed here through late May and then returned to Southern California to mate. They also shared stories of how great the food supply was here at Bonneville, because the next year, 2002, we had 30 California sea lions show up along with 1 harbor seal. In 2003, numbers went up again. 106 California sea lions, 3 Stellar sea lions and 2 harbor seals feasted on salmon, steelhead, lamprey and sturgeon. In 2004, numbers dropped slightly, but they stayed longer. This trend continued in 2005 and 2006.

Remember how sea lions are smart? By 2004, they figured out where the entrances to the fish ladders were. In 2005, some of them were swimming all the way up the ladder to the fish viewing windows!! We had to put a stop to that, so by 2006, we (the Corps) had developed SLEDs (Sea Lion Exclusion Devices), which look like giant jail bars. This device is lowered into the entrance of the fish ladder to block the sea lions from getting in, but allows the salmon to swim in.

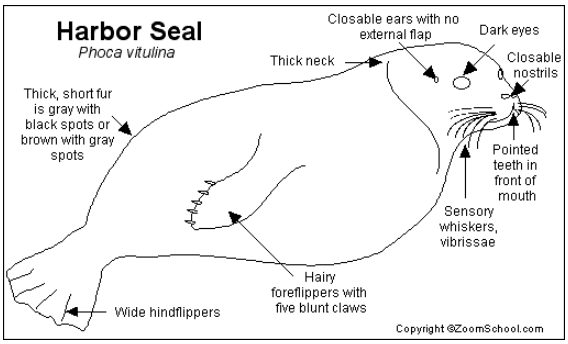
We are taking active measures to keep the pinnipeds from eating salmon. We shoot them with rubber bullets, shoot off pyrotechnics near them, and use loud sounds under water. None of this has made a whole lot of difference in their feeding activity, but we will continue with the hazing anyway.

Why can't we just get rid of them? They are protected under the Marine Mammal Protection Act. Oregon and Washington legislators are working at getting special permission to kill specific sea lions that do the most eating. The process for this will take a couple years, so we shall see what the future holds.

California sea lion: California sea lions are playful, smart, and graceful in the water. The trained "seals" in zoos and aquariums are often California sea lions because they are intelligent, agile and easy to train. Adult males may be up to 8 feet long and 1,000 pounds. California sea lion females are blond to dark brown. Females may be over 5 feet long and weight up to 220 pounds. California sea lion males bark like a dog to communicate with other males and females. Males also have a thick furry mane around the neck.



Stellar sea lion: Mature cows are identifiable by their size and long slender shape. They average about eight or nine feet in length and weigh from six to seven hundred pounds. The bulls are much larger and have massive shoulders. They average twelve feet in length and weigh around 1500 pounds. Many extremely large bulls have been known to weigh well over a ton. The average life span of these animals is believed to be about 20 years. The mature bull has longer hair resembling a mane around his neck.



Harbor Seal: The Harbor Seal has short, thick fur, grows to be up to 6.5 feet (2 m) long and can weigh up to 375 pounds (170 kg).

Canada Goose program

Ah-honk! Ah-honk! These large black and white birds seem to be everywhere on the project, giving you nasty looks if you get too close. This area is a major nesting and brooding place for Canada Geese. When we built the dam, a lot of goose habitat was lost. Our resource management goal is to maintain goose populations at their original levels.

The life of a goose - Geese migrate north to Bonneville in March and start building nests, usually in flat, brushy areas or on islands. After a month of incubation, the eggs hatch in late April. The next stage is called brooding, where the flightless goslings feed until they are strong enough to migrate. Geese look for areas with a lot of fresh, green sprouts to feed on, which means they are attracted to the lawns at the dam. We have set aside several brooding areas for geese, which we call "goose pasture". Some of the areas are: Cascades Island, Robins Island, south of the service center, and the lawns to the west of the VOB. In the spring, you might see a gaggle of goslings waddling through the pastures.

What we do to help geese - The dam has destroyed nesting and brooding areas and has created other hazards. Here's how we try to solve those problems:

- We build nesting boxes to protect geese from predators.
- We fertilize, mow, and plant pastures with clover and rye grass. The rye provides nutritious food, the clover enriches the soil, and the mowing encourages fresh sprouts for the geese to feed on.
- We survey goose populations at the dam and on the lake every spring.
- We build and maintain Goose ramps. When goslings walk from the pastures to the rivers, they often have to walk through the rip-rap on the shoreline. When they do, they fall in between the rocks and become trapped. By dumping gravel on the rip rap, we fill in the holes and provide a safe path for the goslings.

Barrett's Penstemon

The Barrett's Penstemon is a rare plant found mostly in a narrow 5-mile strip between Hood River and Mosier (And the equivalent area on the Washington side of the river). This low-elevation plant likes rocky, exposed cliffs with poor, gravely soil. In May, this gray-green shrub sprouts tubular, rose-color flowers that last two to three weeks.

So, what's the big deal with this plant? It's a rare plant found no where else in the world and it's a candidate for the Endangered Species Act. When we were building the new lock, we discovered several Barrett's Penstemon growing here. It was a significant discovery because it was thought that these plants only grew 25 miles to the east in a different climate zone. The Corps wasn't required to protect the plant, but due to a letter a woman wrote to the Colonel, we decided to take action.

The Corps pioneered a new conservation technique. Botanists from the Berry Botanical Gardens in Portland used cherry pickers (That's the small crane with a bucket that utility trucks use) to gather cuttings and seeds from the plants growing on the cliffs in the construction area. While the botanical gardens were growing their samples, we started building the lock, which destroyed the existing plants. Starting in 1994 and continuing for the next eight years, the botanists are replanting the cliff faces near the lock using the samples they propagated. This technique is unique in that most conservation involves moving the construction site, not the plants.

Protecting historical sites

ARPA. More acronyms for you to remember! This one is easy and universal within the Government and private industry. It stands for Archaeological Resource Protection Act. So what do you need to know about it and why should you care? Great questions, thanks for asking!

As a Park Ranger working in the visitor center you will not be concerned with the legal mumbo jumbo of 32 CFR part 229. Leave that to the outdoor rangers who complete monthly visual inspections of protected traditional, historical, and significant sites within the boundaries of Lake Bonneville. What may be important to you is how and why we have Native American artifacts and historic items on display at our visitor centers.

As you wonder through the display area in the FVB notice the archaeological dig display, the items found and the emphasis expressed for the Native American culture. Without resource protection and investigations prior to construction of PH II these items would have been destroyed. The Act has only been in effect since 1979. Prior to that, not much was done to protect or recover artifacts. Note in the early history of PH I that archaeological surveys and protection was not a priority. Our focus was to build, not to protect!

Many of the items we have on display were recovered during the dig prior to PH II, some were donated by generous citizens, other items are on loan from well-known museums.

When was the last time you walked through the display area and actually read the signs? Who donated the old pair of glasses? Why are there low pits in the dig display? How many fish wheels were on the Columbia? Bonneville Dam and the surrounding area have a rich history, so we are much more than a producer of electricity! Take a walk through Ft. Cascades, read the two brochures, *Preserving Our Cultural Heritage* and the *Ft. Cascade Trail* to learn more.

The last thing you probably should know about ARPA is that it is illegal for anyone to dig, use a metal detector, probe, pick up, or disturb in any way federally protected sites. States and Counties have their own protection laws. If you are visiting any Federal, State, or County Park or National Forest and suspect unlawful acts of any nature, do what our visitors do -- Contact a Park Ranger or other authority. Don't take the law into your hands. Some artifacts are worth thousands of dollars and smugglers or looters often carry weapons and other personal protection!

Resources

- Desk brochures and handouts - Lot of fish information in them
- *Saving the Salmon, A History of the US Army Corps of Engineers Efforts to Protect Anadromous Fish on the Columbia and Snake Rivers* - Blue paperback published by the Corps. A pain to read, but it has lots of good history and information.
- Newspapers, magazines, TV - Can be biased, but there's lots of information.
- Project fish biologists, Fisheries office - Up to the minute information on current fish issues, information on the fish systems here at the dam, and general information.
- *Waterpower in the Wilderness* - Book that explains our fish passage systems
- *Cascade-Olympic Natural History* - Great book that explains fish, plants, and geology.
- *Salmon Passage Notes* - Brochures by Public Affairs; current fish issues
- Rangers - Talk to them about Geese, Penstemon, and historical sites.
- *Hydro Review Special Report, Spotlight on Bonneville Lock and Dam Major Rehabilitation Underway.* Published in Aug. '99. Good summary of all the current work being done.

Geology of the Gorge

50,000,000 - 18,000,000 years ago

Volcanoes erupting in the western Cascades built up a three-mile thick pile of volcanic ash, lava and mud flows. The mud flows were caused by glaciers and snow packs melting from the eruptions. These flows buried trees which became petrified. The lower part of the cliffs north of Bonneville Dam and the eastbound freeway road cuts along I-84 south of the dam expose about 1000 feet (621 meters) of these mud flows.

16,000,000 - 6,000,000 years ago

There is a type of volcano called a basalt flood. It is basically a long fissure in the earth's surface that releases a huge amount of a very fluid lava. Dozens of these volcanoes opened up in far eastern Washington and Oregon, spreading layer upon layer of basaltic lava over 60,000 square miles of the two states. In some places, this layered lava is 2,000 feet thick! If you look at the walls of the gorge, you can see these layers. When basalt cools, it cracks into six-sided basalt columns, some of which can be seen around the new lock.

2,000,000 - 700,000 years ago

The 14 major High Cascade volcanoes and more than 1000 smaller peaks and cinder cones were all built up during this period. The Columbia flowed through a natural low pass in the mountains.

15,000 years ago

During the last ice age, Canada was covered with an ice sheet. A lobe from this sheet grew and blocked off the Clark Fork Valley in Idaho. The river grew into a lake that was 2,000 feet deep, stretched for hundreds of miles, and contained 500 cubic miles of water. Eventually, the water lifted the glacier and the lake drained out under the ice. The resulting torrent tore across eastern Washington at 60 mph and scoured out 300 foot deep canyons called Coulees. As the water sped through the gorge, it scoured away loose rock and was 600 feet deep at Bonneville Dam. Geologists believe that the lake reformed and drained at least 90 times. These floods, the largest in geologic history, were called the Missoula Floods.

300-500 years ago

The last catastrophe was the Cascade Landslide. Probably caused by heavy rains, parts of Table Mountain and Greenleaf Peak north of Bonneville crashed down to cover 14 square miles, displaced the river more than a mile to the south and built a debris dam 270 feet high across the river. Forests along the river as far east as The Dalles were drowned as the lake filled behind the dam. Indian tribes were able to cross the river on this "Bridge of the Gods" for months before the dam was topped and washed away, forming the Cascades Rapids of the Columbia. Similar landslides occur today. The last one happened near Exit 35 on I-84 during a week of heavy rains in February 1996. You can still see the rubble.

Geography

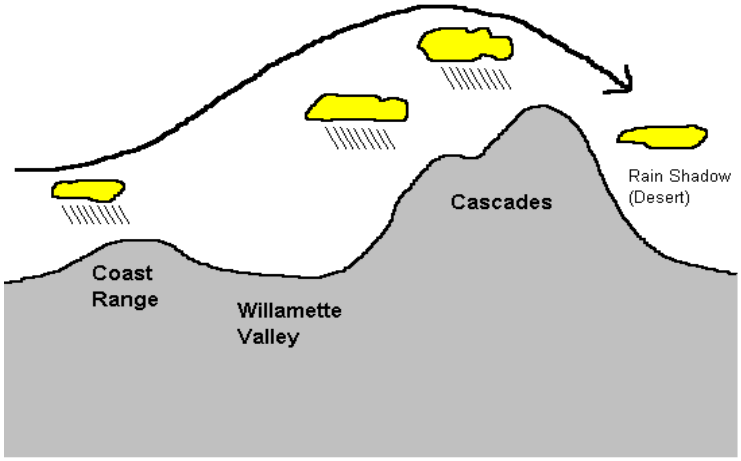
The Columbia River begins its 1,243 mile journey to the sea in Columbia Lake located in southeastern British Columbia. The Columbia drains parts of 7 states and 1 province: Oregon, Washington, Idaho, Wyoming, Montana, Nevada, Utah, and British Columbia. It carries the second largest volume of water in the United States. (The Mississippi River is the first.) There are 14 dams on the Columbia River. 11 of them are in the United States and 3 are in Canada.

The Gorge is generally considered to be 75 miles long, from the Sandy River to the Deschutes River. The average height of gorge walls are 1500-3000 feet. Elevations of local mountains are:

Mt. Defiance	Tallest peak in Gorge	4,960 ft.
Benson Plateau	Tall peak near Eagle Creek	4,000 ft.
Table Mountain	Pyramid mountain N. of dam	3,400 ft.
Beacon Rock	Old volcano plug W. of dam	848 ft.

Climate

The Cascade Mountains affect the weather in the Northwest. They create a moist western region, for all you webbed-footers, and a dryer eastern region so you'll have a warmer place to move to when you retire! Here's why: Weather patterns move from west to east. Air coming off the ocean is moist, so as it comes over land and cools, rain is produced. The Cascades cause this moisture to rise, cooling it off further, creating more rain. After this air passes over the mountains, most of the moisture is gone, creating the dry, desert conditions you find east of the mountains.



This change in weather patterns can be seen as you travel from Portland to The Dalles. Portland gets about 42 inches of rain, so it is a lush, moist area. Bonneville, which is at the heart of the Cascade Mountain range, gets almost 80 inches of rain. As a result, there are

rain forests to the south of the project. As you continue on to Hood River (29 inches of rain) the rain forests thin into pine and oak woodlands. Finally at The Dalles (14 inches of rain) the woodlands turn into grassy desert.

Resources

Cataclysms on the Columbia - A great book about the Misoulla Floods
Geology and Bridge of the Gods desk handouts
The Great Floods - A wonderful video about the Missoula Floods
The Story Behind the Scenery: The Columbia Gorge - Good overview of Gorge Geology.
Cascade-Olympic Natural History - Great book that explains fish, plants, and geology.
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Lewis and Clark

The far reaching significance of Lewis and Clark's expedition is difficult to summarize. Their discoveries were so numerous, their journey so epic, that entire books have been written on single aspects of their exploits without exhausting the material in their journals. The saga of these men including a black slave, an Indian woman, an infant, and a Newfoundland dog is unparalleled in the annals of exploration in multiple facets of scientific discovery, sociological commentary, wilderness acumen, and competence.

The Lewis and Clark expedition was one of the most dramatic and significant episodes in the history of the United States. In 1804-1806, it carried the destiny as well as the flag of our young nation westward from the Mississippi across thousands of miles of mostly unknown land--up the Missouri, over the Rocky Mountains and on to the Pacific via the Columbia River. Their journals mention the fact that back in 1806 while returning to St. Louis, they camped on Bradford Island. It is believed that large house pits uncovered during the PHII archaeology dig may be the ones that Lewis and Clark described as they traveled to the ocean.

In its scope and achievements, the expedition towers among the major explorations of the North American continent. The expedition made their way through this vast land, living mainly off its resources and superbly adapting themselves to the new conditions it imposed. On foot, on horseback, and by boat, they pushed over mountain ranges, across seemingly endless plains, through tangled forests, against powerful currents and raging waters all while fending off menacing animals and encountering alien tribes. These explorers met danger as a matter of course and suffered hunger, fatigue, privation and sickness.

Despite these obstacles, the project was brilliantly managed and executed. Few, if any, comparable explorations have been so free of blunders, miscalculations, and tragedy. Not many explorers have provided such exhaustive and accurate information on the regions they probed. The Lewis and Clark expedition made major contributions to the fields of geography, cartography, ethnology, and natural history. Scientists were kept busy for a long time digesting the mass of raw information, studying plant and animal specimens, analyzing descriptions and translating them into the appropriate technical language.

So when were they here? The Corps of Discovery passed through the western part of the Columbia River Gorge on October 30 – November 1, 1805, and then again April 9 – 11, 1806. It wasn't the best time for them. The Cascade Rapids were treacherous, and the local people were used to extracting tolls from all travelers, even if it meant taking things without permission. For more information about this topic, read the exhibits on BIVC 4th floor, and the L&C Trivia Book.

The 200th anniversary of the Lewis and Clark trip is coming in 2005/2006. We (the Corps) are already planning a variety of activities, exhibits, events, etc. to commemorate that great trip. The original trail crosses a lot of property currently managed by the

Corps, so we have one of the best opportunities to be involved in this. Keep your ears open for what we will be doing here at Bonneville Dam.

The Oregon Trail

Why do we talk about the Oregon Trail here at Bonneville Dam? There are two reasons. First of all, Oregon Trail pioneers floated themselves and their wagons on log rafts down a raging wild Columbia River, past the present-day site of Bonneville Dam. Second, these days of passage down the untamed river were the beginnings of the Columbia's navigation story. Before Bonneville Dam, the river was full of whirlpools, rapids and waterfalls. Only four miles upstream from Bradford Island, lay the churning Cascade rapids, a major hazard on the river route of the Oregon Trail. Many souls were claimed by the treacherous waters. Only after the rapids were flooded under Lake Bonneville did travel become safe on the Columbia.

A little over 150 years ago, our ancestors came west to the Oregon Country, crossing 2000 miles of wilderness. They came to embrace a dream of unsettled open lands, fresh starts, freedom from disease and crowding of the east, and for some, just to "get where I ain't". While newspapers and books bubbled with the joys of reaching Oregon, few of the emigrants were told in detail of the harsh conditions and terrible trials that awaited them between the jumping off towns where wagon trains departed and their new donation land claims in Oregon. Ten percent of the pioneers would succumb to cholera, smallpox, camp fever, accidents, drownings or snakebite. However, those who made it were treated to the privilege of seeing countless buffalo roaming the vast frontier, giant salmon leaping up falls abundance, and the tall unscathed virgin forests of long ago.

One decision that was critical in the Columbia River Gorge was made at the Dalles after 1845. Here the regular wagon road ended. In order to reach their destination in the Willamette Valley, would they take the Columbia River route, floating to Ft. Vancouver, or would they risk early snow in the Cascades while attempting the newly forged Barlow Road? Both routes held obvious dangers as well as advantages. The river route would be much faster and would relieve tired bodies, but the swirling waters tended to overturn their rafts. The Barlow Road was more difficult walking, especially over brutal Laurel Hill, a narrow rocky wagon chute which could tear a wagon to pieces if great care was not taken as they snubbed trees with ropes and lowered their vehicles by pulley down the cliff. Early blizzards were also a frightening possibility, but at least they didn't have to worry about drowning.

As you can see, this incredible journey is woven very obviously in the tapestry of Oregon and Washington history, as well as in our navigation mission. Many visitors will ask about the Oregon Trail information, especially after AV's on the subject.

Resources

The Journals of Lewis and Clark - A good video on their expedition.
West to Oregon - The best video we have on the topic.
The Oregon Trail - A good video on their Journey.

Communication

Basic Communication
Verbal Communication
Non-Verbal Communication
Roving
Feedback

The ranger was gesturing so much that when he pointed to the fish ladder, he put his finger up another visitor's nose.

PA announcement: "Good afternoon ladies and gentlemen. In five minutes, we'll be starting a program on...uh....uh..."

Basic Communication

A simple communication model

Communication is not merely telling a person something. If it was, divorce would be unknown! There are several parts to the communication process:

1. You think of an idea
2. You find words to describe the idea.
3. You say the words.
4. The sound travels though the air and mixes with all the noise in the environment.
5. The listener chooses to hear your voice.
6. The listener converts your words into an idea, based on their view of the world.
7. The listener remembers your idea or acts on it.

As you can see, there are several places where your ideas can be lost. Most of us concentrate on steps 1-4 and forget about the rest. Let's take a look at some of these steps.

Effort vs. Reward

Note step 5: The listener chooses to hear your voice. People are bombarded with so much stuff every day we can't possibly pay attention to all of it. We direct our attention by using a simple formula: Effort vs. Reward. Here's how it works:

Effort we put in:	Reward we get from it:	Our action:
High	High	Might pay attention
High	Low	Why bother?
Low	High	Definitely pay attention
Low	Low	Maybe pay attention

For example, a low effort/high reward situation are credit cards. You can buy anything you want NOW even if you don't have the money (high reward). All you have to do is whip out your card (low effort). Because it's so easy to get what you want with so little planning or effort, it's easy to go into debt. How do we use this formula to help us to communicate to others?

Reducing effort:

- Speak about one topic and be organized. If you babble on about a bunch of unrelated topics, the listeners will have to struggle to understand. It's much easier for them to tune out or walk away from your program.
- Be brief; break up your talking by using visual aids or activities
- Relate the topic to everyday life. Do not use jargon or talk about abstract concepts.
- Speak loudly and clearly

Increasing rewards:

- Involve the listener using interactive, hands-on activities.
- Find an unusual, fun, or timely topic.
- Be friendly, enthusiastic, and approachable

Filters

The visitor chooses to hear your message, so the next step is translating your words into an idea. If I tell you to imagine a mountain, which mountain do you see? Right now, I'm picturing Larch Mountain. You might be picturing Mt. Hood, someone from Europe might picture the Matterhorn, and someone living in Florida may have never seen a mountain! Notice that each individual reconstructs your words into ideas using their personal experiences.

When you communicate, you need to consider the experience, backgrounds, values and opinions of your audience. This is why a warm-up before a presentation is so important. By asking a few questions, you can get enough information to know how to present an idea to your audience in a way they can understand. For example, if your visitors are car mechanics, you might relate the dam to parts of a car: The lake is the fuel, the turbine is the motor, the lake water is used in radiators to cool the generators, etc.

Retaining what they've heard

They've heard your message and translated the words into an idea similar to yours. Wouldn't it be a waste of everyone's efforts if the listener forgot what you said? People tend to remember:

10% of what they read - A book
20% of what they hear - A lecture
30% of what they see - Photographs and diagrams
40% if what they hear and see - Movies and videos
70% of what they say - Participate in a debate or discussion
90% of what they do - Participate in a simulation, do a hands-on activity

This is why we emphasize the use of props and hands-on activities in our programs.

Verbal Communication

Grammar, Vocabulary, and Slang

"Isolinear bus ducts carry the three phase, 13,800 volt current into...a really cool machine which, like, changes the stuff into, you know, bigger volts or something." Why not talk like

a normal person? Also, try to avoid talking like the perfect polished professional with a big, plastic smile on your face. Since you're not running for Congress, you can act like yourself.

Humor

Humor often improves interaction with visitors, as long as it is done in good taste. Don't put someone or thing down. Everyone has the right to their own religion, political, and ethnic views.

Correcting Visitors

Visitor's say and do the strangest things. Your reaction will range from bewilderment to desperately suppressing your laughter. Remember that each person sees the world differently from you because we all process what we see and hear against our unique experiences. For example, a child entered BIVC one day and thought he was in a hospital because of our wheelchair! The upshot of all of this is that you will eventually be in the awkward position of telling a visitor that they are wrong.

Correcting visitors is an art and takes LOTS of tact. Here's an example of how you might approach a "situation": A visitor is telling his friends that the eels are eating algae on the fish viewing windows. If you replied, "Those aren't eels and they're not eating algae!" you will either embarrass someone or get a fist in your mouth (Or a reprimand from your supervisor). A better approach: "They do look like eels, don't they? Actually they're lamprey and they're hanging on to the windows in order to rest while moving upstream!" Now, they are impressed that this good-looking, intelligent, volunteer guide has enlightened them and will be eager to ask more questions. Something you can practice: Try never using the word "no" when talking to visitors.

Listening

Listening and hearing are two different things. Listening means finding the message when you hear the words. Sometimes we have our mind made up about what the other person is trying to say or think we already know what they want and forget to listen. This is easy to do when you hear the same comments and questions from a thousand visitors a day. Let the person finish their sentences before answering their questions.

Conflict Resolution

You might have to deal with an angry visitor. This is when your listening skills will come in very handy. Patiently listen to angry visitors for two reasons: First, they can vent their anger releasing their negative energy. Second, it will allow you to find out what is really bothering them. Don't take anything they say personally; they are mad at the situation, not you. If you do take things personally, you will get sucked into the argument, and end up with an angry visitor, an upset volunteer, and the original problem still unresolved.

Unreasonable Complaint: Be sympathetic and understanding to a person who is angry over something that seems unreasonable. When someone is frustrated, they feel powerless so they complain. How can you help? Listen to their complaint, then offer to let them talk to a supervisor, fill out a suggestion form, or contact the Public Affairs office. By allowing them to take this action, they will feel that they have power in the situation and possibly leave with a better attitude towards us.

Legitimate Complaint: The solution to this one is obvious: *fix the problem*! A lot of people tend to listen to the complaint, apologize, then do nothing! Why not solve the problem at that time?

Dangerous Situation: If a person seems violent, stoned, or drunk get to safety and call for help.

Non-Verbal Communication

People communicate non-verbally 93% of the time by means of body language, behavior and appearance.

Appearance - First impressions are all a visitor will get from you at Bonneville Dam. Your appearance affects how other people think of you and what you are saying. Consider:

Uniforms: We wear uniforms to give us credibility. That's why it should always be neat and clean.

Hygiene: Groom yourself in a way that leaves you approachable. If you have purple hair, 5 o'clock shadow, smell like a horse, or a ring through your nose you might alienate some people.

Behavior: How would you like to be cornered by a smart-aleck volunteer (or ranger!), who makes sure you know everything he/she knows about the dam before they let you go look at the fish?

Punctuality: What are you saying to your coworkers when you are late to work?

Body language - Whether we want to or not, we always communicate with our bodies. If we are open, friendly, and approachable it comes out in our stance. For example, if you hunch your shoulders, look at the ground, and cross your arms while roving, no one will approach you. If you stand tall, arms open, and make eye contact you will be a magnet without even trying.

You are here to be helpful and available. If you adopt the attitude of liking people your body language will reflect it. In general you should:

- Face people squarely,
- Have an open posture - arms open, hands out of your pockets, stand tall, feet spread a little
- Lean toward the person you are talking to - this signals that you are listening
- Maintain good eye contact - this shows you care about what they are saying
- Be relaxed, not stiff

Roving

Another task we do is rove around the visitor center answering people's questions. The basic rule is: *Talk to the visitors!* If you hide in a corner waiting for people to approach, nothing will happen. Walk up to someone, initiate contact and talk to them. Ask if they have any questions. This contact may last five seconds or thirty minutes. The purpose of a rove is to make volunteers and rangers available to the public. It would be appalling for the flagship visitor center of the Corps to be full of visitors and all the staff are hiding out in the office. Remember to write your rove statistics down on the daily program statistics sheet at the information desk.

Study guide

Corps

What does the Corps do in the United States?

What are our four missions at Bonneville Dam?

Since you're with the Army Corps, are you in the military? Are you an engineer? Explain.

What are the Corps contributions to the nation over the past 200 years?

Hydropower

Why doesn't our lake level drop at certain times of the year?

How did the dam contribute during W.W.II?

What is electricity?

Draw a cross-section of the dam and label major parts. Explain how we make electricity, referring to the diagram:

What were the two reasons for the creation of the BPA?

Respond to this common visitor question: “Why are we giving our power to California over the intertie? Do they deserve it? What do we get out of the deal?”

Navigation

Why is the local area so significant for trade and transportation?

What were the major historical events in this area over the past 150 years?

Why is the inland waterway valuable to the Northwest?

Draw a lock and describe how it works:

Recreation

Why does the Corps consider recreation important?

What is there to do here at Bonneville Dam?

After visiting the dam what are five things people can see in the local area?

Resource Management

What are the six stages of a salmon's life cycle?

How do fish ladders work?

How does the fingerling bypass system work?

Explain the spill program:

Here's a common visitor question: "So...what's happening with the fish that I hear about on TV?" Write out an answer:

Geology/Geography

Briefly describe the six stages of the formation of the gorge. Can you see any of these stages from the visitor center?

Why is it so dry in The Dalles?

History

What are things that made Lewis and Clark's expedition so unique?

What hazard in the gorge did the settlers on the Oregon Trail face and how did they overcome it?