UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS TX 75202-2733

NOV 0 2 2011

VIA: Federal Express

Mr. Patrick Adams
President
Altec Petroleum Group
3232 County Road 3460
Pawhuska, OK 74056

Re: In the Matter of Altec Petroleum Group – Docket Number CWA-06-2008-1832
Memoranda and Documentary Evidence produced as required in the October 19, 2011 Order in anticipation for Penalty Hearing.

Dear Mr. Adams,

As ordered by the Regional Judicial Officer, Pat Rankin, please find the U.S. Environmental Protection Agency's ("EPA or Complainant") Memoranda and documentary evidence that we intend to produce at the above referenced hearing. As you are aware, the hearing is scheduled for 9:00a.m. at the Regional Office, 1445 Ross Avenue, Dallas, Texas 75202. Although a hearing has been scheduled, EPA continues to express interest in settling this matter with you in lieu of a hearing. If you are interested in discussing settlement options please do not hesitate to contact me.

Sincerely,

Lorraine Dixon
Assistant Regional Counsel
U.S. EPA, Region 6
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733
Dixon.Lorraine@epa.gov
Tel: (214) 665-7589
Fax: (214) 665-3177

ENVIRONMENTAL PROTECTION AGENCY
REGION 6

IN THE MATTER OF	§	
	§	
ALTEC PETROLEUM GROUP, INC.	§	**DOCKET NO. 06-2008-1832**
PAWHUSKA, OK.	§	
	§	
RESPONDENT	§	

MEMORANDA

Comes Now Complainant, Director of the Compliance Assurance and Enforcement Division, through its attorney, Lorraine Dixon, in accordance with the Consolidated Rules of Practice Governing the Administrative Assessment of Civil Penalties and the Revocation/Termination or Suspension of Permits (the Consolidated Rules), 40 C.F.R. § 22.1 *et. seq.,* and files this Memoranda as directed in this Courts' October 13, 2011 Partial Accelerated Decision.

I. ADMINISTRATIVE PROCEDURES TO DATE

1. Complainant issued an Administrative Complaint pursuant to Section 309(g) of the CWA, 33 U.S.C. § 1319(g), on May 20, 2008, proposing a penalty in the amount of $19,500.

2. Respondent filed a request for a hearing with the Regional Hearing Clerk on June 26, 2008.[1]

3. On June 30, 2008, the Presiding Officer issued a Scheduling Order, ordering the following:

· The parties to discuss settlement on or before July 23, 2008;

· The parties to file a status report of settlement negotiations;[2]

[1] The request did not comply with 40 C.F.R. § 22.15as it did not clearly admit, deny or explain each of the factual allegations continued in the May 20, 2008. Nor did the request state that the respondent was without knowledge.
[2] A Joint Status report was filed on July 23, 2008. In the Joint Status report both parties requested a thirty day extension to file their prehearing exchange.

· Respondent to file an answer to the Complaint as described in 40 C.F.R. § 22.15;[3]

· For both parties to submit a prehearing exchange no later than August 26, 2008;

· To file a response to the prehearing exchange by September 12, 2008; and

· The parties to submit in a prehearing conference with the Presiding Officer on September 23, 2008.

4. On July 31, 2008, the Presiding Officer issued its First Amended Scheduling Order granting both parties request for an extension to file their prehearing exchanges and set a September 26, 2008, date for both parties to file its prehearing exchange.

5. On September 26, 2008, Complainant filed its prehearing Exchange.

6. To date, Respondent has not filed its prehearing exchange.

7. On October 28, 2008, Complainant filed a Motion to Amend the Complaint.

8. On June 9, 2009, the Presiding Officer granted Complainant's Motion to Amend the Complaint.

9. On July 13, 2009, Complainant filed a Motion for Extension of Time to amend its Complaint.

10. On July 15, 2009, Complainant filed its Amended Complaint.

11. Respondent did not file an Answer to the Amended Complaint.

12. On December 22, 2009, the Complainant filed a Motion for Accelerated Decision as to both Liability and Penalty seeking an Order granting full judgment against Respondent, Altec

[3] The Presiding Officer Ordered that the Respondent "… respond paragraph by paragraph to the Complaint, clearly and directly admitting, denying, or explaining each of the factual allegations in the Complaint with regard to which the Respondent has nay knowledge. Where Respondent has no knowledge of a particular factual allegation and so states, the allegation will be deemed to be denied. The answer shall also set out the circumstances or arguments which are alleged to constitute the grounds of any defense. Failure of respondent to admit, deny, or explain and material factual allegation continued in the Complaint will be deemed an admission of the allegation.

Petroleum Group, Inc., and assessing a civil penalty in the amount of $19,500. To date, Respondent has filed no response to this Motion.

13. On May 24, 2011, the Court filed an Order for More Definite Statement ("May 24, 2011 Order").

14. On July 12, 2011, Complainant filed its Response to the May 24, 2011, Court Order for More Definite Statement.

15. On October 13, 2011 this Court granted a Partial Accelerated Decision on liability, however, this Court denied Complainant's motion on penalty ordering a hearing on November 16, 2011. Additionally, the Court ordered that any documentary evidence and memoranda to be filed at the hearing shall be provided to the opposing party by mail or e-mail no later than November 3, 2011.[4]

II. EVIDENCE OF A FAIR AND EQUITABLE PENALTY

16. Section 309 of the Clean Water Act (CWA), (33 U.S.C. § 1319) authorizes the Administrator of the U.S. Environmental Protection Agency ("EPA" or the "Agency") to bring civil and administrative actions against those who violate certain enumerated requirements of the CWA.

17. EPA brings enforcement actions to require alleged violators to promptly correct the violations and remedy any harm caused by the violations. As part of an enforcement action, EPA also seeks substantial monetary penalties which promote environmental compliance and help protect public health by deterring future violations by the same violator and deterring violations by other members of the regulated community. Penalties help ensure a national level playing field by ensuring that violators do not obtain an unfair economic advantage over

[4] In the Penalty Section of the Order the Court made a typo in that it stated the proposed penalty in the Complaint was $16,000 when in fact the proposed penalty in the Complaint was $19,500.

competitors who have done whatever was necessary to comply on time. Penalties also encourage companies to adopt pollution prevention and recycling techniques, so that they minimize their pollutant discharges and reduce their potential liabilities.[5]

18. During the hearing Complainant intends to prove that the proposed penalty, $18,720, was calculated consistent with Section 309 and the March 1, 1995 Interim CWA Settlement Penalty Policy and that the proposed penalty is appropriate to the facts of this case.[6]

19. Complainant will also demonstrate through the testimony of Mr. Matthew Rudolph that the proposed penalty is consistent with the CWA Settlement Penalty Policy and was appropriately and correctly applied to deter future noncompliance by Altec.

21. The Complainant will demonstrate through the testimony of Mr. Matthew Rudolph that the proposed penalty was calculated to ensure a level playing field and to make certain that Altec does not have an economic advantage over their competitors.

22. Finally, the Complainant will demonstrate that the proposed penalty is consistent and was calculated with a logical calculation methodology that was intended to promote a swift resolution of the enforcement action and the underlying violations.

---

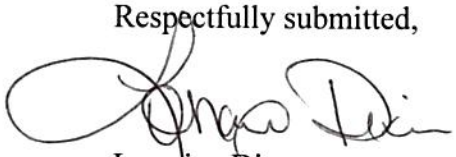
[5] March 1, 1995 Interim CWA Settlement Policy

[6] After reviewing the Economic Benefit Calculations ("BEN") the Complainant has determined that the correct proposed amount for penalty is $18, 720.

III. CONCLUSION

WHEREFORE, at the end of the November 16, 2011 hearing, Complainant respectfully prays the Court will assess a civil penalty in the amount of $18,720, against Respondent, Altec Petroleum Group, Inc.

Respectfully submitted,



Lorraine Dixon
Assistant Regional Counsel
U.S. EPA, Region 6
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733
Dixon.Lorraine@epa.gov
Tel: (214) 665-7589
Fax: (214) 665-3177

CERTIFICATE OF SERVICE

I hereby certify that on the 2nd day of November 2011, the original of the foregoing Memoranda was hand delivered to the Regional Hearing Clerk and the Regional Judicial Officer, U.S. EPA, Region 6, 1445 Ross Avenue, Dallas, Texas 75202-2733, and that true and correct copies were placed in the United States Mail, postage prepaid, addressed to the following:

Mr. Patrick Adams
President
Altec Petroleum Group
3232 County Road 3460
Pawhuska, OK 74056

and

Mr. Patrick Adams
President
Altec Petroleum Group
6035 Fremont St.
Riverside, CA 92504-1114

Sandra Hardy
Sandra Hardy
Paralegal

TABLE OF CONTENTS OF DOCUMENTARY EVIDENCE

1. Letter from the Office of the Attorney General , State of Oklahoma to Patrick S. Adams dated September 19, 2007.
2. Letter from the Office of Attorney General , State of Oklahoma to Patrick S. Adams dated September 20, 2007.
3. October 2, 2007 Inspection report with photographic evidence.
4. November 15, 2007 Sampling Results.
5. March 10, 2008 Inspection Report with photographic evidence.
6. Affidavit of Kent E. Sanborn – EPA Inspector.
7. Vitae of Matthew Rudolph – EPA Enforcement Officer.
8. Affidavit of Matthew Rudolph – EPA Enforcement Officer.
9. Map of Altec drilling site.
10. November 16, 2007, Cease and Desist Administrative Order.
11. March 12, 2008, Record of Communication between Matthew Rudolph and Patrick Adams.
12. July 15, 2009, Amended Complaint,
13. Penalty calculations, including economic benefit calculation ("BEN") for Altec Petroleum as calculated by Matthew Rudolph. (page missing)
14. March 1, 1995 Interim CWA Settlement Penalty Policy.
15. Facts Natural Resources and Water.
16. Issue Paper – Total Dissolved Solids.
17. Analysis of Water Quality for Livestock.
18. Ambient Water Quality Criteria for Chloride – 1988.
19. Complainant's Response to the May 24, 2011, Court Order for More Definite Statement.

OFFICE OF ATTORNEY GENERAL
STATE OF OKLAHOMA

Via Facsimile and U.S. Mail

September 19, 2007

Patrick S. Adams, President
Altec Testing & Engineering, Inc.
323 Country Road 3450
Pawhuska, Oklahoma 74056

Dear Mr. Adams:

I am writing you regarding Altec's activities in the Osage County Western Wall Wildlife Management Area (the "WMA"). The WMA is state-owned property that is regulated and managed by the Oklahoma Department of Wildlife Conservation. State law provides that prior to entering the WMA, Altec first must receive permission from the Department and comply with all applicable regulations. Altec has never received this permission and has not complied with the applicable regulations.

In early August 2007, Altec unlawfully entered the WMA for the purpose of drilling an oil well. Altec's operations at the site have caused significant environmental damage. Furthermore, I am advised that Altec has plans to re-enter the site to perform more drilling operations.

Please be advised that Altec, its employees, and its agents are expressly prohibited from entering the WMA. Cease and desist any and all present and future operations at the WMA.

If you have any questions please contact me at (405) 522-4405.

Sincerely,

Daniel P. Lennington
Assistant Attorney General

cc: Chris Holloway

313 N.E. 21ST STREET • OKLAHOMA CITY, OK 73105 • (405) 521-3921 • FAX: (405) 521-6246

OFFICE OF ATTORNEY GENERAL
STATE OF OKLAHOMA

Via Facsimile and US Mail

September 20, 2007

Patrick S. Adams, President
Altec Testing & Engineering, Inc.
323 Country Road 3450
Pawhuska, Oklahoma 74056

Dear Mr. Adams:

In my correspondence from yesterday, I asked you to cease and desist your operations on the Osage County Western Wall Wildlife Management Area (the "WMA"). I made this request because your operations at the site are unlawful and have caused a significant amount of environmental damage. I also made this request because I had information that Altec planned to return to the site to conduct more operations, which could have resulted in the same type of damage that was done in August and earlier this month.

Upon receiving this letter, you called me and explained that your employees were presently working on-site. You also told me that if Altec abandoned the site now, then the site would present risks to human health and safety, as well as environmental risks. In short, abandoning the site could cause serious problems and make a bad situation worse.

After our phone call, we had a conference call with Alan Peoples of the Oklahoma Department of Wildlife Conservation. During that call, you agreed to cleanup the site at Altec's expense and abate any and all unsafe conditions as soon as possible. You agreed to (1) finish the casing, (2) cement the casing, and (3) cap the well, as soon as possible. You believe this should take no more than 24 hours. You agreed to notify the Department once the well is capped. After this is completed, you agreed to work with the Department to cleanup the site. This will include closing the pits, removing contaminated soils, and taking any other actions necessary to cleanup the site and correct the damage that Altec has done.

Furthermore, you agreed that there will be no further well drilling or completion activity at the site unless and until this matter is completely resolved with the Department, and only if the Department specifically agrees to allow you to continue operations at the site. It is my understanding that the Department will not agree to any further operations at the site until the site is cleaned up, Altec enters into the proper agreements and stipulations

313 N.E. 21ST STREET • OKLAHOMA CITY, OK 73105 • (405) 521-3921 • FAX: (405) 521-6246

with the Department, and all of the surface damages are paid. The Department may very well have other requirements and prerequisites, but you will have to address that with them directly at the appropriate time.

Your point-of-contact for the cleanup will be John Rempe and Buck Ray of the Department. Also, to the extent that you are contacted by USEPA or USFWS, please cooperate with their representatives also.

I also informed you that these steps are necessary to abate a present and immediate danger to human health and the environment. The actions that you will take in this regard do not release you from any liability that you may have incurred, or could possibly incur, with respect to the State of Oklahoma and any other governmental agency.

I also advised you to seek legal counsel, and that once representation is obtained, I will communicate with your attorney. If you have any questions please contact me at (405) 522-4405.

Sincerely,

Daniel P. Lennington
Assistant Attorney General

cc: Chris Holloway

INSPECTION REPORT

REPORT DATE: 10/2/2007 **INCIDENT NO:** 09212007-2

INSPECTION DATE: 9/21/2007

INVESTIGATOR: Kent Sanborn

LOCATION: NW /4, Sec. 36 , T 28N, R 9E
COUNTY: OSAGE

SPILL OR DISCHARGE DATE:
MATERIAL SPILLED: Brine
AMOUNT: UNKNOWN

REPORTED BY:
OWNER/OPERATOR: ALTEC TESTING AND ENGINEERING, INC.
6035 Fremont Street
Riverside, CA 92504-1114
951-367-9055

SURFACE OWNER: STATE OF OKLAHOMA
PHONE: Unknown

EMERGENCY HOTLINE NOTIFIED:

POINT SOURCE: DRILLING PITS
LATITUDE/LONGITUDE: 36 51.970N, 96 17.492W

RECEIVING WATER: ROCK CREEK TRIBUTARY
LATITUDE/LONGITUDE: 36 51.939N, 96 17.582W

INSPECTION OBSERVATIONS:

OPERATOR DRILLED WELL ON STATE LAND. 2 STORAGE PITS WERE CONSTRUCTED TO HOLD DRILLING FLUIDS. AT SOME POINT THE PITS BEGAN LEAKING OUT THE BOTTOM ALONG THE ROCK SHELF THEY WERE CONSTRUCTED ON. THEY WERE NOT LINED. BRINE ENTERED THE SMALL CREEK OVER A PERIOD OF WEEKS TO THE OBJECTION OF THE STATE. BIA THEN CLOSED THE PITS BY DRAINING AND BACKFILLING WITH DIRT. I THEN INSPECTED AND FOUND THE PITS RESTORED. THERE IS EVIDENCE OF BRIN E IN THE CREEK. THERE IS ALSO A WET AREA NEXT TO THE CREEK THAT PROBABLY WAS THE DISCHARGE PATH. TSS IN THE CREEK WAS 30K PPM AND DROPPED TO ABOUT 2500 PPM ABOUT 200 YARDS SOUTH. I TOLD OPERATOR TO DIG A CONTAINMENT PIT TO CATCH ANY RUNOFF FROM THE SITE AND HAUL OFF WITH A TRUCK. AS OF TODAY THAT PIT WAS NOT DUG. RAIN IS EXPECTED TODAY.

HE WAS TOLD TO RESTORE THE SURFACE USING GYP AND COMPOST. I SUGGESTED HE TERRACE THE SITE TO PREVENT SOIL EROSION.

SUPPORTING VIDEO, PICTURES, OR SAMPLES: Photos

OTHER AGENCIES OR PARTIES CONTACTED OR INVOLVED:
BIA, OK DEPT OF WILDLIFE, AG (OK)

REGIONAL COMMENTS/INFORMATION OBTAINED:

Rudolph contacted Respondent on 10/3/07 and informed them of the inspection findings and the resulting enforcement actions.

ALTEC TESTING AND ENGINEERING
NW 36 28N-9E OSAGE CO., OKLAHOMA
SEPTEMBER 21, 2007

Photo 1 taken southwest. Newly drilled well. No production casing set yet.

ALTEC TESTING AND ENGINEERING
NW 36 28N-9E OSAGE CO., OKLAHOMA
SEPTEMBER 21, 2007

Photo 2 taken southwest. Old pit locations were present here before being filled with dirt.

ALTEC TESTING AND ENGINEERING
NW 36 28N-9E OSAGE CO., OKLAHOMA
SEPTEMBER 21, 2007

Photo 3 taken west. Location cleared for drilling. Some wet spots were pits were filled in.

ALTEC TESTING AND ENGINEERING
NW 36 28N-9E OSAGE CO., OKLAHOMA
SEPTEMBER 21, 2007

Photo 4 taken north. Trees were piled in one location on the north side of the drilling site.

ALTEC TESTING AND ENGINEERING
NW 36 28N-9E OSAGE CO., OKLAHOMA
SEPTEMBER 21, 2007

Photo 5 taken west. Close-up of soft and mushy area wet from pit soaked soils.

ALTEC TESTING AND ENGINEERING
NW 36 28N-9E OSAGE CO., OKLAHOMA
SEPTEMBER 21, 2007

Photo 6 taken west. Before pits were filled they reportedly seeped out their base here into the small creek. Note dead trees.

ALTEC TESTING AND ENGINEERING
NW 36 28N-9E OSAGE CO., OKLAHOMA
SEPTEMBER 21, 2007

Photo 7 taken east. Reverse angle photo from creek entry point showing wet ground from seeps and size of drilling location.

ALTEC TESTING AND ENGINEERING
NW 36 28N-9E OSAGE CO., OKLAHOMA
SEPTEMBER 21, 2007

Photo 8 taken south. This part of the creek was drained by a tank truck. TSS was 30k ppm. No oil seen.

ALTEC TESTING AND ENGINEERING
NW 36 28N-9E OSAGE CO., OKLAHOMA
SEPTEMBER 21, 2007

Photo 9 taken southwest. Another part of the creek sucked out by tank truck.

ALTEC TESTING AND ENGINEERING
NW 36 28N-9E OSAGE CO., OKLAHOMA
SEPTEMBER 21, 2007

Photo 10 taken south. This is creek farther south. TSS here is 2500 ppm.

Fax

EPA U.S. Environmental Protection Agency
Region

To: Matt Rudolph

Company:

Fax no:

From: Kw Sanborn

Date: 11-15-07

Pages:

Subject:

ALTEC

Soil, Water & Forage Analytical Laboratory
Oklahoma State University
048 Agricultural Hall, Stillwater, OK 74078
Email: Soils_Lab@mail.pss.okstate.edu

WATER QUALITY REPORT

OSAGE CTY EXT OFC	Name	LabID	476528
628 KIHEKAH	Osage UIC	CustomerCode	57
SECOND FLOOR	Location	SampleNo	10431
PAWHUSKA	OK - 1	Received Date	10/1/2007
(918) 287-4170		Report Date	10/15/2007

Test Results For Irrigation Water

----Cations----		-----Anions-----		-----Other-----	
Sodium(ppm)	5984.5	Nitrate-N(ppm)	<1	pH	4.2
Calcium(ppm)	928.9	Chloride(ppm)	12180.9	EC(µmhos/cm)	34800
Magnesium(ppm)	291.7	Sulfate(ppm)	59.9	Fe	
Potassium(ppm)	45	Boron(ppm)	1.9		
		BiCarbonate(ppm)			

--Derived Values---		--Derived Values(Cont'd)--	
Total Soluble Salts(TSS in ppm)	22968	Sodium Percentage	78.72%
Sodium Adsorption Ratio (SAR)	43.9	Hardness	3517.9
Potassium Adsorption Ratio (PAR)	0.2	Hardness Class	Very Hard
Residual Carbonates (meq)		Alkalinity (ppm as CaCO3)	

Interpretaion And Requirements

Water of this quality is not recommended for crop irrigation due to its high total soluble salts and/or sodium level.

Boron toxicity may occur in poorly drained soils.

Signature

ALTEC

Check @ Secp.

Fax

EPA U.S. Environmental Protection Agency
Region 6

To: Matt Rudolph

Company:

Fax no:

From: Kw Sanborn

Date: 11-15-07

Pages:

Subject:

ALTEC

Oklahoma State University - Soil, Water and Forage Analytical Laboratory

Soil, Water & Forage Analytical Laboratory
Oklahoma State University
048 Agricultural Hall, Stillwater, OK 74078
Email: Soils_lab@mail.pss.okstate.edu

SOIL SALINITY REPORT

OSAGE CTY EXT OFC	Name	LabID	476393
628 KIHEKAH	Osage UIC	CustomerCode	57
SECOND FLOOR	Location	SampleNo	10438
PAWHUSKA	W-D #1	Received Date	9/28/2007
(918) 287-4170		Report Date	10/10/2007

Test Results For Salinity Management :(1:1 Soil to water extraction and converted to saturate paste equivalent)

-----Cations------		---Derived Values---	
Sodium(ppm)	4168.1	Total Soluble Salts(TSS in ppm)	19503
Calcium(ppm)	861.9	Sodium Adsorption Ratio (SAR)	35.5
Magnesium(ppm)	110.4	Potassium Adsorption Ratio (PAR)	0.3
Potassium(ppm)	64	Exchangeable Sodium Percentage (ESP)	33.7
		Exchangeable Potassium Percentage (EPP)	6.5

------Other-------		--Additional--
pH	6.8	240.9
EC(µmhos/cm)	9850	BiCarbonate(ppm)
Boron(ppm)	0.1	
Texture	Coarse	

Interpretaion And Requirements

Total soluble salt in this soil is about 7.3875 times higher than normal and sufficiently high to reduce yield of even salt tolerant crops. Exchangeable sodium is much higher than normal and may be responsible for poor water movement in soil. Salts can be leached downward out of the surface soil, if the soil has good drainage. Leaching will be aided by incorporation of 20 to 30 tons of organic matter per acre in the top 6 inches of soil. Incorporation of 5 tons of gypsum into the surface one to two inches will aid in removal of sodium and speed water movement into the soil. During the reclamation period avoid deep tillage such as moldboard plowing and establish a salt tolerant crop (barley, bermudagrass etc.) to provide ground cover for as much of the growing season as possible. If there is a white salty crust on the soil surface, delay planting the slat tolerant crop until the crust no longer forms during a soil drying cycle. Planting while the salty crust remains will likely result in poor stand establishment. The time for reclamation will depend upon the amount and quality of water that moves through the soil profile. Further information can be found in fact sheet 2226.

Will Lubers
Signature

Wild life Dept.
(a) Seep pond / filled pit

Fax

EPA U.S. Environmental Protection Agency
Region

To: Matt Rudolph

Company:

Fax no:

From: KW Sanborn

Date: 11-15-07

Pages:

Subject: ALTEC

Soil, Water & Forage Analytical Laboratory
Oklahoma State University
048 Agricultural Hall, Stillwater, OK 74078
Email: Soils_lab@mail.pss.okstate.edu

WATER QUALITY REPORT

OSAGE CTY EXT OFC	Name	LabID	476530
628 KIHEKAH	Osage UIC	CustomerCode	57
SECOND FLOOR	Location	SampleNo	10432
PAWHUSKA	OK - 2	Received Date	10/1/2007
(918) 287-4170		Report Date	10/15/2007

Test Results For Irrigation Water

----Cations----		----Anions----		----Other----	
Sodium(ppm)	385.3	Nitrate-N(ppm)	<1	pH	5.1
Calcium(ppm)	95.1	Chloride(ppm)	858.8	EC(µmhos/cm)	2930
Magnesium(ppm)	33.6	Sulfate(ppm)	11.2	Fe	
Potassium(ppm)	13	Boron(ppm)	0.0		
		BiCarbonate(ppm)	2.3		

--Derived Values---		--Derived Values(Cont'd)--	
Total Soluble Salts(TSS in ppm)	1933.8	Sodium Percentage	69.06%
Sodium Adsorption Ratio (SAR)	8.6	Hardness	375.5
Potassium Adsorption Ratio (PAR)	0.2	Hardness Class	Very Hard
Residual Carbonates (meq)		Alkalinity (ppm as CaCO3)	1.9

Interpretaion And Requirements

☐ This water is generally unsatisfactory for irrigation use. It may be used for irrigation only under very special conditions and on the advice of a technician trained in irrigation water use. Use of this water should be confined to occasional use as a supplemental source of water on well-drained soils. It is not recommended for use on medium and heavy textured soils.

☐ If this water is used extensively, it is recommended that a soil sample be obtained every few years from the irrigated fields to determine the extent to which sodium or salts may be accumulating and the need for special management practices.

Signature

Altec

Creek downstream

Fax

EPA U.S. Environmental Protection Agency
Region 6

To: Matt Rudolph

Company:

Fax no:

From: Kim Saarborn

Date: 11-15-07

Pages:

Subject:

ALTEC

Soil, Water & Forage Analytical Laboratory
Oklahoma State University
048 Agricultural Hall, Stillwater, OK 74078
Email: Soils_lab@mail.pss.okstate.edu

SOIL SALINITY REPORT

OSAGE CTY EXT OFC	Name	LabID	476394
628 KIHEKAH	Osage UIC	CustomerCode	57
SECOND FLOOR	Location	SampleNo	10439
PAWHUSKA	W-D #2	Received Date	9/28/2007
(918) 287-4170		Report Date	10/10/2007

Test Results For Salinity Management :(1:1 Soil to water extraction and converted to saturate paste equivalent)

-----Cations------		---Derived Values---	
Sodium(ppm)	4252.0	Total Soluble Salts(TSS in ppm)	19859 4
Calcium(ppm)	907.5	Sodium Adsorption Ratio (SAR)	35.8
Magnesium(ppm)	99.7	Potassium Adsorption Ratio (PAR)	0.3
Potassium(ppm)	58	Exchangeable Sodium Percentage (ESP)	33.8
		Exchangeable Potassium Percentage (EPP)	6.2

-----Other-------		-Additional--
pH	6.8	230.4
EC(µmhos/cm)	10030	BiCarbonate(ppm)
Boron(ppm)	0.0	
Texture	Coarse	

Interpretaion And Requirements

Total soluble salt in this soil is about 7.5225 times higher than normal and sufficiently high to reduce yield of even salt tolerant crops. Exchangeable sodium is much higher than normal and may be responsible for poor water movement in soil. Salts can be leached downward out of the surface soil, if the soil has good drainage. Leaching will be aided by incorporation of 20 to 30 tons of organic matter per acre in the top 6 inches of soil. Incorporation of 5 tons of gypsum into the surface one to two inches will aid in removal of sodium and speed water movement into the soil. During the reclamation period avoid deep tillage such as moldboard plowing and establish a salt tolerant crop (barley, bermudagrass etc.) to provide ground cover for as much of the growing season as possible. If there is a white salty crust on the soil surface, delay planting the slat tolerant crop until the crust no longer forms during a soil drying cycle. Planting while the salty crust remains will likely result in poor stand establishment. The time for reclamation will depend upon the amount and quality of water that moves through the soil profile. Further information can be found in fact sheet 2226.

W.H. Cobby
Signature

Wildlife Dept.

@ Seep pond. / filled pit

FOLLOW-UP INSPECTION REPORT

INSPECTION DATE: 3/10/2008 **INCIDENT NO:** 09212007-2

INVESTIGATOR: Kent Sanborn

LOCATION: NW/4, Sec. 36, T 28, R 9
COUNTY: OSAGE

SPILL OR DISCHARGE DATE:
MATERIAL SPILLED: Brine
AMOUNT: UNKNOWN

REPORTED BY:
OWNER/OPERATOR: ALTEC PETROLEUM GROUP, INC.
323 CR 3460
PAWHUSKA, OK 74056
951-367-9055
SURFACE OWNER: STATE OF OKLAHOMA
PHONE: Unknown

EMERGENCY HOTLINE NOTIFIED:

POINT SOURCE: DRILLING PITS
LATITUDE/LONGITUDE: 36 51.970N, 96 17.492W

RECEIVING WATER: ROCK CREEK TRIBUTARY
LATITUDE/LONGITUDE: 36 51.939N, 96 17.582W

INSPECTION OBSERVATIONS:
ENTIRE LOCATION HAS BEEN GRADE AND WORKED WITH GYPSUM. NO NEW GRASS. NO DAM WAS EVER BUILT TO CONTAIN THE HIGHEST OF THE BRINE. NO WATER WAS EVER REMOVED FROM THE CREEKS FIRST HOLE. TSS AT THAT HOLE TODAY IS 3700-6700 PPM. CREEK DONWSTREAM IS 1200-2200 PPM TSS. WELL IS TA WITH TEST TANK NEARBY.

SUPPORTING VIDEO, PICTURES, OR SAMPLES: Photos
OTHER AGENCIES OR PARTIES CONTACTED OR INVOLVED:
BIA

ALTEC PETROLEUM GROUP, INC.
NW 36-28N-9E OSAGE COUNTY, OK
MARCH 10, 2008

Photo 1 taken south. Area graded and treated with gypsum. Little if any grass growth. No cover to prevent erosion.

ALTEC PETROLEUM GROUP, INC.
NW 36-28N-9E OSAGE COUNTY, OK
MARCH 10, 2008

Photo 2 taken south. Another view of location. Well and test tank in the background.

ALTEC PETROLEUM GROUP, INC.
NW 36-28N-9E OSAGE COUNTY, OK
MARCH 10, 2008

Photo 3 taken south. Creek at entry point. No catch basin or dam was ever build here to catch runoff. No recent effort to removed runoff from creek. TSS ranges from 3700-6700 ppm.

ALTEC PETROLEUM GROUP, INC.
NW 36-28N-9E OSAGE COUNTY, OK
MARCH 10, 2008

Photo 4 taken southeast. Close-up of well and tank. No vegetation growth or ground cover.

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION 6
DALLAS, TEXAS

IN THE MATTER OF	)	
	)	Docket No. CWA-06-2008-1832
Altec Petroleum Group, Inc.	)	
	)	
Respondent.	)	

AFFIDAVIT OF KENT E. SANBORN

I, Kent E. Sanborn, make the following statement truthfully from personal knowledge, under penalty of perjury, in accord with 28 U.S.C. § 1746.

1. I make this statement in my capacity as an Environmental Engineer for the Water Enforcement Branch of the Compliance Assurance and Enforcement Division, U.S. Environmental Protection Agency, Region 6 (EPA).

2. My responsibilities and duties include conducting inspections of oil and gas facitlites for regulation under the Clean Water Act.

3. Respondent owned and operated an oil field facility located in the Northwest Quarter of Section 36, Township 28 North, Range 9 East, Osage County, Oklahoma.

4. On September 21, 2007, I inspected Respondent's facility. I observed that brine had been discharged to the adjacent creek from the drilling location. I measured salinity readings from 2500 ppm to 30,000 ppm in the creek. I took 2 water samples and 2 soil samples from the site. All samples confirmed the field readings of high salinity. I instructed the operator to dig a hole next to the creek to retain any future runoff from the pit area and keep empty with a tank truck.

5. On March 10, 2008, I conducted a second inspection at the Respondent's facility. I found salinity readings in the creek of 1200-2200 ppm. Water was pooled at the west edge of the location and measured 6700 ppm. No pit was dug as requested to catch any further brine runoff to the creek. No water was removed from the creek.

Kent E. Sanborn

12-17-09

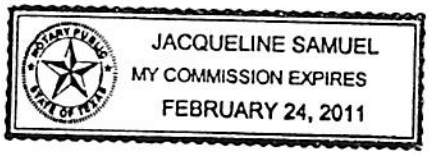
Kent E. Sanborn

Date

Subscribed and sworn to before me, the undersigned Notary Public,

This 22 day of December, 2009

Jacqueline Samuel



MATTHEW RUDOLPH

Home Contact Information:
1108 Peavy Road
Dallas, TX 75218
Phone: 214/404-4663

Work Contact Information:
US EPA Region 6 (6EN-WR)
1445 Ross Ave., Suite 1200
Dallas, TX 75202
Work: 214/665-6434
Email: rudolph.matthew@epa.gov

EDUCATION

Southwest Texas State University, San Marcos, TX
M.S. Computer Science, 05/03

Texas Tech University, Lubbock, TX
B.S. Petroleum Engineering, 12/97

WORK HISTORY

US Environmental Protection Agency Region 6, Dallas, TX – 05/03 – present
Title: Environmental Engineer
Primary job duties in the Region 6 Water Enforcement Branch are as an enforcement officer and inspector for the oil and gas industry. As an enforcement officer develop and act as the lead technical contact for enforcement actions issued for violations of the Clean Water Act (CWA) and the National Pollutant Discharge Elimination System program. Enforcement actions are in the form of Administrative Orders (AOs); Administrative Complaints (penalties); and DOJ referrals. For the development of penalty actions I follow to the CWA Settlement Penalty Policy and to the Supplemental Environmental Project (SEP) policy. Develop SEPs in the form of environmental restoration and protection for oil and gas operators to perform site restoration work and environmental improvements to their facilities.
As an inspector perform inspections at onshore oil and gas facilities and act as the expert witness for violations of the CWA observed or cited during inspections.

Motorola, Austin, TX - 11/99-07/00
Title: Semiconductor Manufacturing Operator
Responsible for the manufacturing and the production of semiconductor wafers. Job duties include: processing wafers on specific recipes; recipe verification; and performing qualifications on manufacturing tools in order to verify the tools are in statistical control with Motorola standards.

Halliburton, Hobbs, NM, and Odessa, TX - 1/98-7/99
Title: Wellsite Engineer
Assisted in the design and the supervision of pumping operations for oil and gas well hydraulic fracturing operations; oil and gas well acidizing operations; and primary and secondary oil and gas well cementing operations. Job duties include: data acquisition; setting up the job site; onsite QA/QC of frac fluids and proppents; and assisting the lab with the pre-testing of fluids for both fracturing and cementing operations.

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION 6
DALLAS, TEXAS

IN THE MATTER OF	)	
	)	Docket No. CWA-06-2008-1832
Altec Petroleum Group, Inc.	)	
	)	
Respondent.	)	

AFFIDAVIT OF MATTHEW RUDOLPH

I, Matthew Rudolph, make the following statement truthfully from personal knowledge, under penalty of perjury, in accord with 28 U.S.C. § 1746.

1. I make this statement in my capacity as an Environmental Engineer for the Water Enforcement Branch of the Compliance Assurance and Enforcement Division, U.S. Environmental Protection Agency, Region 6 (EPA).

2. My responsibilities and duties include enforcement of the Clean Water Act (CWA) related to the regulations of the National Pollutant Discharge Elimination System (NPDES) program with regards to the onshore oil and gas industry. This also includes assessing penalties against facilities for noncompliance of the CWA and the related regulations.

3. As the compliance officer for the matter against Respondent, I calculated the penalty based on a consideration of the required statutory factors in Section 309(g)(3)of the CWA, 33 U.S.C. § 1319(g)(3).

4. At all times relevant to the alleged violations, Respondent owned or operated an oil field facility located in the Northwest Quarter of Section 36, Township 28 North, Range 9 East, Osage County, Oklahoma, and is therefore, an "owner or operator" within the meaning of 40

C.F.R. § 122.2. Respondent's facility was a "point source" of a "discharge" of "pollutants" to a tributary of the South Fork of Pond Creek, which is a "water of the United States" within the meaning of Section 502 of the CWA, 33 U.S.C. § 1362, and 40 C.F.R § 122.2.

5. The oil field facility is located on the Osage Wildlife Management Area, which is state land that is regulated and managed by the Oklahoma Department of Wildlife Conservation (ODWC). ODWC is responsible for managing fish and wildlife in the state of Oklahoma. This area is an extremely environmentally sensitive area which had a creek contaminated from this facility.

6. Under Section 301 of the CWA, 33 U.S.C. § 1311, it is unlawful for any person to discharge any pollutant from a point source to waters of the U.S., except with the authorization of, and in compliance with the NPDES program.

7. Section 402(a) of the CWA, 33 U.S.C. § 1342(a), provides that the Administrator of EPA may issue permits under the NPDES program for the discharge of pollutants from point sources to waters of the U.S. Any such discharge is subject to the specific terms and conditions prescribed in the applicable permit.

8. The Respondent does not have NPDES Program coverage to discharge pollutants from its facility to waters of the U.S.

9. The Respondent's facility is a point source as defined by Section 502(14), 33 U.S.C. § 1362(14).

10. On September 21, 2007, in response to a complaint, an EPA Inspector (EPA) inspected the facility.

11. On November 16, 2007, EPA issued Respondent an Administrative Order (AO) requiring Respondent to take actions to cease further discharges, remove all brine from the

tributary discharged from the facility into waters of the U.S., install a catchment structure to prevent discharges of contaminated fluids from the facility to the tributary, neutralize or extract all the brine contaminated soil located between the facility and the discharge point of entry and provide written certification to EPA region 6 that the actions were completed.

12. On March 10, 2008, EPA staff observed that the Respondent had failed to comply with the November 16, 2007 AO, and observed another discharge from the facility.

13. On July 15, 2008, EPA issued Respondent an Administrative Complaint (Complaint) seeking a penalty of $19,500. The Complaint alleges that Respondent discharged pollutants to waters of the U.S.

Assessment of Civil Penalty Using the Statutory Factors

14. The CWA enumerates in Section 309(g)(3), 33 U.S.C. § 1319(g)(3), the factors that EPA must consider in the assessment of any civil penalty. These statutory penalty factors include: "the nature, circumstances, extent, and gravity of the violation, or violations, and, with respect to the violator, ability to pay, any prior history of such violations, the degree of culpability, economic benefit or savings (if any) resulting from the violation, and such other matters as justice may require." 33 U.S.C. § 1319(g)(3).

15. One of the main goals of assessing a penalty against a violator is deterrence. Penalties deter noncompliance and help protect the environment and public health by deterring future violations. By recovering the economic benefit resulting from noncompliance, penalties also help to ensure that violators do not obtain an economic advantage over their competitors. Before a penalty is calculated using the statutory penalty factors I determined the number of days the Respondent was in violation of the CWA. I considered each day where there was an unauthorized discharge of a pollutant to a waters of the US was a violation of the CWA. For this

case I determined there to be at least two days of violation. There was at least one discharge which occurred on or before the September 21, 2007, inspection and there was at least one discharge which occurred in-between the September 21, 2007, inspection and the March 10, 2008, inspection. The discharges were evident based on the high salinity levels in the impacted water body and the Respondent's failure to comply with the November 2007, AO. The statutory maximum penalty is $11,000 per day per violation. For this case this would give a statutory maximum penalty of $22,000.

16. Based on my analyses of the statutory factors to this case, I calculated a penalty of $19,500, which is less than the statutory maximum penalty of $22,000.

1. Nature, Circumstances, Extent and Gravity of the Violations

Under Section 309(g)(3) of the CWA, 33 U.S.C. 1319(d), EPA must consider the nature, circumstances, extent and gravity of the violations. These factors include the seriousness of the violation and the actual or potential harm resulting from the violation itself, including environmental harm. In this case, there is a risk of environmental harm. Oil field brine is an extremely toxic pollutant to any fresh water ecosystem. Oil field brine was discharged from the facility which then discharged into a tributary of the South Fork of Pond Creek, which flows into the South Fork of Pond Creek, which flows into Pond Creek, which then flows into Hulah Lake/Caney River. Pond Creek is perennial and navigable and is approximately 50 feet in width and 10 feet deep in the center and flows into the Hulah Lake which is built on the Caney River. The Caney River had water flowing in it. This oil field brine is a pollutant in accordance with Section 502(6) of the CWA, 33 U.S.C. § 1362(6).

17. In assessing the penalty, I considered the seriousness of the violation. Oil field brine is a pollutant which is high in salts. In 1988, the EPA's Office of Research and Development

Environmental Research Laboratory in Duluth, Minnesota, performed research and studied the effects chlorides had on aquatic life. From this research the EPA found that freshwater fish were affected from chloride, when associated with sodium (sodium chloride is one form of salt), at levels of 230 ppm if exposed once every three years for a four day period (chronic exposure) and freshwater fish were affected at levels of 860 ppm if exposed once every three years for a period of one hour (acute exposure). The EPA's inspection findings on September 21, 2007, showed salts of 30,000 ppm in the tributary resulting from the discharges. According to the aforementioned research findings freshwater fish exposed to these concentrations would clearly be drastically affected. As previously mentioned this facility is located on the Osage Wildlife Management Area (OWMA) and the facility discharged oil field brine to a waters of the US, which is also located on the OWMA. The OWMA is land managed by the ODWC and is land used for the promotion of fish and wildlife in the state of Oklahoma. These discharges affected a water body which is used for the purposes of promoting fish and wildlife in the state of Oklahoma.

2. Ability to Pay

18. Under Section 309(g)(3) of the CWA, 33 U.S.C. 1319(g)(3), EPA must consider the violator's ability to pay the civil penalty. This particular factor takes into account the different impacts of a penalty on violators by looking at their financial capability and the size of the business. An inability to pay defense can only be invoked when the violator proves it cannot pay the assessed penalty. EPA believes that the $19,500 assessed penalty will not be a hardship on Respondent. Nothing has been brought forth by Respondent to indicate an inability to pay.

3. Prior History of Violations and Degree of Culpability

19. Under Section 309(g)(3) of the CWA, 33 U.S.C. 1319(g)(3), EPA shall consider the

violator's history of violations and the degree of culpability. EPA has no knowledge of the Respondent having any prior history of violations.

20. The EPA should also consider whether the violator made good faith efforts to comply with the statute and the regulations, how quickly the violation was corrected, and how fast the damage was mitigated before the enforcement action was commenced. The Agency must take into regard the degree of effort the violator put forth to remedy the violation and to respond to the enforcement action.

21. Before the Administrative Complaint was issued in July 2008, EPA had previously issued to the Respondent an Administrative Order on November 16, 2007 ordering Respondent to cease discharges from the oil field facility, remove brine from the tributary, install a catchment structure, neutralize and extract the brine from the contaminated soils at the facility, and to provide certification. However, nearly four months after this Administrative Order was issued, Respondent continued to discharge oil field brine from the facility.

22. Respondent failed to properly operate and maintain the oil field facility which resulted in discharges.

23. Respondent did not cease discharges from the facility. Respondent did not install or construct a catchment structure in the drainage area located between the facility and the tributary. Respondent did not remove all the brine from the tributary. Respondent did not properly remove or neutralize the brine contaminated soils located at the facility. Respondent did not submit proper certification within the time requirements set by the AO.

As demonstrated by Respondent's failure to achieve compliance and because Respondent must have known or suspected that additional violations of the CWA would occur by failing to operate and maintain the oil field facility properly, the degree of culpability in this case was

significant and the penalty was assessed accordingly.

5. Economic Benefit

24. Under Section 309(g)(3) of the CWA, 33 U.S.C. 1319(g)(3), EPA must consider the economic benefit, if any, resulting from the violation. The purpose of the economic benefit factor is to remove any economic advantage that the facility may have gained as a result of noncompliance. This factor was calculated to be $740 using EPA's BEN computer model.

6. Other Matters as Justice May Require

25. Under Section 309(g)(3) of the CWA, 33 U.S.C. § 1319(g)(3), EPA can also consider such other matters as justice may require. This particular factor was considered but not used in the calculation of the penalty in this matter.

Conclusion

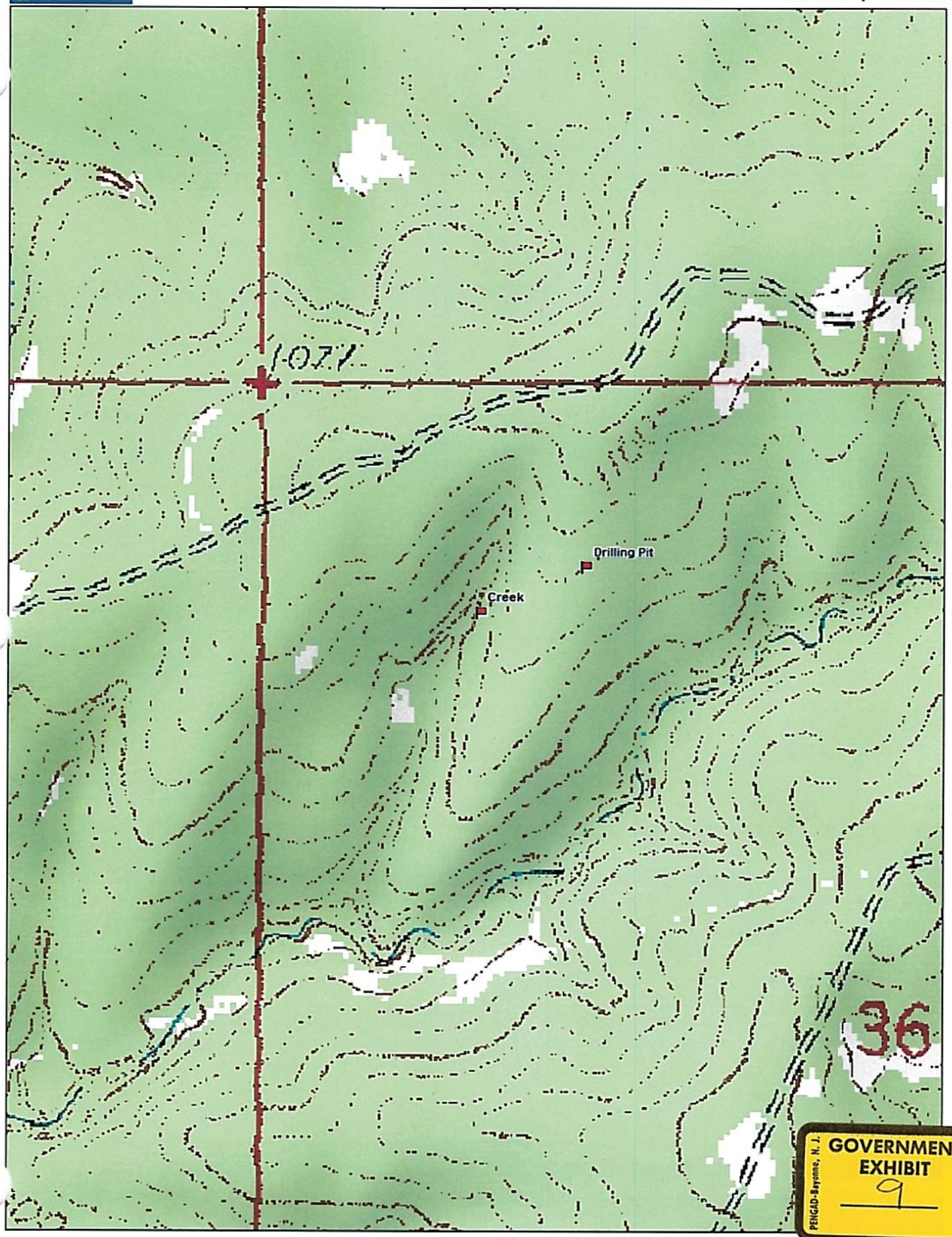
25. In calculating the penalty, I used the statutory factors set forth in Section 309(g)(3) of the Act, 33 U.S.C. § 1319(g)(3), and applied those factors to this case. These factors included the nature, circumstances, extent and gravity of the violations, the violator's ability to pay, any prior history of violations, the violator's degree of culpability, any economic benefit resulting from the violation, and such other matters as justice may require. Respondent violated Section 301 of the CWA, 33 U.S.C. § 1311, by discharging pollutants from its oil field facility into waters of the United States. The penalty I calculated for these violations was $19,500.

Matthew Rudolph
Matthew Rudolph

12/22/09
Date

Subscribed and Sworn to before me, the undersigned Notary Public, Jacqueline Samuel this 22 day of December, 2009.

JACQUELINE SAMUEL
MY COMMISSION EXPIRES
FEBRUARY 24, 2011



GOVERNMENT EXHIBIT 9

PENGAD-Bayonne, N. J.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TEXAS 75202-2733

NOV 16 2007

CERTIFIED MAIL - RETURN RECEIPT REQUESTED: 7005 1820 0003 7458 5223

Mr. Patrick Adams, President
Altec Testing and Engineering, Inc.
6035 Fremont Street
Riverside, CA 92504-1114

Re: Cease and Desist Administrative Order
Docket Number CWA-06-2008-1737
Facility Number OKU000636

Dear Mr. Adams:

Enclosed is an Administrative Order (AO) issued to Altec Testing and Engineering, Inc. for violation of the Clean Water Act (33 U.S.C. § 1251 et seq.). The violation was identified based on our September 21, 2007, inspection of your facility located in the Northwest Quarter Section 36, Township 28 North, Range 9 East, Osage County, Oklahoma, designated as Facility Number OKU000636. The inspection results were discussed with you on October 3, 2007. The violation found consists of an unauthorized discharge of a pollutant, specifically oil field brine, to waters of the United States.

Effective upon receipt of this AO, you shall immediately cease and desist all discharges of pollutants into the identified tributary of Rock Creek, and comply with the provisions of this AO. The Environmental Protection Agency is committed to ensuring compliance with the requirements of the Clean Water Act, and my staff will assist you in any way possible.

If you have any questions, please contact Mr. Matt Rudolph, of my staff, at (214) 665-6434.

Sincerely yours,

John Blevins
Director
Compliance Assurance and
Enforcement Division

Enclosure(s)

cc: Ms. Diane Daniels, Environmental Director
Osage Nation Environmental
and Natural Resources Department
P.O. Box 1495
Pawhuska, OK 74056

Altec Petroleum Group Inc.
323 CR 3460
Pawhuska, OK 74056

U. S. ENVIRONMENTAL PROTECTION AGENCY-REGION 6
FINDINGS OF VIOLATION AND COMPLIANCE ORDER
In the Matter of Altec Testing and Engineering, Inc., Respondent
Docket No. CWA-06-2008-1737

STATUTORY AUTHORITY

The following findings are made and Order issued nder the authority vested in the Administrator of the nited States Environmental Protection Agency (EPA), by ection 309(a) of the Clean Water Act (Act), 33 U.S.C. 1319(a). The Administrator has delegated the authority to sue this Order to the Regional Administrator of PA Region 6 who has further delegated such authority to e Director of the Compliance Assurance and Enforcement ivision.

FINDINGS

1. Respondent, Altec Testing and Engineering, Inc., is a person" as defined by Section 502(5) of the Act, 33 U.S.C. 1362(5).

2. At all times relevant to the violation alleged herein relevant time period) Respondent operated an oil field acility located in the Northwest Quarter Section 36, ownship 28 North, Range 9 East, Osage County, Oklahoma facility), designated as Facility Number OKU000636.

September 21, 2007, an EPA inspector observed ıat utants, namely, oil field brine generated by oil roduction activities, had been recently discharged from eaking storage pits within the facility to "waters of the nited States" as that term is defined by 40 C.F.R. § 122.2. ollutants were discharged to a tributary of Rock Creek, ocated approximately 475 feet down gradient and southwest om the facility. The inspector determined that the water ocated at the discharge point of entry into the tributary of ock Creek was contaminated from brine discharges and ıeasured 30,000 parts-per-million total soluble salts.

4. The storage pits referred to in paragraph 3 above are point sources" as defined by Section 502(14) of the Act, 3 U.S.C. § 1362(14).

5. At no time during the relevant time period did espondent have National Pollutant Discharge Elimination ystem (NPDES) program coverage under the Act which uthorized the discharge of a pollutant from the facility to aters of the United States.

6. During the relevant time period, it was unlawful under ection 301(a) of the Act, 33 U.S.C. § 1319(a), for any erson to discharge a pollutant from a point source to waters f t ited States without a permit issued under ec .02 of the Act, 33 U.S.C. § 1342.

7. On or about September 21, 2007, Respondent discharged and caused the discharge of pollutants from point sources within the facility to waters of the United States without permit coverage under the Act in violation of Section 301(a) of the Act, 33 U.S.C. § 1319(a).

ORDER

Based on these findings and pursuant to the authority of Section 309(a) of the Act, 33 U.S.C. § 1319(a), EPA orders that Respondent take the following actions upon receipt of this Order:

1. cease all discharges of pollutants from the facility;

2. remove all brine from the tributary of Rock Creek, located at Latitude 36° 51.94' North and Longitude 96° 17.58' West, which was discharged from the facility on or about September 21, 2007;

3. install a catchment structure that will catch and prevent the discharges of contaminated fluids from the facility to the tributary of Rock Creek;

4. neutralize or extract all the brine contaminated soil located in the drainage between the facility and the discharge point of entry;

5. within thirty (30) days of the effective date of this Order, Respondent shall provide written certification to the EPA Region 6, that these activities have been completed.

GENERAL PROVISIONS

Issuance of this Order shall not be deemed an election by EPA to waive any administrative, judicial, civil or criminal action to seek penalties, fines or other relief under the Act for the violation alleged herein or other violations which may become known to EPA. EPA reserves the right to seek any remedy available under the law which it deems appropriate.

Failure to comply with this Order or the Act may result in the initiation of an administrative penalty action by EPA or a civil judicial penalty action by the U.S. Department of Justice.

Compliance with this Order does not relieve Respondent of its obligation to comply with all applicable federal, state and local laws.

The effective date of this Order is the date it is ec by the Respondent.

NOV 16 2007

Date

John Blevins
Director
Compliance Assurance and
Enforcement Division

7005 1820 0003 7458 5223

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Sent To: Alec Testing and Engineering
Street, Apt. No.; or PO Box No.: 6035 Fremont Street
City, State, ZIP+4: Riverside CA 92504

PS Form 3800, June 2002 — See Reverse for Instructions

RECORD OF COMMUNICATION	_X_ PHONE CALL _____ DISCUSSION _____ FIELD TRIP ____CONFERENCE_____ OTHER	
TO: Matt Rudolph	**FROM:** Patrick Adams 951-367-9055	**DATE: 3/12/08** **TIME: 4:00 pm**
Subject: Returned my phone call		

Summary: Informed Mr. Adams that the EPA performed a re-inspection at the location on 3/10/08. Informed him it didn't appear he was in compliance with the AO which was issued to Altec in November. Informed him that non-compliances with the CWA, the EPA could pursue penalties as much as $11,000 per day per violation. Informed him there would be a penalty issued against Altec right around $30,000. Mr. Adams informed me he didn't agree with the EPA and the inspection findings from the original inspection conducted on 9/21/07. He felt he complied with what the EPA was requiring him to do. He informed me the original well was drilled with air and there was no salts present on the site, and the reason why there is so much salt on the site was because he flushed the location and the creek adjacent to the location with water which he pulled from a nearby creek which he thought was fresh but that water was also contaminated from brine. He informed me he was wanting to fight this penalty and was wanting to request a hearing.

Conclusions/Actions Taken or Required:

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION 6

In the Matter of	§	Docket No. CWA-06-2008-1832
	§	
Altec Petroleum Group, Inc.	§	
an Oklahoma Corporation	§	Proceeding to Assess a Class I
	§	Civil Penalty under Section 309(g)
	§	of the Clean Water Act
Respondent	§	
	§	ADMENDED COMPLAINT
Facility No. OKU000636	§	

I. Statutory Authority

This Complaint is issued under the authority vested in the Administrator of the United States Environmental Protection Agency (EPA) by Section 309(g) of the Clean Water Act ("the Act"), 33 U.S.C. § 1319(g). The Administrator of EPA has delegated the authority to issue this Complaint to the Regional Administrator of EPA Region 6, who has further delegated this authority to the Director of the Compliance Assurance and Enforcement Division of EPA Region 6 ("Complainant"). This Class I Administrative Complaint is issued in accordance with, and this action will be conducted under, "the Consolidated Rules of Practice Governing the Administrative Assessment of Civil Penalties and the Revocation/Termination or Suspension of Permits," including rules related to Administrative Proceedings not Governed by Section 554 of the Administrative Procedures Act, 40 C.F.R. §§ 22.50 - 22.52.

Based on the following Findings, Complainant finds that the Respondent has violated the Act and the regulations promulgated under the Act and should be ordered to pay a civil penalty.

II. Findings of Fact and Conclusions of Law

1. Altec Petroleum Group, Inc. ("Respondent") is a Corporation which was incorporated under the laws of the State of Oklahoma, and as such, Respondent is a "person," as that term is defined at Section 502(5) of the Clean Water Act, 33 U.S.C. § 1362(5), and 40 C.F.R. § 122.2.

2. At all times relevant to the violations alleged herein, Respondent owned or operated an oil field production facility located in the Northwest Quarter of Section 36, Township 28 North, Range 9 East, Osage County, Oklahoma ("the facility"), and was therefore an "owner or operator" within the meaning of 40 C.F.R. § 122.2.

3. At all relevant times, the facility was a "point source" of a "discharge" of "pollutants," (i.e., oil field brine), to receiving waters of a tributary of the South Fork of Pond Creek, which is a water of the United States within the meaning of Section 502 of the Act, 33 U.S.C. § 1362, and 40 C.F.R. § 122.2.

4. Because the Respondent owned or operated a facility which acted as a point source of a discharge of pollutants to waters of the U.S., the Respondent and the facility are subject to the Act and the National Pollutant Discharge Elimination System (NPDES) program.

5. Under Section 301 of the Act, 33 U.S.C. § 1311, it is unlawful for any person to discharge any pollutant from a point source to waters of the United States, except with the authorization of, and in compliance with, an NPDES permit issued pursuant to Section 402 of the Act, 33 U.S.C. § 1342. According to the NPDES program, the discharge of oil field brine to "waters of the U.S." is a non-permitted discharge.

6. On September 21, 2007, the facility was inspected by an EPA inspector. The inspector observed that oil field brine had been discharged from the production area at the facility, located at

Latitude 36° 51.70' North and Longitude 96° 17.49' West, to a tributary of the South Fork of Pond Creek, located at Latitude 36° 51.94' North and Longitude 96° 17.58' West. The inspector determined that the water at the discharge point of entry into the tributary was contaminated from brine discharges and measured 30,000 parts-per-million (ppm) total soluble salts (TSS). The inspector noted the facility previously had two drilling pits which had been backfilled. The inspector observed an area adjacent to the point of entry to be saturated.

7. On March 10, 2008, the facility was inspected by an EPA inspector. The inspector determined that water located inside the tributary measured 3,700 to 6,700 ppm TSS. The inspector noted that there was no catchment structure to prevent contaminated runoff from the facility from entering the tributary.

8. Each day of unauthorized discharge was a violation of Section 301 of the Act, 33 U.S.C. § 1311.

9. Under Section 309(g)(2)(A) of the Act, 33 U.S.C. § 1319(g)(2)(A), the Respondent is liable for a civil penalty in an amount not to exceed $11,000 per day for each day during which a violation occurs or continues, up to a maximum of $32,500.

10. EPA has notified the Osage Nation Environmental and Natural Resources Department of the issuance of this Complaint and has afforded the tribe an opportunity to consult with EPA regarding the assessment of an administrative penalty against the Respondent as required by Section 309(g)(1) of the Act, 33 U.S.C. § 1319(g)(1).

11. EPA has notified the public of the filing of this Complaint and has afforded the public thirty (30) days in which to comment on the Complaint and on the proposed penalty as required by

Section 309(g)(4)(A) of the Act, 33 U.S.C. § 1319(g)(4)(A). At the expiration of the notice period, EPA will consider any comments filed by the public.

III. Proposed Penalty

12. Based on the foregoing Findings, and pursuant to the authority of Sections 309(g)(1) and (g)(2)(A) of the Act, 33 U.S.C. §§ 1319(g)(1) and (g)(2)(A), EPA Region 6 hereby proposes to assess against the Respondent a civil penalty of nineteen thousand five hundred dollars ($19,500).

13. The proposed penalty amount has been determined based on the statutory factors specified in Section 309(g)(3), 33 U.S.C. § 1319(g)(3), which includes such factors as the nature, circumstances, extent and gravity of the violation(s), economic benefits, if any, prior history of such violations, if any, degree of culpability, and such matters as justice may require. Complainant has specified that the administrative procedures specified in 40 C.F.R. Part 22, Subpart I shall apply to this matter, and the administrative proceedings shall not be governed by Section 554 of the Administrative Practice Act.

IV. Failure to File an Answer

14. If the Respondent wishes to deny or explain any material allegation listed in the above Findings or to contest the amount of the penalty proposed, the Respondent must file an Answer to this Complaint within thirty (30) days after service, whether or not the Respondent requests a hearing as discussed below.

15. The requirements for such an Answer are set forth at 40 C.F.R. § 22.15 (copy enclosed). Failure to file an Answer to this Complaint within thirty (30) days of service, shall constitute an admission of all facts alleged in the Complaint and a waiver of the right to

hearing. Failure to deny or contest any individual material allegation contained in the Complaint will constitute an admission as to that finding or conclusion under 40 C.F.R. § 22.15(d).

16. If the Respondent does not file an Answer to this Complaint within thirty (30) days after service, a Default Order may be issued against the Respondent pursuant to 40 C.F.R. § 22.17. A Default Order, if issued, would constitute a finding of liability, and could make the full amount of the penalty proposed in this Complaint due and payable by the Respondent without further proceedings sixty (60) days after a Final Default Order is issued.

17. The Respondent must send its Answer to this Complaint, including any request for hearing, and all other pleadings to:

Regional Hearing Clerk (6RC-D)
U.S. EPA, Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

18. The Respondent shall also send a copy of its Answer to this Complaint to the following EPA attorney assigned to this case:

Ms. Lorraine Dixon (6RC-EW)
U.S. EPA, Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

19. The Answer must be signed by the Respondent, the Respondent's counsel, or other representative on behalf of the Respondent and must contain all information required by 40 C.F.R. §§ 22.05 and 22.15, including the name, address, and telephone number of the Respondent and the Respondent's counsel. All other pleadings must be similarly signed and filed.

V. Notice of Opportunity to Request a Hearing

20. The Respondent may request a hearing to contest any material allegation contained in this Complaint, or to contest the appropriateness of the amount of the proposed penalty, pursuant to Section 309(g) of the Act, 33 U.S.C. § 1319(g). The procedures for hearings are set out at 40 C.F.R. Part 22, including 40 C.F.R. §§ 22.50 through 22.52.

21. Any request for hearing should be included in the Respondent's Answer to this Complaint; however, as discussed above, the Respondent must file an Answer meeting the requirements of 40 C.F.R. § 22.15 in order to preserve the right to a hearing or to pursue other relief.

22. Should a hearing be requested, members of the public who commented on the issuance of the Complaint during the public comment period will have a right to be heard and to present evidence at such hearing under Section 309(g)(4)(B) of the Act, 33 U.S.C. § 1319(g)(4)(B).

VI. Settlement

23. EPA encourages all parties against whom civil penalties are proposed to pursue the possibility of settlement through informal meetings with EPA. Regardless of whether a formal hearing is requested, the Respondent may confer informally with EPA about the alleged violations or the amount of the proposed penalty. The Respondent may wish to appear at any informal conference or formal hearing personally, by counsel or other representative, or both. To request an informal conference on the matters described in this Complaint, please contact Mr. Matt Rudolph, of my staff, at (214) 665-6434.

24. If this action is settled without a formal hearing and issuance of an opinion by the siding Officer pursuant to 40 C.F.R. § 22.27, this action will be concluded by issuance of a

Consent Agreement and Final Order (CAFO) pursuant to 40 C.F.R. § 22.18(b). The issuance of a CAFO would waive the Respondent's right to a hearing on any matter stipulated therein or alleged in the Complaint. Any person who commented on this Complaint would be notified and given an additional thirty (30) days to petition EPA to set aside any such CAFO and to hold a hearing on the issues raised in the Complaint. Such a petition would be granted and a hearing held only if the evidence presented by the petitioner's comment was material and was not considered by EPA in the issuance of the CAFO.

25. Neither assessment nor payment of a penalty in resolution of this action will affect the Respondent's continuing obligation to comply with all requirements of the Act, the applicable regulations and permits, and any separate Compliance Order issued under Section 309(a) of the Act, 33 U.S.C. § 1319(a), including one relating to the violations alleged herein.

7-14-07
Date

John Blevins
Director
Compliance Assurance and
Enforcement Division

CERTIFICATE OF SERVICE

I certify that the foregoing Class I Administrative Complaint was sent to the following persons, in the manner specified, on the date below:

Original hand-delivered:
Regional Hearing Clerk (6RC-D)
U.S. EPA, Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Copy by certified mail, return receipt requested:
Mr. Patrick Adams, President
Altec Petroleum Group, Inc.
323 County Road 3460
Pawhuska, OK 74056

Copy by mail:
Ms. Diane Daniels, Environmental Director
Osage Nation Environmental
and Natural Resources Department
P.O. Box 1495
Pawhuska, OK 74056

Hand-delivered:
Ms. Lorraine Dixon (6RC-EW)
U.S. EPA, Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Dated: 7-15-09

Diane Dei

Penalty Calculation for Altec Petroleum

Under Section 309(g)(3) of the Clean Water Act (CWA) there are several factors specified for determining the amount of the penalty. These factors take into account the nature, circumstances, extent and gravity of the violation, or violations, and, with respect to the violator, ability to pay, any prior history of such violations, the degree of culpability, economic benefit or savings (if any) resulting from the violation, and such other matters as justice may require.

The following document will determine the following for this case: the maximum penalty and days of violation; the eight different components under CWA section 309(g)(3); and the penalty which should be assessed at a hearing.

Statutory Maximum Penalty and Days of Violation

Under Section 309(g)(3) of the CWA, 33 U.S.C. § 1319(g)(2)(A),the Respondent is liable for a civil penalty in an amount not to exceed $11,000 per day during which a violation continues, up to a maximum of $32,500.

Based on EPA's inspections; information submitted from the Oklahoma Department for Wildlife Conservation; and information submitted from the Respondent there was at a minimum two days of violation.

A drilling reserve pit located at the facility seeped pollutants to a tributary of Rock Creek on or before the EPA's inspection conducted on September 21, 2007. The Oklahoma Department for Wildlife Conservation first documented this seeping pit with photos on or about August 29, 2007. The Respondent submitted documents (Invoice 3005) stating they had spent $685 cleaning up a spill on September 6, 2007.

It appears the pit was back filled in on or about September 20, 2007, from evidence provided by the Oklahoma Department for Wildlife Conservation and the Respondent.

The same reserve pit was closed out improperly and continued to seep pollutants after September 21, 2007, to the tributary of Rock Creek. This is evident from the EPA's inspection conducted on March 10, 2008; samples taken by the Oklahoma Department for Wildlife Conservation; and documentation submitted by the Respondent (Invoice 3010). Invoice 3010 respondent stated "Sucked out hole" on both October 8, 2007 and October 15, 2007. This hole being referenced is located in the creek and the Respondent knowingly was discharging fluids into it. Each day the pit seeped or discharged pollutants to the tributary of Rock Creek was a violation of the CWA.

Days of violation – At least two

Statutory Maximum Penalty - $22,000

CWA Section 309(g)(3) Factors

Nature of the violation - unauthorized and unpermitted discharge of oil field brine (brine) in violation of Section 301 of the CWA. The term "oil field brine" is being used to describe fluids associated with oil and gas activities which are high in salts. Brine includes but is not limited to the following: drilling fluids; drilling returns; produced fluids; cementing fluids; hydraulic stimulation fluids; and etc. Brine is a prohibited pollutant and is extremely toxic to a fresh water ecosystem. No permit was issued for this brine discharge. One of the properly ways of disposing of brine is with a permitted Class II injection well.

Circumstances – The "Altec Petroleum" drilled an oil/gas well in a wildlife conservation area, and next to a relatively permanent creek. A seeping reserve pit at the facility located approximately 470 feet up-gradient of the creek acted as a "point source" "discharge" of "pollutants" to "waters of the US."

Extent and gravity of violation – This factor quantifies the gravity of the violation. The gravity of violation factor is broken down into four different components:

Significance of violation - This factor is based on the degree of exceedance of the most significant effluent limit violation in each month.

Health and environmental harm - A value for this factor is selected for each month in which one or more violations present actual or potential harm to human health or to the environment. Fluids located in the reserve pit which were discharged to the creek were extremely high in chlorides, salts, cementing material, drilling returns, and other contaminates.

Number of effluent violations - This factor is based on the total number of effluent limit violations each month.

Number of non-effluent limit violations - There are six types of non-effluent violations: 1) monitoring and reporting; 2) pretreatment program implementation; 3) sludge handling; 4) unauthorized discharges; 5) permit milestone schedules; and 6) other types of non-effluent violations. For this case the non-effluent violations are: monitoring and reporting; and unauthorized discharges.

Ability to pay – The Respondent has not submitted any documentation in regards to this component. It is believed the Respondent can pay the penalty.

Prior history of such violations – EPA has no knowledge of the Respondent having any prior history of similar violations.

Degree of culpability – The Respondent knowingly had a seeping pit, which was discharging harmful pollutants to a creek. The Respondent neglected and made very poor

Efforts to correct this problem and neglected to correct any harm this problem had caused to the environment. The Respondent knowingly drilled this well in an environmentally sensitive area. This area is a wildlife conservation area and the reserve pit was constructed close to a relatively permanent creek. The Respondent's parent company is an environmental consulting company and therefore should have known better.

The Respondent made a poor attempt to line the pit to stop the seep. The Respondent also made poor attempts in closing out the pit, which continued to seep pollutants after it was back filled in.

Economic benefit or savings – avoided or delayed costs for being noncompliant. This cost was calculated to be $0 (BEN model).

Other matters as justice may require – none at this time.

Penalty - $18,720

Case Name: Altec Petroleum Group Inc.

Prepared by Matt Rudolph and Lorraine Dixon [attorney name].

SETTLEMENT PENALTY CALCULATION WORKSHEET

STEP	AMOUNT
Calculate Statutory Maximum Penalty.	$22,000
1. Nature of the violation	$0
2. Circumstances	$0
3. Economic Benefit calculations [1]	$0
4. Gravity Amounts [2] a. Significance of violation (Monthly Range 0 to 20) b. Health and environmental harm (Monthly Range 0 to 50) c. Number of effluent limit violations (Monthly Range 0 to 5) d. Number of non-effluent limit violations (Monthly Range 0 to 70)	$16,000
5. Ability to pay	$0
6. Prior history of such violations	$0
7. Degree of culpability	$2,720
8. Other matters as justice may require	$0
TOTAL	**$18,720**

[1] See attached BEN calculation

[2] See Interim Clean Water Act Settlement Penalty Policy for gravity calculation and tables referenced to determine the Monthly Range amounts for each component.

Facility Name:	Altec Petroleum Group Inc.		
Docket Number:	CWA-06-2008-1832	Date:	March 13, 2008
Facility No:	OKU000636	Policy:	1995 CWA Settlement Policy
Prepared By:	Matt Rudolph		Version 10.7

Monthly Gravity Component Calculation Worksheet

Discharge Date	Discharge Volume (bbls)	Documented Fish Kill Yes	Documented Fish Kill No	Additive Factors A	Additive Factors B	Additive Factors C	Additive Factors D	**Total Gravity 1+(A+B+C+D) X $1000**
21-Sep-07	Unknown		X		3		4.0	8,000
10-Mar-08	Unknown		X		3		4.0	8,000
Total =	0						Total =	**$16,000**

Case Name:	Altec Petroleum Group Inc.	Date:	March 13, 2008
Prepared by:	Matt Rudolph	Attorney:	Lorraine Dixon
Docket Number:	CWA-06-2008-1832	Permit:	OKU000636

Clean Water Act NPDES Penalty Settlement Calculation Worksheet

Calculate Statutory Maximum Penalty Version 10.7

From:
To:

		Admin.	Judicial		
Unpermitted violations prior 2/97	0	0	0		
Permitted violations prior 2/97	0	0	0		
Unpermitted violations 2/1/97 to 3/15/200	0	0	0		
Permitted violations 2/1/97 to 3/15/2004	0	0	0		
Unpermitted violations after 3/15/2004	2	22,000	65,000	Admin.:	$22,000
Permitted violations after 3/15/2004	0	0	0	Judicial:	$65,000

Economic Benefit (attach BEN printouts, with explanations for calculations)	$0
Total of **Monthly Gravity Amounts**	$16,000
Economic Benefit + Gravity Amounts	$16,000

Gravity Adjustments

Flow Reduction (0-50%)	0%	$0	
Recalcitrance Factor (0-150%)	17%	$2,720	
Quick Settlement Reduction (0-10%)	0%	$0	
Total gravity adjustments		$2,720	$2,720

Preliminary Penalty Amount	$18,720
Litigation Consideration (if any) Regional Counsel Concurrence:_____	$0
Ability to Pay reduction (if any) Attach ABEL, INDIPAY or MUNIPAY report	$0
Bottom Line without Economic Benefit	$18,720
Bottom-line Cash Settlement Penalty	**$18,720**

National Municipal Litigation (NML) Alternative Penalty Calculation

Is Respondent a Muncipality	No		0
Service Population			#REF!
Actual or Potential Harm			
Months of Violation			
Economic Benefit	$0		

ee Section IV.D.7. of the Settlement Policy

Bottom Line with NML	
Supplemental Environmental Projects (see above section for NML SEP calculations)	
Bottom-line with Max. SEP Credit	$4,680

Respondent showed severe recalcitrance: by not respondeing to an AO issued; not wanting to work with the EPA or the Oklahoma Attorney General on this matter.

Litigation Considerations & Inability to Pay $0

The government may reduce the amount of a civil penalty to reflect weaknesses in a case where the facts demonstrate a substantial likelihood that the government will not achieve a higher penalty at trial. This amount is determined by Regional Counsel based on their legal review of the case and their experience in settling similar cases. No litigation consideration amount has been deemed appropriate by Regional Counsel for this case. Additionally, Respondent has not yet claimed an inability to pay. If Respondent makes such a claim, EPA will evaluate the inability to pay according to ABEL and MUNIPAY economic models, and reduce the penalty accordingly.

National Municipal Litigation: #REF!

In those cases against a municipality or other public entity, in which the entity has failed to comply with the CWA, but nevertheless did make good faith efforts to comply, the EPA may mitigate the preliminary penalty amount with this penalty calculation formula using table A of this policy. This facility is not a municipality and does not qualify.

Supplemental Environmental Projects $17,550 80%

Based on the above rationale and information documented in the Monthly Gravity Component Calculation Worksheet and the Settlement Calculation Worksheet, the final bottom line penalty is:

$4,680

Case Conclusion:

Initials	Date of Initials	Name Printed	Title
		Matt Rudolph	Enforcement Officer
		Lorraine Dixon	Attorney

*NOTE: Civil Penalty less than $500,000 or equal to will be approved by the Branch Chief.
Anything over $500,00 will be approved by the Division Director

I. Penalty reduction/increase - Section Chief (20 - 35% below bottom line)
II. Penalty reduction/increase - Branch Chief (35-50% bbl & approves inability to pay below 10%)
III. Penalty reduction/increase - Divisoin Director (more than 50%bbl)

ENFORCEMENT SENSITIVE* *INTERNAL* *ANALYTICAL* * DELIBERATIVE

INTERIM CLEAN WATER ACT SETTLEMENT PENALTY POLICY

March 1, 1995

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ATTACHMENT 1 -- Examples of How to Calculate Statutory Maximum Penalty

ATTACHMENT 2 -- Settlement Penalty Calculation Worksheet

I. INTRODUCTION

Section 309 of the Clean Water Act (CWA), (33 U.S.C. §1319) authorizes the Administrator of the U.S. Environmental Protection Agency ("EPA" or "Agency") to bring civil judicial and administrative actions against those who violate certain enumerated requirements of the CWA. In such actions the Administrator may seek civil penalties.

EPA brings enforcement actions to require alleged violators to promptly correct the violations and remedy any harm caused by the violations. As part of an enforcement action, EPA also seeks substantial monetary penalties which promote environmental compliance and help protect public health by deterring future violations by the same violator and deterring violations by other members of the regulated community. Penalties help ensure a national level playing field by ensuring that violators do not obtain an unfair economic advantage over competitors who have done whatever was necessary to comply on time. Penalties also encourage companies to adopt pollution prevention and recycling techniques, so that they minimize their pollutant discharges and reduce their potential liabilities.

This Policy implements the Agency's February 1984 general *Policy on Civil Penalties* (#GM-21) and the companion document, *A Framework for Statute Specific Approaches to Penalty Assessments* (#GM-22), both issued on February 16, 1984. This Policy revises and hereby supersedes the *Clean Water Act Penalty Policy for Civil Settlement Negotiations* issued on February 11, 1986.[1]

This document sets forth the policy of the EPA for establishing appropriate penalties in settlement of civil judicial and administrative actions. Subject to the circumstances of a particular case, this policy provides the lowest penalty figure which the Federal Government should accept in a settlement. This Policy is drafted so that violators whose actions, or inactions, resulted in a significant economic benefit and/or harmed or threatened public health or the environment will pay the highest penalties. Obviously, where settlement is not possible, the Government reserves the right to seek penalties up to the statutory maximum.

II. PURPOSE

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[1] The guidances issued to interpret and supplement the 1986 Penalty Policy are also superseded. These documents are the: Addendum to the Clean Water Act Civil Penalty Policy for Administrative Penalties, issued August 28, 1987; Guidance on Penalty Calculations for POTW Failure to Implement an Approved Pretreatment Program, issued December 22, 1988; Bottomline Penalties for Cases Involving More than Five Years of Non-Compliance, issued May 11, 1992; Gravity Penalty Pilot Policy for Clean Water Act Cases, issued November 12, 1992; and Final Interim Guidance on Use of Litigation Consideration Reductions in the Clean Water Act Penalty Policy, issued October 10, 1993 (which incorporated the November 1992 Gravity Penalty Pilot Policy).

The purpose of this Policy is to further four important environmental goals. First, penalties should be large enough to deter noncompliance. Second, penalties should help ensure a level playing field by ensuring that violators do not obtain an economic advantage over their competitors. These two goals generally require that penalties recover the economic benefit of noncompliance, plus an appropriate gravity amount. Third, CWA penalties should be generally consistent across the country. This is desirable as it not only prevents the creation of "pollution havens" in different parts of the nation, but also provides fair and equitable treatment to the regulated community wherever they may operate. Fourth, settlement penalties should be based on a logical calculation methodology to promote swift resolution of enforcement actions and the underlying violations.

III. APPLICABILITY

This Policy applies to all CWA civil judicial and administrative actions filed after the effective date of this Policy, and to all such pending cases in which the government has not yet transmitted to the defendant or respondent an oral or written proposed settlement penalty amount. This Policy also may be applied (instead of the 1986 version) in pending cases in which penalty negotiations have commenced if application of this Policy would not be disruptive to the negotiations. This Policy applies to civil judicial and administrative penalties sought under CWA §309, including: violations of NPDES permit limits and conditions; discharges without an NPDES permit; violations of pretreatment standards and requirements (including local limits and pretreatment programs); violations of §405 sludge use or disposal requirements; violations of §308 information requests; and violations of §309(a) compliance orders. This Policy does not apply to actions brought exclusively under CWA §311 (oil and hazardous substance spills) nor for violations of requirements in §404 ("wetlands" cases involving disposal of dredged or fill material). Separate penalty policies apply to these two types of cases.

This Policy sets forth how the Agency generally expects to exercise its enforcement discretion in deciding on an appropriate enforcement response and determining an appropriate settlement penalty. In some cases, the calculation methodology set forth here may not be appropriate, in whole or part; in such cases, with the advance approval of the Assistant Administrator, an alternative or modified approach may be used.

This Policy only establishes how the Agency expects to calculate the minimum penalty for which it would be willing to settle a case. The development of the penalty amount to plead in an administrative or judicial complaint is developed independent of this Policy, except that the Agency may not seek a settlement penalty in excess of the statutory maximum penalty for the violations alleged in the complaint. This Policy is not intended for use by EPA, violators, courts, or administrative judges in determining penalties at a hearing or trial. (Also see §VI below).

A settlement penalty calculation is generally required before the Agency files an administrative complaint or refers a civil action to the Department of Justice. The penalty

calculation should be revised as relevant new information is discovered during the course of the litigation. The penalty calculation should be reviewed periodically (e.g.,on the anniversary of when the complaint was filed) to determine if any revisions to the calculation are necessary.

IV. PENALTY CALCULATION METHODOLOGY

Before proceeding to calculate the settlement penalty, Agency staff should estimate the statutory maximum penalty in order to determine the potential maximum penalty liability of the discharger.[2] The penalty which the government seeks in settlement may not exceed this statutory maximum amount. Examples of how to calculate the statutory maximum are set forth in Attachment 1. In general, the statutory maximum penalty for violations of an effluent limit for a period longer than one day includes a separate penalty for each day in the time period (assuming there was a discharge on each day).

The settlement penalty is calculated based on this formula:

Penalty = Economic Benefit + Gravity +/- Gravity Adjustment Factors - Litigation Considerations - Ability to Pay - Supplemental Environmental Projects.

Each component of the penalty calculation is discussed below. A worksheet summarizing the penalty calculation is included as Attachment 2.

A. Economic Benefit

Consistent with EPA's February 1984 *Policy on Civil Penalties,* every effort should be made to calculate and recover the economic benefit of noncompliance. The objective of the economic benefit calculation is to place violators in the same financial position as they would have been if they had complied on time. Persons that violate the CWA are likely to have obtained an economic benefit as a result of delayed or completely avoided pollution control expenditures during the period of noncompliance. Commonly delayed and avoided CWA pollution control expenditures, include, but are not limited to:

- Monitoring and Reporting (including costs of the sampling and proper laboratory analysis);
- Capital equipment improvements or repairs, including engineering design, purchase, installation, and replacement;

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[2] This calculation of the statutory maximum penalty, done as part of the settlement penalty calculation, is a legal evaluation, subject to the attorney-work product privilege. This calculation is not intended for use in court.

- Operation and maintenance expenses (e.g. labor, power, chemicals) and other annual expenses; and

- One-time acquisitions (such as land purchase).

The standard method in settlement efforts for calculating the economic benefit from delayed and avoided pollution control expenditures is through the use of the Agency's BEN model. Refer to the "BEN User's Manual" (Office of Enforcement, December 1993, or any subsequent revision) for specific information on the operation and proper use of BEN. There is no minimum amount triggering the use of the BEN model. In estimating economic benefit using the BEN model, the benefit should be calculated from the first date of noncompliance, but EPA generally does not go back no more than five years prior to the date when the complaint should be filed.[3]

The BEN model will produce a valid estimate of the economic benefit from delayed and avoided compliance costs only if it is properly used.[4] Before using the BEN model you need a defensible theory of on-time compliance: that is, the pollution control system or measures the violator should have installed and operated earlier to have prevented the CWA violations at issue in the case.[5] As a general rule, the best evidence of what the violator should have done to prevent the violations, is what it eventually does (or will do) to achieve compliance.[6]

In some cases, the BEN model may not be an appropriate methodology for estimating economic benefit or will not capture the full scope of the economic benefit. For example, if the violator is a privately-owned regulated utility, the standard BEN model may not be appropriate. In this situation, the Agency should consider a wrongful profits analysis and seek to recover the profits and other competitive market benefits the violator obtained as a result of operating during the period of violation.[7] In another type of case, if the violator decides that its "method of

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[3] The five year guideline for when the BEN and gravity calculations starts is a policy decision. Legally, there is nothing that prevents EPA from calculating economic benefit or gravity from the first date of violation, even if that is more than five years before the complaint is filed, as long as the statutory maximum penalty (calculated pursuant to the five year statute of limitations) exceeds the settlement penalty amount.

[4] The BEN model does not calculate the "competitive advantage" benefits a firm may have obtained as a result of operating in violation of the law. Such benefits include profits and increases in market share from selling goods and services during the period of violation.

[5] The BEN model is comparing the compliance costs the violator would have paid if it had complied on-time, versus the usually smaller compliance costs it actually pays by complying late.

[6] See BEN User's Manual, December 1993, page 6-2.

[7] Regions should consult Headquarters for how to conduct this analysis; a financial consultant is likely to be needed.

compliance" is to cease operations at the facility, conducting a BEN analysis may be complicated.[8] In a few unusual cases, economic benefit may be negative: this means, e.g., operating the old inefficient treatment system was more expensive than purchasing and operating a new, more efficient treatment system. When economic benefit is negative, the settlement calculation enters zero as the economic benefit.

B. Gravity Component

The gravity calculation methodology is based upon a logical scheme and criteria that quantifies the gravity of the violation based upon the CWA and its regulatory programs. Every reasonable effort must be made to calculate and recover a gravity component in addition to the economic benefit component. As EPA's February 1984 *Policy on Civil Penalties,* states on page 4:

> The removal of the economic benefit of noncompliance only places the violator in the same position as he would have been if compliance had been achieved on time. Both deterrence and fundamental fairness require that the penalty include an additional amount to ensure that the violator is economically worse off than if [he] had obeyed the law.

The gravity component of the penalty is calculated for each month in which there was a violation. The total gravity component for the penalty calculation equals the sum of each monthly gravity component. The monthly gravity formula is:

Monthly gravity component = (1 + A + B + C + D) x $1,000.

The four gravity factors -- A, B, C, and D -- are considered for each month in which there were one or more violations. Values are assigned to each of the four factors as described in the text and tables below. In performing the gravity calculation, the monthly gravity component is calculated from the first date of noncompliance up to when the violations ceased or the date the complaint is expected to be filed, but EPA has the option to start the gravity calculation no more than five years prior to the date when the complaint should be filed. (See footnote #4.) In cases with continuing violations, the gravity calculation should be revised periodically to include additional months of violations that have occurred since the previous calculation.

---

[8] In cases where a facility determines that it can only comply by ceasing operations, an appropriate BEN analysis would be to input the savings obtained from the delayed closure costs and the avoided costs of not treating the wastewater during the period of noncompliance. See Appendix B in BEN User's Manual. If it is not possible to estimate these avoided treatment costs, then a wrongful profit analysis is necessary.

"A" -- Significance of Violation (Monthly Range 0 to 20). This factor is based on the degree of exceedance of the most significant effluent limit violation in each month. Values for this factor are selected from within designated ranges; violations of toxic monthly effluent limits are weighted most heavily. Values are selected using the table below based on the effluent value which yields the highest factor A value. Regions select a particular value for factor A within the designated range. For purposes of this table conventional and nonconventional pollutants include biochemical oxygen demand, chemical oxygen demand, total oxygen demand, dissolved oxygen, total organic carbon, total suspended solids, total dissolved solids, inorganic phosphorous compounds, inorganic nitrogen compounds, oil and grease, calcium, chloride, fluoride, magnesium, sodium, potassium, sulfur, sulfate, total alkalinity, total hardness, aluminum, cobalt, iron, vanadium and temperature. Factor A values for fecal coliform and pH, which are calculated using logarithmic scales, are calculated using the special scales at the bottom of the table. All other pollutants are classified as toxic pollutants.

If there were no effluent limit violations in a particular month, but there were other violations, then factor A is assigned a value of zero in that month's gravity calculation. In pretreatment cases in which the industrial user was not required to provide monthly compliance reports, and provided less frequent effluent data (e.g., in a 40 CFR §403.12(e) periodic compliance report), any effluent violations reported in the report are assumed to represent identical violations in each month of the reporting period for purposes of calculating gravity if there is substantial evidence supporting this assumption. Examples of such evidence are: (1) no pretreatment equipment was in operation during the period and (2) the production and treatment operations remained consistent during the period. This means the monthly gravity calculation, with a factor A value, should be repeated for all of the months covered by the report.[9] If there was no evidence indicating continuing violations throughout the period covered by the periodic compliance report, then a value for Factor A should be assigned only for the month in which the sampling occurred. If the industrial user did not notify the control authority and repeat the sampling after finding the effluent violation as required by 40 CFR §403.12(g)(2), then an appropriate value for gravity Factor D should be assigned for this notification or monitoring violation(s).

---

[9] The pretreatment regulations, 40 CFR §403.12(g)(3), require the periodic compliance reports to contain data which "is representative of conditions occurring during the reporting period." For example, if an industrial user reports in its December (semi-annual) periodic compliance report that it violated the daily maximum cadmium limit by 150% in September, and this was the most significant effluent violation, using the Gravity Factor A Table, factor A will be assigned a value between 3 and 7 for each of the six months covered by the report (July - December) if, e.g., EPA had evidence that the facility lacked treatment equipment during that period and wastewater generating operations were consistent during the period.

GRAVITY FACTOR A -- SIGNIFICANCE OF THE VIOLATION

Select a value for factor A based on the effluent limit violated in the month which produces the highest range of values for factor A.

Percent by which effluent limit was exceeded:			Factor A Value Ranges	
Monthly Average	7-day Average	Daily Maximum	Toxic Pollutants	Conventional & Nonconventional Pollutants
1 - 20	1 - 30	1 - 50	1 - 3	0 - 2
21 - 40	31 - 60	51 - 100	1 - 4	1 - 3
41 - 100	61 - 150	101 - 200	3 - 7	2 - 5
101 - 300	151 - 450	201 - 600	5 - 15	3 - 6
301 - >	451 - >	601 - >	10 - 20	5 - 15

Percent Exceedance of Fecal Coliform Limit:	Standard Units above or below pH limit:	Factor A Value Ranges:
0 - 100	0 - .50	0 - 5
101 - 500	.51 - 2.0	2 - 8
501 - 5,000	2.01 - 3.0	4 - 10
5,001 - >	3.01 - 4.0	6 - 12
	4.01 - >	8 - 15

"B" -- Health and Environmental Harm (Monthly Range 0 to 50). A value for this factor is selected for each month in which one or more violations present actual or potential harm to human health or to the environment. Values are selected using the table below based on the type of actual or potential harm that yields the highest factor value.

GRAVITY FACTOR B -- HEALTH AND ENVIRONMENTAL HARM	
Type of Actual or Potential Harm	**Factor B Value Ranges**
Impact on Human Health (e.g., interference with drinking water supplies, harm or increased risks to subsistence fishing)	10 - 50
Impact on Aquatic Environment (or the POTW)	
Water quality-based effluent standard(s) or whole effluent toxicity limit violated	1 - 10
Fish kill, beach closing, restrictions on use of water body; or pass through or interference at the POTW caused by the IU discharge.	4 - 50
Other impact on aquatic environment	2 - 25

"C" -- Number of Effluent Limit Violations (Monthly Range 0 to 5). This factor is based on the total number of effluent limit violations each month. (Violations of interim limitations in administrative orders are not counted here, but included as part of recalcitrance.) In order to properly quantify the gravity of the violations, all effluent limit violations are considered and evaluated. Violations of different parameters at the same outfall are counted separately and violations of the same parameter at different outfalls are counted separately. The guidelines in Attachment 1 for calculating the statutory maximum penalty are generally not applicable for selecting the value for gravity factor C (e.g., violation of a weekly limit need not be calculated as 7 separate violations). A minimum factor C value of 1 is generally appropriate whenever there are violations of two or more different pollutants. Values for this factor may be selected by comparing the number of effluent limits exceeded with the number of effluent limits in the permit: e.g., if all of the limits in the permit were violated in a month, a value of 5 would be appropriate; if 50 percent of the limits in the permit were violated, a factor of 2 or 3 would be appropriate.

"D" -- Significance of Non-effluent Limit Violations. This factor has a value ranging from 0 (zero) to 70 and is based on the severity and number of the six different types of non-effluent limitation requirements violated each month. There are six types of non-effluent violations: 1) monitoring and reporting; 2) pretreatment program implementation; 3) sludge handling; 4) unauthorized discharges; 5) permit milestone schedules; and 7) other types of non-effluent violations. The value for factor D for each month in which there is a non-effluent limit violation is selected pursuant to the table on the next page. The factor D value for a given month is the sum of the highest value for each type of non-effluent limit violation.

With regards to monitoring and reporting violations, the failure to submit a report in a timely manner should generally not be treated as a continuing violation past the month in which the report is due. For example, if an industrial user fails to submit a baseline monitoring report as required by 40 CFR 403.12(b), this should be counted as a violation only in the month when the

report was due. Given the importance of such a report, if the violator fails to submit the report at all a factor D value of 5 or more may be appropriate for this violation.[10]

With regards to pretreatment program implementation violations, "key program activities" include: identifying all industrial users; issuing appropriate control mechanisms to all significant industrial users (SIUs); inspecting SIUs; enforcing industrial user self-monitoring; enforcing pretreatment standards (including local limits); submitting pretreatment reports to the approval authority; and failing to comply with other significant pretreatment program obligations. The 1989 *Guidance for Reporting and Evaluating POTW Noncompliance with Pretreatment Requirements* or subsequent revisions may be helpful in evaluating the seriousness of pretreatment program implementation violations.

As an example of calculating factor D for a given month, assume a discharger did not sample for 4 of the 8 parameters in its permit, the discharge monitoring report was submitted 20 days late, and there were several days of discharge of a process wastestream through an unauthorized outfall without any treatment. Using the factor D table, for Type 1, a value of 4 may be selected based on the failure to conduct sampling for half of the parameters; the delay in submitting sampling data is not considered since the other Type 1 violation produces a higher value. For the unauthorized discharge of the process wastestream, a value of 6 may be selected for Type 4. Since there are no Type 2, 3, 5, and 6 violations, a value of 0 is entered for each of these Types. Thus, the total value for factor D for this month is 10.

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[10] The failure to provide the regulatory agency with required sampling data on the discharge is a very serious violation as this eliminates the government's ability to perform necessary oversight and allows the discharger to avoid the possible application of gravity factor A.

GRAVITY FACTOR D -- NON-EFFLUENT LIMIT VIOLATIONS	
THE FACTOR D VALUE FOR A GIVEN MONTH IS THE SUM OF THE HIGHEST VALUE FOR EACH TYPE OF NON-EFFLUENT LIMIT VIOLATION.	
Type and Extent of Violation	**Factor D Value Ranges**
1. Effluent Monitoring and Reporting Violations:	
Failure to conduct or submit adequate pollutant sampling data for 1 or more pollutant parameters (but not all parameters)	1 to 6
Failure to conduct or submit any required pollutant sampling data in a given month but with a reasonable belief that the facility was in compliance with applicable limits.	2 to 6
Failure to conduct or submit any required pollutant sampling data in a given month without a reasonable basis to believe that facility was otherwise in compliance with applicable limits.	6 to 10
Failure to conduct or submit whole effluent toxicity sampling data	4 to 10
Delay in submitting sampling data	0 to 5
Failure to submit a pretreatment baseline report, 90-day compliance report, or periodic compliance report (40 CFR 403.12(b), (d), or (e,) or failure to sample again after finding a violation (40 CFR 403.12(g)(2)).	2 to 8
Any other monitoring or reporting violation	0 to 10
2. Pretreatment Program Implementation Violations : All key program activities implemented, with some minor violations. One or two key program activities not implemented Many key program activities not implemented Few if any program activities implemented	 0 to 4 2 to 6 4 to 8 6 to 10
3. Failure to properly control, treat, or dispose of sludge	1 to 10
4. Unauthorized discharge: e.g., discharge through an unpermitted outfall, discharge of a wastestream not identified in the permit, sewer overflows, or spill (other than oil or §311 hazardous substance)	1 to 20
5. Violation of permit milestone schedule	1 to 10
6. Any other type of noneffluent limit violation	1 to 10

C. Gravity Adjustment Factors

In certain circumstances as explained below, the total monthly gravity amount may be adjusted by three factors: flow reduction factor (to reduce gravity); history of recalcitrance (to increase gravity); and the quick settlement reduction factor (to reduce gravity). The resulting figure -- benefit + (gravity +/- gravity adjustments) -- is the preliminary penalty amount.

Flow Reduction Factor for Small Facilities. The total monthly gravity amount may be reduced based on the flow of the facility. This factor is applicable to direct and indirect discharges, both municipal and non-municipals. Flow reduction percentages are selected using the table below. In order to ensure that these reductions are directed at small facilities (that are not otherwise part of large corporation), this gravity reduction does not apply to non-municipals if the facility or parent corporation employs more than 100 individuals.

FLOW REDUCTION FACTOR	
AVERAGE DAILY WASTEWATER DISCHARGE FLOW (in gallons per day)	PERCENTAGE REDUCTION FACTOR OF TOTAL GRAVITY
Less than 5,000	50
Between 5,000 and 9,999	40
Between 10,000 and 19,999	30
Between 20,000 and 29,999	20
Between 30,000 and 49,999	10
Between 50,000 and 99,999	5
100,000 and above	0 (i.e., no reduction)

History of Recalcitrance Adjustment Factor. The "recalcitrance" factor is used to increase the penalty based on a violator's bad faith, or unjustified delay in preventing, mitigating, or remedying the violation. Recalcitrance is also present if a violator failed to comply with an EPA issued administrative compliance order or a §308 information request, or with a prior state or local enforcement order. This factor is applied by multiplying the total gravity component by a percentage between 0 and 150. In administrative penalty actions, violations of administrative compliance orders are not included in the recalcitrance calculation (because EPA lacks the authority to seek penalties in the administrative forum for violations of administrative compliance orders).

A minimum recalcitrance factor of 10 percent is generally appropriate for each instance in which a violator fails to substantially comply in a timely manner with an administrative compliance

order ("AO"), a §308 information request, or a state enforcement order. Thus, if a particular discharger violated 3 AOs, a minimum recalcitrance factor of 30 percent is generally appropriate. If a violator completely fails to comply with an AO or §308 request, a recalcitrance factor of 20 percent may be appropriate for that failure, while if there were only minor violations of the AO or request, a recalcitrance factor of 5 percent may be appropriate for that violation.

Quick Settlement Adjustment Factor. In order to provide an extra incentive for violators to negotiate quickly and reasonably, and in recognition of a violator's cooperativeness, EPA may reduce the gravity amount by 10 percent if EPA expects the violator to settle quickly. For purposes of this reduction factor, in Class I administrative enforcement actions, a quick settlement is when the violator signs an administrative consent order resolving the violations within four months of the date the complaint was issued or within four months of when the government first sent the violator a written offer to settle the case, whichever date is earlier. In Class II administrative enforcement actions and judicial cases, the controlling time period is 6 and 12 months, respectively. If the violator is not able to sign the consent order within this time period, this adjustment does not apply.

Environmental Auditing Adjustment Factor. This interim revision of the Penalty Policy contains no explicit gravity adjustment factor for violators that conduct, or fail to conduct, environmental audits, disclose the results to the government, promptly correct the violations and remedy any harm. This interim revision of the Policy (and the original 1986 version), however, automatically produces smaller penalty amounts for violators who promptly remedy violations. This is because violators who promptly remedy violations will have shorter histories of violations and this automatically reduces both the economic benefit and gravity amounts. After the Agency completes its review of its environmental auditing policy, this Policy may be reissued with an explicit adjustment factor for this factor. In the interim, Regions, may with the advance approval of Headquarters, appropriately adjust the gravity amount based on the presence, or absence, of an environmental auditing program.

D. Litigation Considerations (to decrease preliminary penalty amount)

1. Overview. The government should evaluate every penalty with a view toward litigation and attempt to ascertain the maximum civil penalty the court or administrative judge is likely to award if the case proceeds to trial or hearing. Many enforcement cases may have mitigating factors, weaknesses or equitable problems that could be expected to persuade a court to assess a penalty less than the statutory maximum amount. The simple existence of weaknesses in a case, however, should not automatically result in a litigation consideration reduction of the preliminary bottom-line settlement penalty amount (economic benefit + gravity $\pm$ gravity adjustment factors). The government may reduce the amount of the civil penalty it will accept at settlement to reflect weaknesses in its case where the facts demonstrate a substantial likelihood that the government will not achieve a higher penalty at trial.

2. Legal Evaluation. The mere existence of weaknesses or limitations in a case should not result in a reduction of the preliminary bottom-line settlement penalty amount, unless the Agency determines that the preliminary settlement amount is more than EPA is likely to obtain at trial.[11] In evaluating potential litigation consideration reductions, EPA legal staff should: (a) Determine the statutory maximum penalty; (b) Evaluate what penalty the court might assess at trial given the particular strengths and weaknesses of the case; and, (c) Compare this amount to the preliminary settlement amount (benefit + gravity + recalcitrance).

While Agency legal staff cannot predict the exact penalty amount a court might assess at trial, case law indicates that a court should use the statutory maximum as its preliminary penalty figure, and then reduce that amount, as appropriate, using only the penalty assessment factors in §309(d) of the Act. Fitting the facts of EPA's enforcement case to the method adopted by the courts in recent CWA penalty decisions provides the Agency with the clearest method to estimate penalty litigation outcomes.[12]

3. Application. Adjustments for litigation considerations are taken on a factual basis specific to the case. Before a complaint is filed, the application of certain litigation considerations is almost always premature, since the Agency generally does not have enough information to fully evaluate litigation risk regarding the assigned judge's previous ruling on similar matters, the court's informed opinion, or witness performance. Other litigation considerations, including evidentiary matters, witness availability, and equitable defenses often may not be reliably demonstrated until after case filing. Reductions for these litigation considerations are more likely to be appropriate after the Agency obtains an informed view, through discovery and settlement activities, of the strengths and weaknesses in its case and how the specific court views penalties in the case. Pre-filing settlement negotiations are often helpful in identifying and evaluating litigation considerations, especially regarding potential equitable defenses, and thus reductions based on such litigation considerations may be appropriately taken before the complaint is filed. As a general rule, the greater the disparity between the maximum statutory penalty and the preliminary penalty amount, the less litigation considerations should affect the Agency's settlement position.

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[11] In many situations, weaknesses or limitations in a case are already accounted for in the preliminary penalty calculation. For example, the gravity calculation will be less in those circumstances in which the period of violation was brief, the exceedances of the limitations were small, the pollutants were not toxic, or there is no evidence of environmental harm. The economic benefit calculation also will be smaller when the violator has already returned to compliance since the period of violation will be shorter.

[12] The prevailing CWA case law on the assessment of penalties indicates that, in assessing a penalty, a court begins at the statutory maximum amount and reduces the penalty based on the specific factors set out in section 309(d) of the CWA. See Atlantic States Legal Foundation v. Tyson Foods, 897 F.2d 1128 (11th Cir. 1990). In contrast, settlement penalties calculated pursuant to this Policy build the Agency's bottom line negotiating position upward from zero, generally ending up with a figure orders of magnitude less than the statutory maximum penalty.

4. Possible Litigation Considerations. While there is no universal list of litigation considerations, the following factors may be appropriate in evaluating whether the preliminary settlement penalty exceeds the penalty the Agency would likely obtain at trial:

a. Known problems with the reliability or admissibility of the government's evidence proving liability or supporting a civil penalty;

b. The credibility, reliability, and availability of witnesses;[13]

c. The informed, expressed opinion of the judge assigned to the case (or person appointed by the judge to mediate the dispute), after evaluating the merits of the case.[14]

d. The record of the judge in any other environmental enforcement case presenting similar issues. (In contrast, the reputation of the judge, or the judge's general demeanor, without a specific penalty or legal statement on a similar case, is rarely sufficient as a litigation consideration.)

e. Statements made by federal, State or local regulators that may allow the respondent or defendant to credibly argue that it believed it was complying with the federal law under which EPA is seeking penalties.

f. The payment by the defendant of civil penalties for the same violations in a case brought by another plaintiff.[15]

g. The development of new, relevant case law.

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[13] The credibility and reliability of witnesses relates to their demeanor, reputation, truthfulness, and impeachability. For instance, if a government witness has made statements significantly contradictory to the position he is to support at trial, his credibility may be impeached by the respondent or defendant. The availability of a witness will affect the settlement bottom-line if the witness cannot be produced at trial; it does not relate to the inconvenience or expense of producing the witness at trial.

[14] This factor, except as provided below with respect to the record of the judge or other trier of fact, may not be applied in anticipation, or at the stage of initial referral, and should not be distorted by taking at face value what a judge attempting to encourage a settlement might say.

[15] If the defendant has previously paid civil penalties for the same violations to another plaintiff, this factor may be used to reduce the amount of the settlement penalty by no more than the amount previously paid for the same violations. (If the previous plaintiff was a State qualified to preempt federal enforcement under EPA's interpretation of Section 309(g)(6), EPA's complaint should not include counts already addressed by a penalty. See "Supplemental Guidance on Section 309(g)(6) (A) of the Clean Water Act," memorandum from Frederick F. Stiehl, Enforcement Counsel for Water, to Regional Counsels, March 5, 1993, and "Guidance on State Action Preempting Civil Penalty Enforcement Actions Under the Federal Clean Water Act, OE/OW, August 28, 1987.)

h. A blend of troublesome facts and weak legal arguments such that the Agency faces a significant risk of obtaining a nationally significant negative precedent at trial.

5. Not Litigation Considerations. In contrast to the above list of possible litigation considerations, the following items are not litigation considerations:

a. A generalized goal to avoid litigation or to avoid potential precedential areas of the law.[16]

b. A duplicative use of elements included or assumed elsewhere in the Penalty Policy, such as inability to pay, "good faith"[17], "lack of recalcitrance", or a lack of demonstrated environmental harm[18].

c. Off-the-record statements by the court, before it has had a chance to evaluate the specific merits of the case are, by themselves, not a reason to reduce the preliminary settlement penalty amount. (Compare with 4.c above.)

d. The fact that the receiving water is already polluted or that the water can assimilate additional pollution is not a litigation consideration.[19]

e. By itself, the failure of a regulatory agency to initiate a timely enforcement action is not a litigation consideration.[20]

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[16] A generalized desire to minimize litigation costs is not a litigation consideration.

[17] The efforts of the violator to achieve compliance or minimize the violations after EPA, a State or pretreatment control authority has initiated an enforcement action (i.e., an administrative or judicial enforcement action) do not constitute "good faith" efforts. If such efforts are undertaken before the regulatory agency initiates an enforcement response, the settlement penalty calculation already includes such efforts through a potentially smaller economic benefit amount, a shorter or less serious gravity component, or a lack of any recalcitrance. The Penalty Policy assumes all members of the regulated community will make good faith efforts both to achieve compliance and remedy violations when they occur; consequently the settlement penalty calculation begins at zero and builds upward, with no reductions for good faith. In contrast, the absence of good faith efforts provides the basis for increasing the penalty through use of the recalcitrance factor.

[18] The gravity calculation will reflect the lack of environmental harm. Courts have considered the extent of environmental harm associated with violations in determining the "seriousness of violations" pursuant to the factors in §309(d), and have used the absence of any demonstrated or discrete identified environmental harm to impose less than the statutory maximum penalty. Proof of environmental harm, however, is neither necessary for liability nor for the assessment of penalties.

[19] See, e.g., Natural Resources Defense Council v. Texaco Refining and Mktg., 800 F. Supp. 1, 24 (D. Del. 1992).

[20] See PIRG v. Powell Duffryn, 913 F. 2d 64, 80-81 (3rd Cir. 1990).

6. Approval of Litigation Considerations. The Agency recognizes that the quantitative evaluation of litigation considerations often reflects subjective legal opinions. Therefore, EPA Regions may reduce the preliminary penalty amount for litigation considerations for up to one-third of the net gravity amount (i.e., gravity as modified by the gravity adjustment factors) without Headquarters approval (where such approval would otherwise be required). Of course, such a reduction must be fully explained and maintained in the case file. This reduction is not applicable in municipal cases in which the tables in D.7 below are used.

7. Municipal Cases. In those cases against a municipality or other public entity (such as a sewer authority) in which the entity has failed to comply with the Clean Water Act but nevertheless did make good faith efforts to comply, the Agency may mitigate the preliminary penalty amount based on this national municipal litigation consideration. The preliminary penalty amount (economic benefit + gravity ± gravity adjustments) may be mitigated to no less than the cash penalty determined by operation of the two tables set forth below. In addition, the cash penalty amount established by the tables may be reduced based on compelling ability to pay considerations and by up to 40 percent for appropriate supplemental environmental projects. Reducing the cash penalty below the amount established by the national municipal litigation consideration (other than for ability to pay considerations or for 40 percent based on a SEP) requires compelling evidence of other considerations and the prior approval of Headquarters (even if Headquarters' approval of the settlement would otherwise not be required).

The national municipal litigation consideration is a discretionary factor and the Agency is under no obligation to use it in all municipal cases.[21] It should only be used if there is some evidence that the municipality made a good faith effort to comply. The national municipal litigation consideration is based on the economic benefit, environmental impact, duration and size of the facility, and is derived, in part, on the settlement penalties EPA has obtained from judicial municipal cases settled between October 1988 and December 1993. There are three steps to calculate a penalty using the national municipal litigation consideration tables.

1. Using Table A determine the economic benefit environmental impact factor amount. This dollar amount is found by selecting an appropriate value from the range in the appropriate cell in Table A. The economic benefit is the benefit previously calculated pursuant to section IV.A. above. Impact of the violations is based on the actual or potential (risk) of harm caused, in whole or part, by the violations.

2. Using Table B determine the population months of violations factor amount. This dollar amount is found by selecting an appropriate value from the range in the appropriate cell in Table B. The service population is the total population served by the violating

[21] The national municipal litigation consideration is primarily intended to apply in cases in which there has been a failure to timely construct treatment facilities or other capital projects; it may not be appropriate in pretreatment failure to implement cases.

POTW(s) during the period. The months of violation are the total number of months calculated pursuant to section IV.B above. (If the service population exceeds 3 million, the Table B value is found by combining values from multiple rows. For example, if the service population was 4.5 million, the factor B penalty contribution would be the sum of a value selected from the appropriate cell in the 1,000,001 to 2,000,000 population row plus a value selected from the appropriate cell in the 2,000,001 to 3,000,000 population row.)

3. Sum the selected factor values from Tables A and B. Note that the factor values in Tables A and B are in thousands of dollars.

NATIONAL MUNICIPAL LITIGATION CONSIDERATION -- TABLE A

ECONOMIC BENEFIT ENVIRONMENTAL IMPACT FACTOR IN THOUSANDS OF DOLLARS									
IMPACT OF VIOLATIONS ON HUMAN HEALTH OR THE ENVIRONMENT	**ECONOMIC BENEFIT RANGES IN THOUSANDS OF DOLLARS**								
	.001 to 50	50 to 100	100 to 250	250 to 1,000	1,000 to 2,000	2,000 to 5,000	5,000 to 10,000	10,000 to 25,000	greater than 25,000
No actual or potential harm.	6 to 9	11 to 15	17 to 23	32 to 43	49 to 67	75 to 103	110 to 151	167 to 230	283 to 389
Minor actual or potential harm (e.g., water quality-based effluent or whole effluent toxicity limit violated).	9 to 11	16 to 19	25 to 29	47 to 55	73 to 86	112 to 131	164 to 192	251 to 293	424 to 495
Moderate actual or potential harm (e.g., fish kill, beach closing, restrictions on use of water body, raw sewage discharges).	13 to 14	22 to 25	33 to 38	63 to 71	98 to 110	150 to 168	219 to 246	335 to 376	566 to 636
Severe actual or potential harm (e.g., repeated beach closings, interference with drinking water supplies).	17 to 32	30 to 55	46 to 84	87 to 158	135 to 245	206 to 374	301 to 548	460 to 837	778 to 1,414

NATIONAL MUNICIPAL LITIGATION CONSIDERATION -- TABLE B

POPULATION MONTHS OF VIOLATION FACTOR IN THOUSANDS OF DOLLARS

SERVICE POPULATION	MONTHS OF VIOLATION											
	1 to 6	7 to 12	13 to 18	19 to 24	25 to 30	31 to 36	37 to 42	43 to 48	49 to 54	55 to 60	61 to 66	66>
100 to 5,000	0 to 0.6	0 to 1.8	0.1 to 3	0.1 to 4.2	0.1 to 5.4	0.1 to 6.6	0.2 to 7.8	0.2 to 9	0.2 to 10.2	0.2 to 11.4	0.3 to 12.6	0.3 to 14
5,001 to 25,000	0.6 to 3	1.8 to 9	3 to 15	4.2 to 21	5.4 to 27	6.6 to 33	7.8 to 39	9 to 45	10.2 to 51	11.4 to 57	12.6 to 63	14 to 70
25,001 to 50,000	3 to 6	9 to 18	15 to 30	21 to 42	27 to 54	33 to 66	39 to 78	45 to 90	51 to 102	57 to 114	63 to 126	70 to 140
50,001 to 100,000	6 to 12	18 to 36	30 to 60	42 to 84	54 to 108	66 to 132	78 to 156	90 to 180	102 to 204	114 to 228	126 to 252	140 to 280
100,001 to 250,000	12 to 30	36 to 90	60 to 150	84 to 210	108 to 270	132 to 330	156 to 390	180 to 450	204 to 510	228 to 570	252 to 630	280 to 700
250,001 to 500,000	30 to 60	90 to 180	150 to 300	210 to 420	270 to 540	330 to 660	390 to 780	450 to 900	510 to 1,020	570 to 1,140	630 to 1,260	700 to 1,400
500,001 to 1,000,000	60 to 120	180 to 360	300 to 600	420 to 840	540 to 1,080	660 to 1,320	780 to 1,560	900 to 1,800	1,020 to 2,040	1,140 to 2,280	1,260 to 2,520	1,400 to 2,800
1,000,001 to 2,000,000	120 to 240	360 to 720	600 to 1,200	840 to 1,680	1,080 to 2,160	1,320 to 2,640	1,560 to 3,120	1,800 to 3,600	2,040 to 4,080	2,280 to 4,560	2,520 to 5,040	2,800 to 5,600
2,000,001 to 3,000,000	240 to 360	720 to 1,080	1,200 to 1,800	1,680 to 2,520	2,160 to 3,240	2,640 to 3,960	3,120 to 4,680	3,600 to 5,400	4,080 to 6,120	4,560 to 6,840	5,040 to 7,560	5,600 to 8,400

E. Ability to Pay (to decrease preliminary penalty amount)

The Agency typically does not request settlement penalties, which combined with the cost of the necessary injunctive relief, that are clearly beyond the financial capability of the violator. This means EPA should not seek a penalty that would seriously jeopardize the violator's ability to continue operations and achieve compliance, unless the violator's behavior has been exceptionally culpable, recalcitrant, threatening to human health or the environment, or the violator refuses to comply.

The adjustment for ability-to-pay may be used to reduce the settlement penalty to the highest amount that the violator can reasonably pay and still comply with the CWA. The violator has the primary burden of establishing the claim of inability to pay. The violator must submit the necessary information demonstrating actual inability to pay as opposed to unwillingness to pay. Further, the claim of inability to pay a penalty should not be confused with a violator's aversion to make certain adjustment in its operations in order to pay the penalty.[22]

If the violator is unwilling to cooperate in demonstrating its inability to pay the penalty, this adjustment should not be considered in the penalty calculation, because, without the cooperation of the violator, the Agency will generally not have adequate information to determine accurately the financial position of the violator. In some cases, the Agency may need to consult a financial expert to properly evaluate a violator's claim of inability to pay.

If the violator demonstrates an inability to pay the entire negotiated penalty in one lump sum (usually within 30 days of consent decree entry), a payment schedule should be considered. The penalty could be paid in scheduled installments with appropriate interest accruing on the delayed payments. The period allowed for such installment payments should generally not extend beyond three years.

If a payment schedule will not resolve the violator's ability-to-pay issue, as a last recourse, the Agency can reduce the amount it seeks in settlement to a more appropriate amount in situations in which inability-to-pay can be clearly documented and reasonably quantified.

In the case of municipalities, one quick way to evaluate whether there might be an ability to pay issue is to examine the most recent bond rating (within the past 5 years). If the bond rating is below BBB (Standard & Poor's rating scale) or below Baa (Moody's rating scale), the community may be in poor financial condition and a detailed financial evaluation by an appropriate expert may be necessary to determine whether the financial condition affects the ability to pay a penalty.

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[22] For example, a business may have to use funds that were previously designated to develop a new product line to pay a penalty and thus the new product line would be delayed. Similarly, a penalty could be paid using company funds that otherwise would have gone to pay its executives bonuses.

V. SUPPLEMENTAL ENVIRONMENTAL PROJECTS (SEPs)

Supplemental Environmental Projects (SEPs) are defined by EPA as environmentally beneficial projects which a violator undertakes, but is not otherwise legally required to perform, in exchange for favorable penalty consideration in settlement of an enforcement action. In order for a violator to receive a settlement penalty reduction in exchange for performing such a project, the project must conform with the EPA's SEP Policy, or be approved in advance by the Assistant Administrator[23]. A SEP may be allowed in a municipal case, even if the cash penalty is less than economic benefit, provided the cash penalty is no less than 60 percent of the amount provided in section IV.D.7. Use of SEPs in a particular case is entirely within the discretion of EPA, and the Department of Justice in judicial cases.

VI. OTHER TYPES OF PENALTIES

This Policy only establishes how the Agency expects to calculate the minimum penalty for which it would be willing to settle a case. The development of the penalty amount to plead in an administrative or judicial complaint is developed independent of this Policy. This Policy is not intended and should not be used as the basis for a penalty demand in a complaint, an administrative hearing or, a civil judicial trial. The Agency will not use this Penalty Policy in arguing for a penalty at trial or in an administrative penalty hearing.[24] In those cases which proceed to trial or an administrative hearing, the Agency should seek a penalty higher than that for which it is willing to settle.

If the "bottom-line" settlement penalty calculated pursuant to this Policy exceeds the maximum penalty that can be obtained in an administrative penalty action pursuant to §309(g) of the CWA, the Agency should instead proceed judicially.[25] In rare circumstances, the statutory maximum penalty may be less than the "bottom-line" settlement penalty in civil judicial cases; in such circumstances, the statutory maximum penalty should serve as the new "bottom-line" penalty.

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[23] See "EPA Policy on the Use of Supplemental Environmental Projects in Enforcement Settlements", transmitted on February 12, 1991 by the Assistant Administrator for Enforcement, or subsequent revisions.

[24] If that were to occur, then the defendant would have no incentive to settle with EPA. See *Guidance on the Distinctions Among Pleading, Negotiating, and Litigating Civil Penalties for Enforcement Cases Under the Clean Water Act,* OECM/OW, January 19, 1989.

[25] For further guidance on choosing between administrative and judicial enforcement options, see "Guidance on Choosing Among Clean Water Act Administrative, Civil and Criminal Enforcement Actions", which was Attachment 2 to the August 28, 1987 "Guidance Documents and Delegations for Implementation of Administrative Penalty Authorities Contained in 1987 Clean Water Act Amendments".

VII. DOCUMENTATION, APPROVALS, AND CONFIDENTIALITY

Each component of the settlement penalty calculation (including all adjustments and subsequent recalculations) must be clearly documented with supporting materials and written explanations in the case file. In all cases in which a settlement penalty may not comply with the provisions of this Policy, or in a case in which application of this Policy appears inappropriate, the penalty must be approved in advance by the EPA Assistant Administrator for Enforcement and Compliance Assurance.

Documentation and explanations of a particular settlement penalty calculation constitute confidential information that is exempt from disclosure under the Freedom of Information Act, is outside the scope of discovery, and is protected by various privileges, including the attorney-client privilege and the attorney work-product privilege. While individual settlement penalty calculations are confidential documents, this Policy is a public document and may be released to anyone upon request. Further, as part of settlement negotiations between the parties, the Agency may choose to release parts of the case-specific settlement calculations. The release of such information may only be used for settlement negotiations in the case at hand and, of course, may not be admitted into evidence in a trial or hearing. See Rule 408 of Federal Rules of Evidence.

This Policy is purely for the use of U.S. EPA enforcement personnel in settling cases. EPA reserves the right to change this Policy at any time, without prior notice, or to act at variance to this Policy. This Policy does not create any rights, implied or otherwise, in any third parties.

ATTACHMENT 1 TO INTERIM CWA SETTLEMENT PENALTY POLICY

EXAMPLES OF HOW TO CALCULATE STATUTORY MAXIMUM PENALTY

Violation scenario	Maximum statutory penalty*	Authority
Violation of daily maximum limit for pollutant A, on the 5th of January.	$25,000	Plain reading of CWA, § 309(d): "$25,000 per day for each violation"
Violation of daily maximum limit for pollutant A, on the 5th, 10th, and 15th of January.	$75,000	Plain reading of CWA, § 309(d): "$25,000 per day for each violation"
Violation of daily maximum limits for each of pollutants A and B, on the 5th of January.	$50,000	Tyson Foods and Powell Duffryn, as well as plain reading of CWA, § 309(d): "$25,000 per day for each violation"
Violation in January of weekly average for pollutant A.	$25,000 per day, multiplied by 7 days $175,000.	Tyson Foods, 897 F.2d at 1139. Also see, Gwaltney, 897 F. 2d at 314.
Violation in January of monthly average limit for pollutant A.	$25,000 per day, multiplied by 31 days in January = $775,000	Tyson Foods, 897 F.2d at 1139. Also see, Gwaltney, 897 F. 2d at 314.
Violation in January of monthly average limit for pollutant A, in which there is evidence that there were no discharges on 4 days (e.g. plant shut down on Sundays).	$25,000 per day, multiplied by 27 days in January = $675,000	Natural Resources Defense Council v. Texaco , 2 F.3d 493, 507-508 (3rd Cir. 1993).
Violation in January of monthly average limits for both pollutants A and B.	$50,000 per day, multiplied by 31 days in January, = $1,550,000	Tyson Foods, 897 F.2d at 1140, footnote 22
Violation in January of monthly average limit for pollutant A, and of daily maximum limit for pollutant B on January 5th and 15th.	$775,000 for pollutant A, + $50,000 ($25,000 per day x 2) for pollutant B, = $825,000	Tyson Foods, 897 F.2d at 1140, under "The interaction of daily and monthly violations"
Violation in January of monthly average limit for pollutant A, and of daily maximum limit for pollutant A on Jan. 5th and 15th.	25,000 per day, multiplied by 31 days in January, = $775,000.	Tyson Foods, 897 F.2d at 1140, under "The interaction of daily and monthly violations"
Failure to properly monitor** for pollutant A on 4 required days in January.	$100,000.	Statutory language, CWA §309.

Violation scenario	Maximum statutory penalty*	Authority
Failure to properly monitor for pollutants A, B, and C on January 15.	$75,000.	Statutory language, CWA §309.
Failure to monitor for a monthly pollutant parameter.	$25,000 for each day in which the discharger was required to monitor for that pollutant.	Statutory language, CWA §309.
Failure to submit adequate discharge monitoring report on time (each failure to monitor for a particular pollutant is subject to a separate penalty calculation).	$25,000.	Statutory language, CWA §309.
Failure to timely submit a report or other document (each failure to timely complete an activity covered by the report is subject to a separate penalty calculation).	$25,000	Settlement policy discretion.

NOTES:

* For administrative penalty cases the penalty per day for each violation is $10,000 and may not exceed the total penalty amount allowed in a Class I or Class II administrative proceeding.

** For purposes of calculating penalties, the act of monitoring for a particular pollutant includes the sequence of events starting with the collection of the wastewater sample through completion of the analytical testing of the sample. The obligation to report the results of the monitoring is a separate act subject to a separate penalty calculation.

The guidelines set forth here reflect EPA's policy on how to calculate the statutory maximum penalty with regards to ensuring that all settlement penalties sought pursuant to the Penalty Policy do not exceed such statutory maximum. At trial or in a hearing, EPA reserves the right to calculate the statutory maximum pursuant to more aggressive assumptions.

ATTACHMENT 2 TO INTERIM CWA SETTLEMENT PENALTY POLICY

Case Name_____ Date_____

Prepared by _____ and _____ [attorney name].

SETTLEMENT PENALTY CALCULATION WORKSHEET

	STEP	AMOUNT
1.	Calculate Statutory Maximum Penalty (period of violations from _____ through _____)	
2.	Economic Benefit (attach BEN printouts, with explanations for calculations)	
3.	Total of Monthly Gravity Amounts	
4.	Economic Benefit + Gravity (lines 2 + 3)	
5.	Gravity Adjustments	
	a. Flow Reduction Factor ___ (0 to 50%) X line 3	
	b. Recalcitrance Factor ___ (0 to 150%) X line 3	
	c. Quick Settlement Reduction __ (0 or 10%) X line 3	
	d. Total gravity adjustments (negative amount if net gravity reduction) (lines 5.b. - 5.c - 5.a)	
6.	Preliminary Penalty Amount (lines 4 + 5.d)	
7.	Litigation Consideration Reduction (if any)	
8.	Ability to pay reduction (if any)	
9.	Reduction for Supplemental Environmental Projects (if any)	
10.	**Bottom-line Cash Settlement Penalty** (Line 6 less lines 7, 8 and 9. Or, if applicable, amount calculated by national municipal litigation consideration in §IV.D.6, less no more than 40% of that amount for appropriate SEPs.)	

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Measuring salinity

Salinity is the accumulation of salt in soil and water. High salt levels can adversely affect plant growth, soil structure, water quality and infrastructure.

High salt levels occur naturally in many parts of the Australian landscape but in many cases have been exacerbated where human activities accelerate the mobilisation and accumulation of salt.

Methods for measuring salinity

It is important to identify saline areas so they can be appropriately managed. There are a range of methods for measuring salinity. Two common ways are by using an electrical conductivity (EC) meter or by measuring how much salt is in a solution of soil or water.

An EC meter measures how much electricity moves through a solution—the saltier the solution, the more electricity moves through it, and the higher the conductivity reading. EC can be easily measured in the field or in a laboratory. A wide range of EC meters are available, ranging in price and size.

Electrical conductivity can be expressed in different units—for soil, EC is measured in dS/m (deci-Siemens/metre), while water is measured in µS/cm (micro-Siemens/centimetre). It is important to always calibrate the EC meter before use.

Another way to detect salinity is by measuring how much salt is in a solution—this measurement is called total dissolved solids (TDS) or total dissolved ions (TDI). It is measured in units of mg/l (milligrams/litre) or ppm (parts per million). Higher readings mean more salt is present in the solution.

Measuring salinity in water

Salinity in surface water and groundwater can be easily measured in the field by collecting a water sample, inserting an EC probe into the sample and reading the value shown on the meter.

Alternatively, a water sample can be collected and forwarded to a laboratory for testing of salinity and chemical composition. The container should be entirely filled with the water sample to exclude air. Samples for laboratory analysis should be forwarded as quickly as possible. Delays and high temperatures will change the composition of salts in the sample, affecting the results. Typical salinity values for water are given in Table 1.

Measuring salinity in soil

EC is usually measured in the field using a 1:5 soil:water suspension ($EC_{1:5}$), or in a laboratory using a soil saturation extract EC (EC_{se}) or a 1:5 solution.

To measure $EC_{1:5}$ in the field, put approximately 10ml of distilled water, rainwater or tank water into a jar, container or tube. Add small soil particles until the contents of the container increase by 5ml to bring the volume to 15ml. Add additional water to bring the total volume to 30ml. Shake intermittently for five minutes and allow it to settle for five minutes. Dip an EC probe into the solution and take a reading. Remember to wash the EC probe after using it.

The interpretation of EC values to determine soil salinity levels depends on the texture of the soil. Salts are readily dissolved out of sandy soils whereas salts are more tightly held by clay soils. This means that the same amount of salt will have a greater impact on sandy soils then it will on clay soils. As a guide, sandy or loamy soils are moderately saline if $EC_{1:5}$ is above 0.3 dS/m, and clay soils are moderately saline if $EC_{1:5}$ is above 0.6 dS/m.

As the $EC_{1:5}$ is measured on a diluted sample, a more realistic measurement of the actual salt levels that a plant will encounter can be measured on a saturated extract (EC_{se}). This can be done by some laboratories. As a guide, soils are generally considered saline if their EC_{se} is greater than 2–4 dS/m.

Salinity tolerance ratings for soils are usually based on EC_{se} values, rather than $EC_{1:5}$. To convert $EC_{1:5}$ to EC_{se}, identify the texture of the soil, and use the following guide:

Soil type	Multiply $EC_{1:5}$ by
Sand	23
Sandy loam	14
Loam	10
Clay loam	9
Light clay	7.5
Heavy clay	6

For example, sand with an $EC_{1:5}$ of 0.3 dS/m is equivalent to an EC_{se} of 6.9 dS/m, while a heavy clay with an $EC_{1:5}$ of 0.3 dS/m is equivalent to an EC_{se} of 1.8 dS/m. Soil salinity classes are shown in Table 2.

L137 June 2007 Produced by South West Region Author: Kristie Watling

Table 1. Guide to typical salinity limits for waters. It is important to also check other water quality parameters (e.g. chemical composition, sodium absorption ratio, metals etc) before use.

		Electrical Conductivity (EC) (µS/cm)	(dS/m)	TDS (mg/l or ppm)
Distilled water		1	0.001	0.67
Rainfall		30	0.03	20
Sewage effluent		840	0.84	565
Freshwater		0–1500	0–1.5	0–1000
Great Artesian Basin water		700–1000	0.7–1.0	470–670
Brackish water		1500–15 000	1.5–15	1000–10 050
Upper limit recommended for drinking		1600	1.6	1070
Tolerances of livestock to salinity in drinking water (at these values, animals may have an initial reluctance to drink, but stock should adapt without loss of production)	Beef cattle	5970–7460	5.9–7.5	4000–5000
	Dairy cattle	3730–5970	3.7–5.9	2500–4000
	Sheep	7460–14 925	7.5–14.9	5000–10 000
	Horses	5970–8955	5.9–8.9	4000–6000
	Pigs	5970–8955	5.9–8.9	4000–6000
	Poultry	2985–4475	2.9–4.4	2000–3000
General limits for irrigation	Salt sensitive crops	650	0.65	435
	Moderately salt sensitive crops	1300	1.3	870
	Salt tolerant crops	5200	5.2	3485
	Generally too saline for crops	8100	8.1	5430
Salt water swimming pool		5970–8955	5.9–8.9	4000–6000
Seawater		55 000	55	36 850
Dead Sea		110 000	110	73 700

Note: To convert from µS/cm to dS/m, divide by 1000. To approximately convert from µS/cm to mg/l, multiply by 0.67.

Table 2. Approximate soil salinity classes.

Salinity Rating	EC_{se} (dS/m)	
Slightly saline	1.5–2	Salinity effects usually minimal
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Salinity tolerance of crops

As a general guide, salt tolerant crops include barley, canola, cotton, beetroot, soybean, wheat, olives and sorghum. Moderately salt tolerant crops include lucerne, tomato, cabbage, potato and carrots. Low salt tolerant crops include maize, sugar cane, celery, lettuce and pumpkin.

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Further information

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Natural Resources and Water

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10/19/01 CD
11/29/01 CD
7/12/02 CD
03/14/03 CD
3/27/03 CD

Issue Paper –
Total Dissolved Solids (TDS)

I. Background

The TDS is a measure of all constituents dissolved in water. The principal inorganic anions dissolved in water include carbonates, chlorides, sulfates and nitrates. The principal cations are sodium, potassium, calcium and magnesium.

The current Iowa water quality standard for Total Dissolved Solid (TSD) was developed in the 70's and is stated in IAC [567] Chapter 61.3(2)g *General water quality criteria* as follows:

"Total dissolved solids shall not exceed 750 mg/l in any lake or impoundment or in any stream with a flow rate equal to or greater than three times the flow rate of upstream point source discharges."

Several NPDES permittees have noted that Iowa's long standing Total Dissolved Solids (TDS) numerical criteria of 750 mg/l is inconsistent with current toxicity information. This criterion is listed as one of the General Water Quality Criteria that are applicable to all waters. Data that provided by a Permittee indicates that warm water aquatic species are tolerant of a more relaxed TDS level.

The triennial review of the TDS criteria would address the issue and also include the implementation methodology for wasteload allocations.

II. Site-Specific Toxicity Data for TDS

IPSCO Steel Inc. provided the toxicity testing for Fathead minnow (*Pimephales promelas)* and Ceriodaphnia (*Ceriodaphnia dubia)* to IDNR on March 14, 1996. The facility was planning to collect the treated process wastewater and storm water in a detention pond and then discharge into Comrie Creek, a tributary of the Mississippi River. In order to determine the maximum level of effluent TDS that would potentially be acceptable from an aquatic acute toxicity standpoint, acute toxicity tests were conducted. Since the facility was under construction during that time and no wastewater was being generated, a simulated effluent from the process wastewater systems in conformance with the guidelines established by the IDNR standard Operating Procedure for Effluent Toxicity Testing was used. A 48-hour toxicity testing on the indicator species were conducted. The acute toxicity testing indicated that the LC50 response level to the TDS for Fathead minnow is between 5000 mg/l and 7000 mg/l. The LC50 response level to the TDS for Ceriodaphnia was between 2500 mg/l and 3000 mg/l.

III. TDS Information from Different Sources

All species of fish and other aquatic life must tolerate a range of dissolved solids concentrations in order to survive under natural conditions. According to the redbook of EPA (Quality Criteria for Water, 1976), studies have shown that lakes with dissolved solids in excess of 15,000 mg/l were unsuitable for most freshwater fishes.

It has also been reported that for livestock, 3000 mg/l of TDS should be satisfactory for animal consumption under most circumstances.

The report that IPSCO Steel Inc. submitted to IDNR included some TDS testing information on different freshwater fishes and other organisms. Table 1 presents the information on certain species that also present in Iowa streams.

Table 1. Toxicity Test Data on Certain Species based on Literature

Organisms	**Concentration (mg/L)**	**Reported Effect**
Daphnia magna	9,500-11,500	96-hr LC50
Hyalella azteca	11,500	96-hr LC50
Bigmouth buffalo Emerging fry	9,000	Upper tolerance limit
Black buffalo Emerging fry	9,000	Upper tolerance limit
Channel catfish	14,000	Upper tolerance limit
Black bullhead	8,000 10,000	Median toxicity threshold in NaCl Probable lethal limit
Yellow perch	11,500	No adverse effects
Fathead minnow	6,000-7,000 5,300-5,900	Acutely lethal 96-hr LC50
Green Sunfish	10,700 20,000	Median toxicity threshold in NaCl Lethal
Bluegill	11,900	Lethal limit
Golden Shiner	5,600	Upper tolerance limit
Common Carp	12,000 18,500-19,000	No observed effect Upper tolerance limit
Beef cattle	10,000	Safe upper limit
Dairy cattle	7,150	Safe upper limit
Poultry	2,860	Safe upper limit

IV. TDS Criteria in Other States

1. Kansas

(1) Domestic Water Supply:

Chloride – 250 mg/l
Sulfate – 250 mg/l

(2) Aquatic Life Use:

Chloride – 860 mg/l (Acute)

(3) Agricultural Livestock Use:
Sulfate – 1000 mg/l

2. Missouri

(1) Drinking Water Use:

Chloride – 250 mg/l
Sulfate – 250 mg/l

(2) Protection of Aquatic Life:

Chloride – 860 mg/l (Acute), 230 mg/l (Chronic)

3. Nebraska

(1) Drinking Water Use

Chloride: 250 mg/l
Sulfate: 250 mg/l
TDS: 500 mg/l

(2) Agricultural Use

Conductivity: 2,000 μmho/cm between April 1 and September 30 (equivalent to TDS of 1280 – 1400 mg/l).
NO3 and NO2 as Nitrogen: not to exceed 100 mg/l
Selenium: not to exceed 0.02 mg/l

3. Illinois

(1) General Water Quality Standards:

Chloride – 500 mg/l
Sulfate – 500 mg/l
TDS – 1000 mg/l

(2) Public and Food Processing Water Supply Standards

Chloride – 250 mg/l
Sulfate – 250 mg/l
TDS – 500 mg/l

(3) Secondary Contact and Indigenous Aquatic Life Standards:

TDS – 1500 mg/l.

4. State of Pennsylvania

For Public Water Supply use, the TDS, chloride and sulfate water quality standards are:

Parameters	Monthly Average	Daily Maximum
TDS	500	750
Chloride	-	250
Sulfate	-	250

These standards **only** apply to public water supply uses.

Most States have a TDS criterion of 500 mg/l for domestic drinking water supply, and chloride and sulfate range from 200 to 250 mg/l for domestic water supply. For aquatic life, the values range from 250 mg/l to 2500 mg/l. Some states limit the TDS concentration not exceeding 133% of ambient stream concentration. Some States do not have any specific numeric criteria for TDS.

V. Discussion of TDS as a Water Quality Parameter

Some studies (Mount et al., 1997) indicated that aquatic organisms respond differently to different TDS compositions. Mount et al. (1997) also demonstrated that relative ion toxicity was in the order of $K^+ > HCO_3^- \approx Mg^{2+} > Cl^- > SO_4^{2-}$. EPA's chloride criteria document (1988) indicated that when compared on the basis of chloride, the chlorides of potassium, calcium, and magnesium are generally more acutely toxic to aquatic animals than sodium chloride. Thus, the toxicity of TDS may vary depending on the specific constituent compositions of the TDS in the effluent. The same problems would relate to the effects of TDS on livestock. However, there is still a lack of sufficient research data required to quantify the potential effects of all the different constituents of TDS.

VI. Agricultural Uses: TDS and Individual Ions

A. Livestock Watering

Both the US and Canada have developed "Guides to the Use of Saline Waters for Livestock Watering." The Canadian Task Force on Water Quality (1987) published both a Summary – Guidelines for Livestock Drinking Water Quality and a Guide to Use of Saline Water for Livestock Watering. They are listed as follows:

Table 2. Summary – Guidelines for Livestock Drinking Water Quality

Parameter	Guidelines (mg/l)
Major Ions and Nutrients	
Calcium	1000
Nitrate plus nitrite	100
Nitrite alone	10
Sulfate	1000
TDS	3000

The National Academy of Sciences (1974) published a Guide to the Use of Saline Waters for Livestock and Poultry. It states that "if the TDS is between 1000 – 2999 mg/l, the waters should be satisfactory for all classes of livestock and poultry. They may cause temporary and mild diarrhea in livestock not accustomed to them or watery droppings in poultry, but should not affect their health or performance."

The web site of "Manitoba Agriculture and Food" pointed out an upper limit of 300 – 400 mg/l of magnesium has been suggested for dairy cows. For sodium, water with over 800 mg sodium/l can cause diarrhea and a drop in milk production in dairy cows.

The EPA's "Quality Criteria for Water" (1976) stated that chickens, swine, cattle, and sheep can survive on saline waters up to 15,000 mg/l salts of sodium and calcium combined with bicarbonates, chlorides, and sulfates but only 10,000 mg/l of corresponding salts of potassium and magnesium. The approximate limit for highly alkaline waters containing sodium and calcium carbonates is 5,000 mg/l.

Rodenburg (1989) indicated that routine water analysis for livestock use should include TDS, sodium, magnesium, calcium, sulfate, nitrate, iron and pH. Rodenburg (1989) also pointed out that studies demonstrate that magnesium, sodium, and sulfate are toxic at lower levels than calcium, chloride or bicarbonate, and that there will be highly variable response to water of 1000 to 5000 mg/l TDS, depending on which ions dominate. He provided the water quality criteria for dairy cattle. The following table lists the major ion criteria for dairy cattle based on Rodenburg (1989).

Table 3. Water Quality Criteria for Dairy Cattle

Ions	Max. Recommended Concentration (mg/l)
Sulfate	1000
Magnesium	800
Sodium	800
Calcium (dry cows & growing bulls)	1000
Calcium (milking cows & heifers)	2000
Nitrate-N	100

Most of the studies on TDS are based on sodium chloride constituent. Different studies recommended different safe values of sodium chloride for livestock uses. The National Academy of Sciences (1974) reported the safe sodium chloride value for cattle as 10,000 mg/l. And Jaster et al (1978) reported that the safe sodium chloride value for dairy cows were 2500 – 3500 mg/l. Some studies indicated that for poultry the safe sodium chloride value was 3000 mg/l.

To summarize the status of the current studies of TDS toxicity on aquatic life and livestock, it is recognized that the toxicity of TDS may vary depending on the specific constituent compositions of the TDS in the effluent. However, there are a lot of uncertainties about the potential effects of all the different constituents of TDS. Based on limited studies on TDS and the individual ions, the following water quality criteria should meet the livestock uses.

Table 4. Recommended Water Quality Criteria for Livestock Uses

Ions	Recommended Criteria for Livestock Uses (mg/l)
Calcium	1000
Magnesium	800
Sodium	800
Sulfate	1000
Nitrate+Nitrite-N	100

B. Irrigation Water Uses

Peterson (1999) pointed out that TDS levels below 700 mg/l are considered safe; TDS between 700 mg/l and 1,750 mg/l are considered possibly safe, while levels above these levels are considered hazardous to any crop. Peterson (1999) also listed the tolerance of selected crops to TDS in irrigation water, for example, corn as *slightly tolerant* (TDS < 800 mg/l) and soybean as *very tolerant* (TDS < 3500 mg/l). However, as long as the TDS concentration is less than 2,800 mg/l, no reduction in crop yield for moderately sensitive crops including corns and soybeans (Peterson, 1999). Generally forage crops are the most resistant to salinity, followed by field crops, vegetable crops, and fruit crops which are generally the most sensitive.

Irrigation water containing large amounts of sodium is of special concern due to sodium's effects on the soil structure. Crops grown on soil having an imbalance of calcium and magnesium may also exhibit toxic symptoms. Sulfate salts affect sensitive crops by limiting the uptake of calcium and increasing the adsorption of sodium and potassium, resulting in a disturbance in the cationic balance within the plant. The bicarbonate ion in soil solution harms the mineral nutrition of the plant through its effects on the uptake and metabolism of nutrients. High concentrations of potassium may introduce a magnesium deficiency and iron chlorosis. An imbalance of magnesium may be toxic, but the effects of both can be reduced by high calcium levels. The Surface Water Quality Objectives published by Saskatchewan Environment and Resource Management in August 1997 listed corn as one of the *moderately tolerant* plant to sodium and chloride. The tolerance concentration to chloride and sodium in irrigation water for corns are Chloride (335 – 710mg/l) and Sodium (230 – 460mg/l). Also, Mills (2001) provided the following toxicity values for chloride, iron and NO3 to plants.

Table 5. Toxicity Data for Chloride, Iron and NO3 in Irrigation water

Chloride Ion Conc.	Suitability for Irrigation
< 350 mg/l	Suitable all crops
350 – 700 mg/l	Suitable for high, medium and low salt tolerant crops
700 – 900 mg/l	Suitable for high and medium salt tolerance crops
900 – 1300 mg/l	Suitable for high salt tolerant crops only.
Greater than 1300 mg/l	Too saline for irrigation of any crops
Iron	< 1 mg/l
NO3	<133 mg/l

Since corn is *moderately tolerant* to chloride, it should be able to tolerate 700 – 900 mg/l of chloride concentration. Some studies have shown that for surface irrigation, most tree crops and woody plants are sensitive to sodium and chloride, while most annual crops are not sensitive ("Water Quality and Crop Production").

To summarize the water quality requirement for irrigation uses, the following criteria should apply:

Table 6. Water Quality Criteria for Irrigation Uses

Ions	Criteria for Irrigation Uses (mg/l)
Chloride	900
NO3	<133 mg/l

However, at the Technical Advisory Committee meeting on March 21, 2003, the committee members agreed to drop the chloride value of 900 mg/l for irrigation uses at this time because of lack of sufficient information. The IDNR and the committee could visit the issue later when new information becomes available.

VI. Proposed Ion Criteria for Iowa

Based on the literature review and the recommendations by WQS Technical Advisory Committee, the Department proposes the following ion criteria and approach for the protection of both the agricultural use and the aquatic life use.

1. Protection of Agricultural Uses

(1) Ion Criteria Values

Table 7. Recommended Water Quality Criteria for Agricultural Uses

Ions	Recommended Criteria for Livestock Uses (mg/l)
Calcium	1000
Magnesium	800
Sodium	800
Sulfate	1000
Nitrate+Nitrite-N	100

On March 21, 2003, the TAC members agreed that the above ion criteria values should be included in the Support Document for implementation since these numbers are based on guidelines for livestock uses not criteria-based toxicity tests.

(2) Implementation

The ion criteria values shown in Table 7 should be applied at the end-of-pipe in general use waters, and at the end of the mixing zone in designated waters.

2. Protection of Aquatic Life Uses

The Technical Advisory Committee on the March 21th meeting agreed that in order to protect the aquatic life uses, Whole Effluent Toxicity (WET) test of TDS is required **whenever the facility requests for a permit renewal every five years**. The facility also needs to measure the ion constituents in the effluent at the same time. The following table lists the parameters need to be included in the specific ion constituent test.

Table 8. Ion Constituents Tested in the WET Test

Ions
TDS
Calcium
Potassium
Magnesium
Sodium
Sulfate
Ion
Nitrate+Nitrite-N

If the effluent discharges into a general use stream, 100% of the effluent should be used in the WET test. If the effluent discharges directly into a designated stream, a 2.5% of the stream 7Q10 flow is allowed for dilution in the WET test. The WET test should follow the EPA published manual of "*Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*" adopted as final rule on November 19, 2002. And the WET test should be performed for two freshwater organisms: *fathead minnows* and *Ceriodaphnia dubia.*

In conclusion, all Waters of the State should meet the above requirements to protect both the agricultural and aquatic life uses.

VIII. Proposed Rule Changes: reserved for future.

References

Birge, W. J., J.A. Black, A.G. Westerman, T.M. Short, S.B. Taylor, D.M. Bruser, and E.D. Wallingford. 1985. Recommendations on numerical values for regulating iron and chloride concentrations for the purpose of protecting warmwater species of aquatic life in the commonwealth of Kentucky. University of Kentucky, Lexington, K.Y.

Jaster, E.H., J.D. Schuh, and T.N. Wegner. 1978. Physiological Effects of Saline Drinking Water on High Producing Dairy Cows. Journal of Dairy Science. Vol. 61:66.

Mills, B. Interpreting Water Analysis for Crop and Pasture. March 2001. Farming Systems Institute, Toowoomba.

Mount, David R., et al. 1997. Statistical models to predict the toxicity of major ions to Ceriodaphnia Dubia, Daphnia Magna and Pimephales Promelas (Fathead Minnows). Environmental Toxicology and Chemistry. Vol. 16:10, pp. 2009-2019.

Peterson, H.G. Irrigation and Salinity. 1999. WateResearch Corp. and Agriculture and Agri-Food Canada-Prairie Farm Rehabilitation Administration.

Rodenburg, J. Practical Water Evaluation for Dairy Cattle. Ontario Ministry of Agriculture & Food, Woodstock, Ontario, Canada.

The Task Force on Water Quality Guidelines of the Canadian Council of Resource and Environmental Ministers. March 1987. Canadian water quality guidelines.

U.S. EPA. Quality Criteria for Water. July 1976. Office of Water and Hazardous Materials, Washington, D.C. 20460.

U.S. EPA. 1988. Ambient water quality criteria for Chloride. Office of Water Regulations and Standards, Washington, D.C. 20460.

Appendix A: Ion Concentration Comparison
(surface water vs. groundwater vs. industrial discharge)

Table A1. Surface and Groundwater Ion Concentrations

	Groundwater (70 stations-2000 water year)	Des Moines R. at Des Moines	Missouri R. @ Omaha	Mississippi River@ Clinton	WAPSIPINICON River@ TRIPOLI	IOWA River@Rc
TDS	555	422	522.9	230.6	249	411.8
Hardness as CaCo3	356		270	163.	--	--
Ca	89	77.2	66.3	38.9	51.0	83.6
Mg	29	27.8	25.4	15.7	11.7	26.5
K	4	2.8	7.0	2.61	2.0	2.6
Na	32	17.8	55.7	9.15	9.7	9.5
CO3 as CaCo3	--	--	1.0	1.00	0	0.6
HCO3 as CaCo3	--	--	199.3	170.	155	282
Chloride	22	33.2	14.8	13.98	21.4	19.9
Sulfate	106	77.5	197.6	25.92	21.5	42.3
NO3	5	7.5	1.5	1.80	5.3	7.1

The following shows a few sample industrial discharge characteristics:

Table A2. ADM – Des Moines Discharge Characteristics

		Effluent	Des Moines River
Parameter	Month	Concentration (mg/l)	Concentration (mg/l)
TDS	9/02	443	400
	8/02	544	380
	7/02	645	380
	6/02	593	400
	5/02	322	390
	4/02	418	480
	3/02	705	470
	2/02	716	540
	1/02	640	550
	12/01	464	380
	11/01	420	340
	10/01	334	350

Table A3. Siouxland Ethanol Facility, Sioux Center, Sioux County, IA

Parameters	Raw Groundwater	RO Reject Water	Surface Water (Tributary)
TDS	2113	7288	703 (Big Sioux data)
Ca	305	1033	129
Mg	138	458	58
K	0	0	1.5
Na	148	485	20

Cl	23	131	35
SO4	1420	4716	107
NO3	10	30	128
HCO3	155	412	NA

Table A4. Midwest Grain Processors in Kossuth County

Parameters	Groundwater Source (mg/l)	Tower Blowdown Effluent
TDS	878	3020
Ca		136
Mg		194
K		0
Na		222
Iron		0.588
Cl		14.6
SO4		1510

Table A5. Little Sioux Ethanol: Simulated Blowdown

Parameters	Tower Blowdown Effluent
TDS	3240 as CaCO3
Ca	637.5
Mg	184.8
K	32.5
Na	297
Iron	1.3
Cl	26.9
SO4	2265

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Animal Health Fact Sheet

Analysis of Water Quality for Livestock

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Animals are able to ingest a wide variety of different types of water and survive. However, some salts and elements, at high levels, may reduce animal growth and production or may cause illness and death.

The measures used to evaluate water quality include salinity, hardness, pH, sulfate, nitrate and analysis for other specific elements known to be toxic. Waters can be evaluated for these characteristics at university or commercial laboratories. Microbiological agents (bacterial, viral and protozoan) can be spread through water and cause disease. These are not usually evaluated in livestock waters, but samples could be submitted to an animal disease diagnostic laboratory for culture. Only certain laboratories are prepared to test for pesticides and organic toxins.

A. Salinity

Salinity refers to salts dissolved in water. The anions (negatively charged ions) commonly present include: carbonate, bicarbonate, sulfate, nitrate, chloride, phosphate and fluoride. The cations (positively charged ions) include calcium, magnesium, sodium and potassium.

Salinity may be measured as Total Dissolved Solids (TDS) or Total Soluble Salts (TSS) and is expressed as parts per million (ppm) (which is equivalent to mg/l or ug/ml). Salinity may also be measured by electrical conductivity (EC) and is then expressed as reciprocal micro ohms per centimeter (umhos/cm) or decisiemens per meter (dS/m). There is a close correlation of EC and ppm with the values of ppm being about 3/5 of those for EC (@ 300 ppm, EC = 500 umhos/cm and @ 3,000 ppm, EC = 5,000 umhos/cm). The effects seem to be the same whether one or several salts are involved. The conversion factors are listed in Table 6.

An abrupt change from water of low salinity to water of high salinity may cause animals harm while a gradual change would not. Animals can consume water of high salinity (TDS) for a few days, without harm, if they are then given water of low salinity (TDS). Animal tolerance also varies with species, age, water requirement, season of the year, and physiological condition.

As the TDS of water increases, intake also increases, except at very high content where the animals refuse to drink. Depressed water intake is accompanied by depressed feed intake.

The ions of magnesium (Mg), calcium (Ca), sodium (Na) and chloride (Cl) all contribute to the salinity of water, and they may cause toxic effects because of this salinity effect or by interference with other elements. But, these four are not usually considered toxic otherwise.

Salinity by itself tells nothing about which elements are present, but this may be of critical importance. So when the salinity is elevated, the water should be analyzed for the specific anions and cations.

The following tables give guidelines on potential uses of waters of various salinity:

Table 1: TDS and Species Variation(1)

Species	Total Dissolved Solids (ppm)				
	Excellent	Good	Fair	Poor	Limit
Humans	0-800	800-1600	1600-2500	2500-4000	5000*
Horses,Working	0-1000	1000-2000	2000-3000	3000-5000	6000
Horses, Others	0-1000	1000-2000	2000-4000	4000-6000	10000
Cattle	0-1000	1000-2000	2000-4000	4000-6000	10000
Sheep	0-1000	1000-3000	3000-6000	6000-10000	15000
Chickens & Poultry	0-1000	1000-2000	2000-3000	3000-5000	6000
Swine	(Young pigs and market pigs appear to tolerate less than cattle)				

*The limit for drinking water in Utah is 2,000 ppm.

Table 2. A Guide to the Use of Saline Waters for Livestock and Poultry(2)

Total Soluble Salts Content of Waters (mg/L or ppm)	Comment
Less than 1,000 ppm (1670 umhos/cm)	These waters have a relatively low level of salinity and should present no serious burden to any livestock or poultry.
1,000-2,999 ppm (1670-5008 umhos/cm)	These waters should be satisfactory for all classes of livestock and poultry. They may cause temporary and mild diarrhea in livestock not accustomed to them, or watery droppings in poultry (especially at the higher levels), but should not affect their health or performance.
3,000-4,999 ppm (5010-8348 umhos/cm)	These waters should be satisfactory for livestock, although they may cause temporary diarrhea or be refused at first by animals not accustomed to them. They are poor waters for poultry, often causing watery feces and (at the higher levels of salinity) increased mortality and decreased growth, especially in turkeys.
5,000-6,999 ppm (8350-11688 umhos/cm)	These waters can be used with reasonable safety for dairy and beef cattle, sheep, swine and horses. Avoid the use of those approaching the higher levels for pregnant or lactating animals. They are not acceptable waters for poultry, almost always causing some type of problem, especially near the upper limit, where reduced growth and production or increased mortality will probably occur.

Total Soluble Salts Content of Waters (mg/L or ppm)	Comment
7,000-10,000 ppm (11,690-16,700 umhos/cm)	These waters are unfit for poultry and probably for swine. Con 7,000-10,000 ppm (11,690-16,700 umhos/cm considerable risk may exist in using them for pregnant or lactating cows, horses, sheep, the young of these species, or for any animals subjected to heavy heat stress or water loss. In general, their use should be avoided, although older ruminants, horses, and even poultry and swine may subsist on them for long periods of time under conditions of low stress
More than 10,000 ppm (16,700 umhos/cm)	The risks with these highly saline waters are so great that they cannot be recommended for use under any conditions.
35,000 ppm (58,450 umhos/cm)	Brine

B. HARDNESS

Water containing appreciable amounts of calcium and magnesium are called "hard" because it is hard to make such water lather with soap. The free calcium and magnesium react with soap to form an insoluble curd-like material. If they are removed, the water will lather easily.

Water "hardness" is not necessarily correlated with salinity. Saline waters can be very soft if they contain low levels of calcium and magnesium (the cations which cause hardness). Calcium and magnesium are usually present at less than 1,000 ppm in water. The calcium carbonate content of waters of various hardness is classed as:

Water Hardness	mg/l
Soft	0-60
Moderate	61-120
Hard	121-180
Very Hard	>180

Hardness does not cause urinary calculi

Softening the water through exchange of calcium and magnesium with sodium may cause problems if the water is already high in salinity.

C. pH

The pH is a measure of acidity or alkalinity. A pH of 7 is neutral, under 7 is acidic and over 7 is alkaline. Most waters in the western states are slightly alkaline. The preferred pH is 6.0 to 8.0 for dairy animals and from 5.5 to 8.3 for other livestock. Highly alkaline waters may cause digestive upsets, diarrhea, poor feed conversion and reduced water/feed intake.

D. SULFATE

Sulfate imparts a bitter taste to the water, but animals can acclimate to it. Consider diluting high sulfate water for weanling pigs and for animals who are not accustomed to it. The maximum recommended levels are:

Table 3. Maximum Recommended Levels of Sulfate

Animals	ppm Sulfate (SO4) ppm	Sulfate as Sulfur (SO4-S)
Calves	< 500	< 167
Adult Cattle	< 1,000	< 333

Magnesium sulfate (Epsom salt) and sodium sulfate (Glauber salt) tend to make water taste objectionable. Sulfate levels up to 1500 ppm produce slight effects on livestock and levels of 1500 to 2500 produce temporary diarrhea. When the sulfate level reaches 3500 ppm, it is unfit for sows. Water with levels above 4500 ppm should not be used.(3)

E. NITRATE

Nitrate toxicity is seldom caused by a water source alone, but it may contribute to a problem feed source. The nitrate ion (NO3-) itself is not especially toxic. However, nitrite (NO2-) is readily absorbed and is quite toxic (10 times more than nitrate). The bacteria present in the digestive tract of ruminants and herbivores can readily convert nitrate to nitrite. The clinical signs of nitrate poisoning in animals include lack of coordination, labored breathing, blue discoloration of mucous membranes, vomiting and abortions. Dairy cows can have reduced milk production without showing any clinical signs. If animals show signs of nitrate poisoning or a problem is suspected, a veterinarian should be consulted to determine if nitrate is the problem, and administer an antidote if needed.

The following table can be used as a guide for nitrate in water, but must be considered along with the forage level.

Table 4. Nitrate Content (ppm)(1)

	Nitrate-N (NO3-N	Nitrate (NO3)	Potassium Nitrate (KNO3)	Interpretation
A. Water: (ppm)	0-100 100-300 Over 300	0-440 440-1300 Over 1300	0-720 720-2100 Over 2100	Considered safe. Exercise caution. Consider additive effect of nitrate in feed. Potentially toxic.
B. Forages: (%)	0-.15% 0.15-0.45% Over .45%	0-0.65% 0.65-2% Over 2%	0-1% 1-3% Over 3%	Considered safe. Exercise caution. May need to dilute or limit feed forages Potentially toxic.
C: Other elements	Several other elements can contaminate water under special circumstances. These will require special tests and are usually not performed unless there are indications of a problem. Questions of cost, accuracy and range of detection must be evaluated. Then a request should be made for the specific elements desired.			

Table 5. Recommended Limits of Concentration of Some Potentially Toxic Substances in Drinking Water for Livestock Safe Upper Limit of Concentration (mg/L)

Element	U.S. EPA (for humans)	U.S. EPA (for livestock)	NAS (for livestock
Aluminum	—		—
Arsenic (b)	0.05	5.0	0.2
Barium (c)	1.0	0.2	NE*
Berylium (c)	—	—	—
Boron	—	NE*	—
Cadmium	0.01	5.0	0.05
Chromium	0.05	0.05	1.0
Cobalt	—	1.0	1.0
Copper (c)	1.0	1.0	0.05
Fluoride	4.0/2.0 (e)	0.5	2.0
Iron (e)	0.3	2.0	NE*
Lead (a) (b)	.005	No limit	0.1
Manganese (e)	0.05	No limit	NE*
Mercury (c)	0.002	0.001	0.01
Molybdenum	—	No limit	NE*
Nickel	—	—	1.0
Nitrate (d)	10	100	100
Nitrite (c)	—	33	33
Selenium (a)	0.01	0.05	—
Vanadium (a)	—	0.1	0.1
Zinc (e)	5.0	25.0	25.0

*Not established. Experimental data available are not sufficient to make definite recommendations.

(a) Lead is cumulative and problems may begin at threshold value (0.05 mg/L).

(b) The safe limit is below the lowest detectable level.

(c) Analyses available only at certain laboratories.

(d) As Nitrate-N (NO3-N).

(e) Secondary standard. Drinking water limits for humans are classed as primary and secondary. Primary limits are health related and are enforced by law. Secondary limits are for aesthetics and are recommendations.

G. Conversion Factors and Tables

Table 6. Conversion Factors for Salinity Measures

ppm to umhos = ppm x 5/3 = _____ umhos/cm

umhos to ppm = umhos/cm x 3/5 = _____ ppm

(umhos/cm) to dS/m = (umhos/cm) x (0.001) = _____ dS/m (or mmhos/cm)

dS/m (or mmhos/cm) to (umhos/cm) = dS/m / 0.001 = _____ umhos/cm

ppm to dS/m = ppm x 0.0017 = _____ dS/m

dS/m to ppm = dS/m / 0.0017 = _____ ppm

Table 7: Nitrate and Nitrite Expressions and Conversion Factors for Converting from One Form of Expression to Another

	FORM A		FORM B		
	Nitrogen (N)	Nitrite (NO2)	Nitrate (NO3)	Potassium Nitrate (KNO3)	Sodium Nitrate (NaNO3)
Nitrate-Nitrogen (N)	1.0	3.3	4.4	7.2	6.1
Nitrate (NO3)	0.23	0.74	1.0	1.63	1.37
Nitrite (NO2)	0.3	1.0	1.34	2.2	1.85
Potassium Nitrate(KNO3)	0.14	0.64	0.61	1.0	.84
Sodium Nitrate (NaNO3)	0.16	0.54	0.72	1.2	1.0

To convert Form A to the equivalent amount of Form B, multiply A by the appropriate conversion factor. (Form A X Conversion Factor = Form B)

Examples:
1. 1.0% nitrate-nitrogen (N) X 4.4 = 4.4% nitrate (NO3)
2. 1.0% nitrate (NO3) X 0.23 = 0.23% nitrate-nitrogen (N)
3. 1.0% KNO3 X 0.61 = 0.61% nitrate (NO3)
4. 1.0% KNO3 X 0.14 = 0.14% nitrate-nitrogen (N)

Table 8. Conversions, Equivalents and Abbreviations

To convert Ca to CaCO3 multiply by 2.50
To convert SO4 to S multiply by 0.333
One U.S. gallon of water weighs 8.345 lbs.
One cubic foot of water weighs 62.43 lbs.
One U.S. gallon equals .13368 cubic foot
One kilogram equals 2.2 pounds
One pound equals 454 grams
One ounce equals 28.35 grams
ppm is parts per million
ppb is parts per billion
One part per million is equal to 1 mg/l
One part per million is equal to 1 mg/kg
One part per million is 0.0001 percent
One percent is 10000 parts per million

H. REFERENCES

1. Boyles, S. et al. Livestock and water. North Dakota State University, Extension Service Bulletin #AS-954. June 1988.

2. National Academy of Sciences. Nutrients and toxic substances in water for livestock and poultry. 1974.

3. Kober, J.A. Water: The most limiting nutrient. Agri-Practice 14:39-42. February 1993.

4. Carson, T.L. Water quality for livestock. In Current Veterinary Therapy, Food Animal Practice 3. W.B. Saunders and Co., 1993, pg. 375-377.

5. Water Quality Criteria, 1972. National Academy of Science - National Academy of Engineering, Environmental Study Board, ad hoc Committee on Water Quality Criteria, U.S. Gov't. Printing Office.

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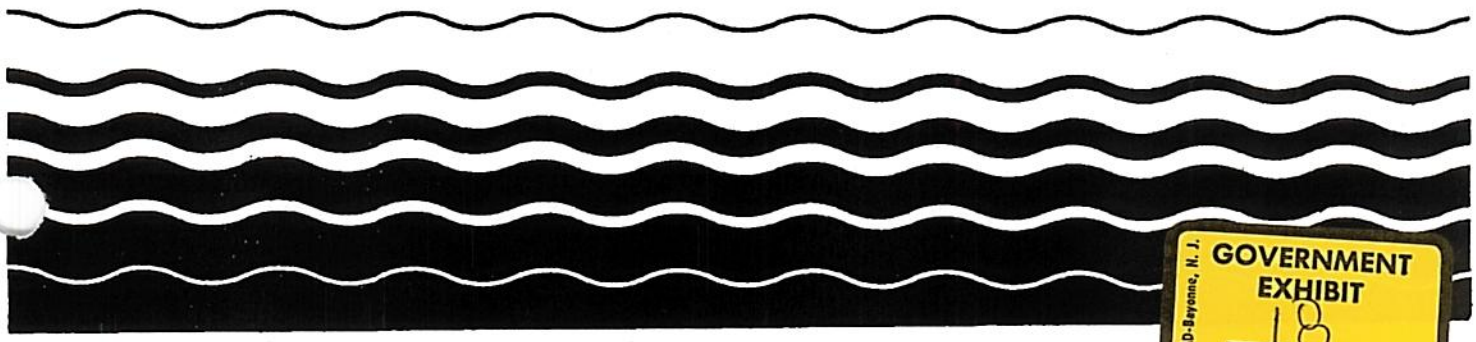

AMBIENT AQUATIC LIFE WATER QUALITY CRITERIA FOR

CHLORIDE

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
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NOTICES

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FOREWORD

Section 304(a)(1) of the Clean Water Act of 1977 (P.L. 95-217) requires the Administrator of the Environmental Protection Agency to publish water quality criteria that accurately reflect the latest scientific knowledge on the kind and extent of all identifiable effects on health and welfare that might be expected from the presence of pollutants in any body of water, including ground water. This document is a revision of proposed criteria based upon consideration of comments received from other Federal agencies, State agencies, special interest groups, and individual scientists. Criteria contained in this document replace any previously published EPA aquatic life criteria for the same pollutant(s).

The term "water quality criteria" is used in two sections of the Clean Water Act, section 304(a)(1) and section 303(c)(2). The term has a different program impact in each section. In section 304, the term represents a non-regulatory, scientific assessment of ecological effects. Criteria presented in this document are such scientific assessments. If water quality criteria associated with specific stream uses are adopted by a State as water quality standards under section 303, they become enforceable maximum acceptable pollutant concentrations in ambient waters within that State. Water quality criteria adopted in State water quality standards could have the same numerical values as criteria developed under section 304. However, in many situations States might want to adjust water quality criteria developed under section 304 to reflect local environmental conditions and human exposure patterns before incorporation into water quality standards. It is not until their adoption as part of State water quality standards that criteria become regulatory.

Guidance to assist States in the modification of criteria presented in this document, in the development of water quality standards, and in other water-related programs of this Agency has been developed by EPA.

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Introduction

The major anthropogenic sources of chloride in surface waters are deicing salt, urban and agricultural runoff, and discharges from municipal wastewater plants, industrial plants, and the drilling of oil and gas wells (Birge et al. 1985; Dickman and Gochnauer 1978; Sonzogni et al. 1983). Beeton (1965) reported that concentrations of chloride had been rising in Lake Erie, Lake Ontario, and Lake Michigan since the early 1900s, and in Lake Huron since the 1950s, but Sonzogni et al. (1983) stated that the rate of change of chloride inputs to the Great Lakes had stabilized or decreased.

Chloride has long received special attention from researchers interested in fish. In 1937, Ellis discussed the concept that "fresh-water fish tolerate an osmotic pressure of the external medium equal to that of their own blood if the various salts and substances in the water are balanced against each other so as to exclude the specific toxic effects" and presented supporting data. Chloride has been used as a nutrient and prophylactic for fish (Hinton and Eversole 1979; Phillips 1944). It has also been suggested for use as a reference toxicant (Adelman and Smith 1976a,b; Threader and Houston 1983).

Because anthropogenic sources of chloride are unlikely to pose a threat to saltwater species, this document concerns effects on only freshwater species. Unless otherwise noted, all concentrations of chloride in water reported herein from toxicity and bioconcentration tests are expected to be essentially equivalent to dissolved chloride concentrations. All concentrations are expressed as chloride, not as the chemical tested. An understanding of the "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses" (Stephan et al. 1985), hereinafter referred to as the Guidelines, and the response to public comment (U.S. EPA 1985a) is necessary in order to understand the

following text, tables, and calculations. Results of such intermediate calculations as recalculated LC50s and Species Mean Acute Values are given to four significant figures to prevent roundoff errors in subsequent calculations, not to reflect the precision of the value. The latest comprehensive literature search for information for this document was conducted in August 1985; some more recent information was included.

Acute Toxicity to Aquatic Animals

Data that may be used, according to the Guidelines, in the derivation of a freshwater Final Acute Value for chloride are presented in Table 1. When compared on the basis of mg of chloride/L, the chlorides of potassium, calcium, and magnesium are generally more acutely toxic to aquatic animals than sodium chloride (Biesinger and Christensen 1972; Dowden 1961; Dowden and Bennett 1965; Hamilton et al. 1975; Patrick et al. 1968; Trama 1954). Only for sodium chloride, however, are enough data available to allow derivation of a water quality criterion. In addition, it seems likely that most anthropogenic chloride in ambient water is associated with sodium, rather than potassium, calcium, or magnesium (Dickman and Gochnauer 1978; Sonzogni et al. 1983).

Results listed in Table 1 from Dowden and Bennett (1965), Hamilton et al. (1975), and Kostecki and Jones (1983) were obtained from 24- and 48-hr tests, rather than the 96-hr tests specified in the Guidelines. Use of such results is considered acceptable for chloride because the acute values changed little from 24 to 48 or 96 hours, depending on the species, in acute toxicity tests on chloride. For example, ratios of 24-hr and 48-hr LC50s for sodium chloride with a midge and a daphnid were 0.91 and 0.81, respectively (Dowden and Bennett 1965; Thornton and Sauer 1972). Reed and Evans (1981) obtained a

ratio of 1.0 for 24-hr and 14-day LC50s determined with the channel catfish, bluegill, and largemouth bass (Table 5). Adelman and Smith (1976a,b) and Adelman et al. (1976) obtained ratios of 24- and 96-hr LC50s of 0.74 and 0.97 with goldfish and fathead minnows, respectively, in tests in which the fish were fed (Table 5).

Adult fingernail clams were more sensitive than juveniles (Anderson 1977), but for the American eel (Hinton and Eversole 1978) and the bluegill (Cairns and Scheier 1959) smaller organisms were slightly more sensitive than larger ones. No pronounced relationships have been observed between the acute toxicity of chloride to freshwater animals and hardness, alkalinity, or pH.

Species Mean Acute Values (Table 1) were calculated as geometric means of the acute values from tests on sodium chloride, and then Genus Mean Acute Values (Table 3) were calculated as geometric means of the Species Mean Acute Values. Of the twelve genera for which acute values are available, the most sensitive genus, Daphnia, was only 6 times more sensitive than the most resistant, Anguilla. Invertebrates were generally more sensitive than vertebrates. The Final Acute Value for chloride was calculated to be 1,720 mg/L using the procedure described in the Guidelines and the Genus Mean Acute Values in Table 3. The acute value for Daphnia pulex is lower than the Final Acute Value.

Chronic Toxicity to Aquatic Animals

The available data that are usable according to the Guidelines concerning the chronic toxicity of chloride are presented in Table 2. In the life-cycle test with Daphnia pulex, survival was as good as in the control treatment at chloride concentrations up to 625 mg/L (Birge et al. 1985). At 314 mg/L, reproduction was as good as in the control, but at 441 and 625 mg/L,

reproduction was reduced by 27 and 39%, respectively. Thus, the chronic limits are 314 and 441 mg/L, the chronic value is 372.1 mg/L, and the acute-chronic ratio is 3.951.

In an early life-stage test with rainbow trout, a chloride concentration of 2,740 mg/L killed all the exposed organisms (Spehar 1987). Survival was 54% at 1,324 mg/L, but was 97% or higher at 643 mg/L and at two lower concentrations and in the control treatment. The mean weights of the fish alive at the end of the test at 1,324 mg/L and the lower tested concentrations were within 5% of the mean weight of the fish in the control treatment. The chronic value and the acute-chronic ratio obtained with the rainbow trout were 922.7 mg/L and 7.308, respectively.

In an early life-stage test with the fathead minnow, Pimephales promelas, Birge et al. (1985) found that weight was as good as in the control treatment up to a chloride concentration of 533 mg/L. Survival was reduced 9% by a concentration of 352 mg/L and was reduced 15% by 533 mg/L. The chronic value is 433.1 mg/L, and the acute-chronic ratio is 15.17.

The three acute-chronic ratios available for chloride are 7.308, 15.17, and 3.951 (Table 3). The geometric mean of these three is 7.594, which is used as the Final Acute-Chronic Ratio. Division of the Final Acute Value by the Final Acute-Chronic Ratio results in a Final Chronic Value of 226.5 mg/L, which is substantially lower than all three chronic values in Table 2.

Toxicity to Aquatic Plants

Data on the toxicity of chloride to aquatic plants show a wide range of sensitivities (Table 4). The alga, Spirogyra setiformis, was extremely sensitive to the effects of chloride; inhibition of growth, chlorophyll, and fixation of ^{14}C occurred at 71 mg/L (Shitole and Joshi 1984). Growth of

Netrium digitus was affected at 200 mg/L, but the other sixteen tested species were affected by concentrations ranging from 642 to 36,400 mg/L. A Final Plant Value, as defined in the Guidelines, cannot be obtained because no test in which the concentrations of chloride were measured and the endpoint was biologically important has been conducted with an important aquatic plant species.

Eyster (1962) reported that a concentration of 0.18 mg/L stimulated the growth of many algae, and Sonzogni et al. (1983) discussed the possibility that concentrations above 10 mg/L might shift phytoplankton communities toward nuisance, taste-and-odor-causing blue-green algae. When chloride was added to a small stream at a concentration of 610 mg/L, the algal density decreased whereas the bacterial density increased.

Although most of the data on toxicity of chloride to freshwater plants has been obtained with sodium chloride, some evidence indicates that a similar cation-anion toxicity relationship exists for both aquatic plants and animals. Patrick et al. (1968) demonstrated that potassium chloride was 2.3 times more toxic to a diatom than sodium chloride (Table 4), although calcium chloride was 1.3 times less toxic than sodium chloride. Tuchman and Stoermer (Manuscript a,b) found that potassium chloride had a greater inhibitory effect on algal population dynamics and nutrient uptake than sodium chloride.

Bioaccumulation

No data that are usable according to the Guidelines are available concerning the accumulation of chloride by freshwater species.

Other Data

Additional data on the lethal and sublethal effects of chloride on freshwater species are presented in Table 5. Anderson (1944,1948) and

Biesinger and Christensen (1972) found the same cation-anion toxicity relationship that is apparent in Table 1. Sreenivasan et al. (1979) reported that the rotifer, Brachionus rubens, tolerates chloride up to at least 1,400 mg/L. Wallen et al. (1957) reported that magnesium chloride was less toxic to the mosquitofish than sodium chloride; however, these tests were conducted in very turbid water and therefore the results might be atypical. A concentration of 13% sodium chloride in the diet of trout caused no ill effects, whereas 25 mg in gelatin capsules caused edema and death of brook trout (Phillips 1944). Food consisting of 12% sodium chloride did not affect growth of Atlantic salmon (Shaw et al. 1975). Hasan and Macintosh (1986) and Tomasso et al. (1980) reported that chloride reduced the acute toxicity of nitrite to fish.

Unused Data

Some data concerning the effects of chloride on aquatic organisms and their uses were not used because the tests were conducted with species that are not resident in North America (e.g., Coetzee and Hattingh 1977; Das and Srivastava 1978; Ferri and Sesso 1982; Katz and Ben-Sasson 1984; Meech and Thomas 1980; Schiewer 1974,1984; Stangenberg 1975; Vaidya and Nagabhushanam 1979). Jennings (1976) compiled data from other sources. Data were not used when chloride was a component of an effluent (Birge et al. 1985). Reports by Batterton et al. (1972), Hosiaisluoma (1976), and Palmer and Maloney (1955) provided no usable data on the toxicity of chloride. Arnold (1974), Davis et al. (1972), and Edmister and Gray (1948) did not adequately describe their test procedures or results or both.

Results of some laboratory tests were not used because the tests were conducted in distilled or deionized water without addition of appropriate

salts (e.g., Kardatzke 1980,1981; Lee 1973; Mahajan et al. 1979; Pappas and Pappas 1983; Stamper 1969; Thornton and Wilhm 1974,1975; Zaim and Newson 1979) or were conducted in chlorinated or "tap" water (e.g., Kumar and Srivastava 1981). Christensen (1971/72) and Christensen and Tucker (1976) exposed plasma or enzymes. Length of exposure was not reported by Batterton and Van Baalen (1971). High control mortalities occurred in tests reported by Lewis (1971). Tests conducted without controls (e.g., Vosjan and Siezen 1968) or with too few test organisms (e.g., Leblanc and Surprenant 1984) were also not used. Hughes (1968,1973) did not adequately acclimate the test organisms. Ten-day LC50s (Threader and Houston 1983) were not used because the fish had not been fed during the tests.

Many studies were not used because they addressed the metabolism, regulation, or transport, rather than toxicity, of chloride (e.g., Carrasquer et al. 1983; Castille and Lawrence 1981; De Renzis and Maetz 1973; Greenway and Setter 1979a,b; Hinkle et al. 1971; Konovalov 1984; McCormick and Naiman 1984; Ooshima and Oguri 1974; Perry et al. 1984; Shomer-Ilan and Waisel 1976; Sullivan et al. 1981; Ticku and Olsen 1977). Some references were not used because they were foreign-language reports for which no translation was available and no useful data could be obtained from the English abstracts (e.g., Frahm 1975; Mushak 1968; Schiewer 1976; Turoboyski 1960).

Summary

Although few data are available concerning the toxicity of any chloride salt other than sodium chloride, the data that are available indicate that, when compared on the basis of mg of chloride/L, the chlorides of potassium, calcium, and magnesium are generally more toxic to freshwater species than sodium chloride. Based on tests on sodium chloride, the acute sensitivities

of freshwater animals to chloride ranged from 1,470 mg/L for Daphnia pulex to 11,940 mg/L for the American eel. Invertebrate species were generally more sensitive than vertebrates. Results from tests with a variety of species show that if freshwater animals do not die within the first 24 hr of the test, they probably will not die during periods ranging from 48 hr to 11 days. No relationships have been observed between the acute toxicity of chloride to freshwater animals and hardness, alkalinity, pH, or life-stage of the test organisms.

A life-cycle test with Daphnia pulex and early life-stage tests with the rainbow trout and fathead minnow produced chronic values of 372.1, 922.7, and 433.1 mg/L, respectively. The acute-chronic ratios were calculated to be 3.951 for Daphnia pulex, 7.308 for rainbow trout, and 15.17 for the fathead minnow. Freshwater plants were affected at concentrations of chloride ranging from 71 to 36,400 mg/L. No data are available concerning bioaccumulation of chloride by freshwater organisms.

National Criteria

The procedures described in the "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses" indicate that, except possibly where a locally important species is very sensitive, freshwater aquatic organisms and their uses should not be affected unacceptably if the four-day average concentration of dissolved chloride, when associated with sodium, does not exceed 230 mg/L more than once every three years on the average and if the one-hour average concentration does not exceed 860 mg/L more than once every three years on the average. This criterion probably will not be adequately protective when the chloride is associated with potassium, calcium, or magnesium, rather than sodium In

addition, because freshwater animals have a narrow range of acute susceptibilities to chloride, excursions above this criterion might affect a substantial number of species.

Implementation

As discussed in the Water Quality Standards Regulation (U.S. EPA 1983a) and the Foreword to this document, a water quality criterion for aquatic life has regulatory impact only after it has been adopted in a State water quality standard. Such a standard specifies a criterion for a pollutant that is consistent with a particular designated use. With the concurrence of the U.S. EPA, States designate one or more uses for each body of water or segment thereof and adopt criteria that are consistent with the use(s) (U.S. EPA 1983b,1987). In each standard a State may adopt the national criterion, if one exists, or, if adequately justified, a site-specific criterion.

Site-specific criteria may include not only site-specific criterion concentrations (U.S. EPA 1983b), but also site-specific, and possibly pollutant-specific, durations of averaging periods and frequencies of allowed excursions (U.S. EPA 1985b). The averaging periods of "one hour" and "four days" were selected by the U.S. EPA on the basis of data concerning how rapidly some aquatic species react to increases in the concentrations of some pollutants, and "three years" is the Agency's best scientific judgment of the average amount of time aquatic ecosystems should be provided between excursions (Stephan et al. 1985; U.S. EPA 1985b). However, various species and ecosystems react and recover at greatly differing rates. Therefore, if adequate justification is provided, site-specific and/or pollutant-specific concentrations, durations, and frequencies may be higher or lower than those given in national water quality criteria for aquatic life.

Use of criteria, which have been adopted in State water quality standards, for developing water quality-based permit limits and for designing waste treatment facilities requires selection of an appropriate wasteload allocation model. Although dynamic models are preferred for the application of these criteria (U.S. EPA 1985b), limited data or other considerations might require the use of a steady-state model (U.S. EPA 1986). Guidance on mixing zones and the design of monitoring programs is also available (U.S. EPA 1985b,1987).

Table 1. Acute Toxicity of Chloride to Aquatic Animals

Species	Method[a]	Chemical	Hardness (mg/L as $CaCO_3$)	LC50 or EC50 (mg/L)[b]	Species Mean Acute Value (mg/L)[c]	Reference
			FRESHWATER SPECIES			
Snail, *Physa gyrina*	F, M	Sodium chloride	100	2,540	2,540	Birge et al. 1985
Snail, *Physa heterostropha*	S, U	Potassium chloride	-	451	-	*Academy of Natural* Sciences 1960; Patrick et al 1968
Fingernail clam (adult >5 cm), *Musculium transversum*	S, M	Potassium chloride	263	168	-	Anderson 1977
Fingernail clam (adult >5 cm), *Musculium transversum*	S, M	Potassium chloride	243	254	-	Anderson 1977
Fingernail clam (juvenile <5 cm), *Musculium transversum*	S, M	Potassium chloride	263	472	-	Anderson 1977
Fingernail clam (juvenile <5 cm), *Musculium transversum*	S, M	Potassium chloride	243	907	-	Anderson 1977
Fingernail clam (juvenile <5 cm), *Musculium transversum*	S, M	Potassium chloride	234	1,655[d]	-	Anderson 1977
Cladoceran (1st instar), *Daphnia magna*	S, U	Sodium chloride	-	<2,562[e]	-	Anderson 1946

Table 1 (continued)

Species	Method[a]	Chemical	Hardness (mg/L as $CaCO_3$)	LC50 or EC50 (mg/L)[b]	Species Mean Acute Value (mg/L)[c]	Reference
Cladoceran, *Daphnia magna*	S, U	Potassium chloride	-	171	-	Dowden 1961
Cladoceran, *Daphnia magna*	S, U	Calcium chloride	-	486	-	Dowden 1961
Cladoceran, *Daphnia magna*	S, U	Sodium chloride	-	2,024	-	Dowden 1961
Cladoceran, *Daphnia magna*	S, U	Calcium chloride	-	1,923	-	Dowden and Bennett 1965
Cladoceran, *Daphnia magna*	S, U	Magnesium chloride	-	2,774	-	Dowden and Bennett 1965
Cladoceran, *Daphnia magna*	S, U	Sodium chloride	-	3,583	-	Dowden and Bennett 1965
Cladoceran, *Daphnia magna*	S, U	Potassium chloride	45	86	-	Biesinger and Christensen 1972
Cladoceran, *Daphnia magna*	S, U	Calcium chloride	45	92	-	Biesinger and Christensen 1972
Cladoceran, *Daphnia magna*	S, U	Magnesium chloride	45	409	-	Biesinger and Christensen 1972
Cladoceran, *Daphnia magna*	S, U	Sodium chloride	45	2,565	2,650	Biesinger and Christensen 1972

Table 1. (continued)

Species	Method[a]	Chemical	Hardness (mg/L as $CaCO_3$)	LC50 or EC50 (mg/L)[b]	Species Mean Acute Value (mg/L)[c]	Reference
Cladoceran, *Daphnia pulex*	R, M	Sodium chloride	93	1,470	1,470	Birge et al. 1985
Isopod, *Lirceus fontinalis*	F, M	Sodium chloride	100	2,950	2,950	Birge et al. 1985
Caddisfly, *Hydroptila angusta*	S, U	Sodium chloride	124	4,039[f]	4,039	Hamilton et al. 1975
Mosquito (larva), *Culex* sp.	S, U	Sodium chloride	-	6,222[f]	6,222	Dowden and Bennett 1965
Midge, *Chironomus attenuatus*	S, U	Sodium chloride	-	4,900	4,900	Thornton and Sauer 1972
Midge, *Cricotopus trifascia*	S, U	Potassium chloride	124	1,434	-	Hamilton et al. 1975
Midge, *Cricotopus trifascia*	S, U	Sodium chloride	124	3,795	3,795	Hamilton et al. 1975
American eel (55 mm), *Anguilla rostrata*	S, U	Sodium chloride	44	10,900	-	Hinton and Eversole 1978
American eel (97.2 mm), *Anguilla rostrata*	S, U	Sodium chloride	44	13,085	11,940	Hinton and Eversole 1979
Rainbow trout, *Salmo gairdneri*	R, U	Sodium chloride	-	3,336[g]	-	Kostecki and Jones 1983
Rainbow trout, *Salmo gairdneri*	F, M	Sodium chloride	46	6,743	6,743	Spehar 1987

Table 1. (continued)

Species	Method[a]	Chemical	Hardness (mg/L as $CaCO_3$)	LC50 or EC50 (mg/L)[b]	Species Mean Acute Value (mg/L)[c]	Reference
Goldfish, *Carassius auratus*	S, U	Sodium chloride	-	8,388[g]	-	Dowden and Bennett 1965
Goldfish, *Carassius auratus*	S, M	Sodium chloride	149	9,455[h]	8,906	Threader and Houston 1983
Fathead minnow, *Pimephales promelas*	F, M	Sodium chloride	100	6,570	6,570	Birge et al 1985
Bluegill, *Lepomis macrochirus*	S, U	Potassium chloride	39	956	-	Trama 1954
Bluegill, *Lepomis macrochirus*	S, U	Calcium chloride	39	6,804	-	Trama 1954
Bluegill, *Lepomis macrochirus*	S, U	Sodium chloride	39	7,846	-	Trama 1954
Bluegill (3.9 cm), *Lepomis macrochirus*	S, U	Calcium chloride	-	6,080	-	Cairns and Scheier 1959
Bluegill (6.1 cm), *Lepomis macrochirus*	S, U	Calcium chloride	-	6,080	-	Cairns and Scheier 1959
Bluegill (14.2 cm), *Lepomis macrochirus*	S, U	Calcium chloride	-	7,232	-	Cairns and Scheier 1959
Bluegill, *Lepomis macrochirus*	S, U	Potassium chloride	-	965	-	Academy of Natural Sciences 1960; Patrick et al. 1968

Table 1. (continued)

Species	Method[a]	Chemical	Hardness (mg/L as $CaCO_3$)	LC50 or EC50 (mg/L)[b]	Species Mean Acute Value (mg/L)[c]	Reference
Bluegill, *Lepomis macrochirus*	S, U	Calcium chloride	-	6,816	-	Academy of Natural Sciences 1960; Patrick et al. 1968
Bluegill, *Lepomis macrochirus*	S, U	Sodium chloride	-	7,897	-	Academy of Natural Sciences 1960; Patrick et al. 1968
Bluegill, *Lepomis macrochirus*	S, U	Potassium chloride	-	2,640[g]	-	Dowden and Bennett 1965
Bluegill, *Lepomis macrochirus*	S, U	Calcium chloride	-	5,344[g]	-	Dowden and Bennett 1965
Bluegill, *Lepomis macrochirus*	S, U	Sodium chloride	-	8,616[g]	-	Dowden and Bennett 1965
Bluegill, *Lepomis macrochirus*	F, M	Sodium chloride	100	5,870	5,870	Birge et al. 1985

[a] S = static; R = renewal; F = flow-through; U = unmeasured; M = measured

[b] Concentration of chloride not the chemical

[c] Only data obtained with sodium chloride were used in calculation of Species Mean Acute Values Data for other salts are presented for comparison purposes only.

[d] Test temperature = 7°C; the other tests with this species were at 17°C.

[e] Not used in calculations because quantitative values are available for this species.

[f] This value is from a 48-hr test (see text)

[g] This value is from a 24-hr test (see text)

[h] This value was derived from the published graph

Table 2. Chronic Toxicity of Chloride to Aquatic Animals

Species	Test[a]	Chemical	Hardness (mg/L as $CaCO_3$)	Limits (mg/L)[b]	Chronic Value (mg/L)	Reference
			FRESHWATER SPECIES			
Cladoceran, *Daphnia pulex*	LC	Sodium chloride	100	314-441	372.1	Birge et al. 1985
Rainbow trout, *Salmo gairdneri*	ELS	Sodium chloride	46	643-1,324	922.7	Spehar 1987
Fathead minnow, *Pimephales promelas*	ELS	Sodium chloride	100	352-533	433.1	Birge et al. 1985

[a] LC = life-cycle or partial life-cycle; ELS = early life-stage.

[b] Measured concentrations of chloride.

Acute-Chronic Ratio

Species	Hardness (mg/L as $CaCO_3$)	Acute Value (mg/L)	Chronic Value (mg/L)	Ratio
Cladoceran, *Daphnia pulex*	100	1,470	372.1	3.951
Rainbow trout, *Salmo gairdneri*	46	6,743	922.7	7.308
Fathead minnow, *Pimephales promelas*	100	6,570	433.1	15.17

Table 3. Ranked Genus Mean Acute Values with Species Mean Acute-Chronic Ratios

Rank[a]	Genus Mean Acute Value (mg/L)	Species	Species Mean Acute Value (mg/L)[b]	Species Mean Acute-Chronic Ratio[c]
		FRESHWATER SPECIES		
12	11,940	American eel, *Anguilla rostrata*	11,940	-
11	8,906	Goldfish, *Carassius auratus*	8,906	-
10	6,743	Rainbow trout, *Salmo gairdneri*	6,743	7.308
9	6,570	Fathead minnow, *Pimephales promelas*	6,570	15.17
8	6,222	Mosquito, *Culex* sp.	6,222	-
7	5,870	Bluegill, *Lepomis macrochirus*	5,870	-
6	4,900	Midge, *Chironomus attenuatus*	4,900	-
5	4,039	Caddisfly, *Hydroptila angusta*	4,039	-
4	3,795	Midge, *Cricotopus trifascia*	3,795	-
3	2,950	Isopod, *Lireus fontinalis*	2,950	-
2	2,540	Snail, *Physa gyrina*	2,540	-

Table 3. (continued)

Rank[a]	Genus Mean Acute Value (mg/L)	Species	Species Mean Acute Value (mg/L)[b]	Species Mean Acute-Chronic Ratio[c]
1	1,974	Cladoceran, *Daphnia magna*	2,650	-
		Cladoceran, *Daphnia pulex*	1,470	3.951

[a] Ranked from most resistant to most sensitive based on Genus Mean Acute Value.

[b] From Table 1.

[c] From Table 2.

Final Acute Value = 1,720 mg/L

Criterion Maximum Concentration = (1,720 mg/L) / 2 = 860.0 mg/L

Final Acute-Chronic Ratio = 7.594 (see text)

Final Chronic Value = (1,720 mg/L) / 7.594 = 226.5 mg/L

Table 4. Toxicity of Chloride to Aquatic Plants

Species	Chemical	Duration (days)	Effect	Concentration (mg/L)[a]	Reference
			FRESHWATER SPECIES		
Alga, Anacystis nidulans	Sodium chloride	4	Growth inhibition	>24,300	Schiewer 1974
Alga, Anabaena variabilis	Sodium chloride	4	Growth inhibition	14,300	Schiewer 1974
Alga, Chlamydomonas reinhardtii	Sodium chloride	3-6	Growth inhibition	3,014	Reynoso et al. 1982
Alga, Chlorella emersonii	Sodium chloride	8-14	Growth inhibition	7,000	Setter et al. 1982
Alga, Chlorella fusca fusca	Sodium chloride	28	Growth inhibition	18,200	Kessler 1974
Alga, Chlorella fusca rubescens	Sodium chloride	28	Growth inhibition	24,300	Kessler 1974
Alga, Chlorella fusca vacuolata	Sodium chloride	28	Growth inhibition	24,300	Kessler 1974
Alga, Chlorella kessleri	Sodium chloride	28	Growth inhibition	18,200	Kessler 1974
Alga, Chlorella luteoviridis	Sodium chloride	28	Growth inhibition	36,400	Kessler 1974

Table 4. (continued)

Species	Chemical	Duration (days)	Effect	Concentration (mg/L)[a]	Reference
Alga, *Chlorella minutissima*	Sodium chloride	28	Growth inhibition	12,100	Kessler 1974
Alga, *Chlorella protothecoides*	Sodium chloride	28	Growth inhibition	30,300	Kessler 1974
Alga, *Chlorella saccharophilia*	Sodium chloride	28	Growth inhibition	30,300	Kessler 1974
Alga, *Chlorella vulgaris*	Potassium chloride	90-120	Growth inhibition	23,800	De Jong 1965
Alga, *Chlorella vulgaris*	Sodium chloride	90-120	Growth inhibition	24,100	De Jong 1965
Alga, *Chlorella vulgaris tertia*	Sodium chloride	28	Growth inhibition	18,200	Kessler 1974
Alga, *Chlorella vulgaris vulgaris*	Sodium chloride	28	Growth inhibition	24,300	Kessler 1974
Alga, *Chlorella zofingiensis*	Sodium chloride	28	Growth inhibition	12,100	Kessler 1974
Alga, *Pithophora oedogonia*	Sodium chloride	10	Inhibition of growth, chlorophyll, and ^{14}C fixation	886	Shitole and Joshi 1984
Alga, *Spirogyra setiformis*	Sodium chloride	10	Inhibition of growth, chlorophyll, and ^{14}C fixation	71	Shitole and Joshi 1984
Desmid, *Netrium digitus*	Sodium chloride	21	Growth inhibition	200	Hosiaisluoma 1976

Table 4. (continued)

Species	Chemical	Duration (days)	Effect	Concentration (mg/L)[a]	Reference
Desmid, *Netrium digitus*	Sodium chloride	21	Growth inhibition	250	Hosiaisluoma 1976
Diatom, *Nitzschia linearis*	Potassium chloride	5	EC50	642	Academy of Natural Sciences 1960; Patrick et al. 1968
Diatom, *Nitzschia linearis*	Calcium chloride	5	EC50	2,003	Academy of Natural Sciences 1960; Patrick et al. 1968
Diatom, *Nitzschia linearis*	Sodium chloride	5	EC50	1,482	Academy of Natural Sciences 1960; Patrick et al. 1968
Eurasian watermilfoil, *Myriophyllum spicatum*	Sodium chloride	32	50% reduction in dry weight	3,617	Stanley 1974
Eurasian watermilfoil, *Myriophyllum spicatum*	Sodium chloride	32	50% reduction in dry weight	4,964	Stanley 1974
Angiosperm (seed), *Potamogeton pectinatus*	Sodium chloride	28	Reduced germination	1,820	Teeter 1965
Angiosperm (9-wk old plants), *Potamogeton pectinatus*	Sodium chloride	35	Reduced dry weight	1,820	Teeter 1965
Angiosperm (13-wk old plants), *Potamogeton pectinatus*	Sodium chloride	35	Reduced shoots and dry weight	1,820	Teeter 1965

[a] Concentration of chloride, not the chemical

Table 5. Other Data on Effects of Chloride on Aquatic Organisms

Species	Chemical	Hardness (mg/L as $CaCO_3$)	Duration	Effect	Concentration (mg/L)[a]	Reference
			FRESHWATER SPECIES			
Alga, *Chlorella pyrenoidosa*	Sodium chloride	-	24 hr	Inhibited growth	301	Kalinkina 1979; Kalinkina and Strogonov 1980 Kalinkina et al. 1978
Protozoan, *Paramecium tetraurelia*	Sodium chloride	-	5 days	17% reduction in cell division	350[b]	Cronkite et al. 1985
Cladoceran (1st instar), *Daphnia magna*	Potassium chloride	-	16 hr	LC50	179	Anderson 1944
Cladoceran (1st instar), *Daphnia magna*	Calcium chloride	-	16 hr	LC50	853	Anderson 1944
Cladoceran (1st instar), *Daphnia magna*	Sodium chloride	-	16 hr	LC50	3,747	Anderson 1944
Cladoceran, *Daphnia magna*	Potassium chloride	-	64 hr	Incipient inhibition	207	Anderson 1948
Cladoceran, *Daphnia magna*	Calcium chloride	-	64 hr	Incipient inhibition	589	Anderson 1948
Cladoceran, *Daphnia magna*	Magnesium chloride	-	64 hr	Incipient inhibition	555	Anderson 1948
Cladoceran, *Daphnia magna*	Sodium chloride	-	64 hr	Incipient inhibition	2,245	Anderson 1948
Cladoceran, *Daphnia magna*	Potassium chloride	45	21 days	Reproductive impairment	44[c]	Biesinger and Christensen 1972

Table 5. (continued)

Species	Chemical	Hardness (mg/L as $CaCO_3$)	Duration	Effect	Concentration (mg/L)[a]	Reference
Cladoceran, *Daphnia magna*	Calcium chloride	45	21 days	Reproductive impairment	206[c]	Biesinger and Christensen 1972
Cladoceran, *Daphnia magna*	Magnesium chloride	45	21 days	Reproductive impairment	239[c]	Biesinger and Christensen 1972
Cladoceran, *Daphnia magna*	Sodium chloride	45	21 days	Reproductive impairment	1,062[c]	Biesinger and Christensen 1972
Caddisfly, *Hydroptila angusta*	Potassium chloride	124	48 hr	LC50	2,119	Hamilton et al. 1975
Goldfish, *Carassius auratus*	Sodium chloride	-	24 hr 96 hr -	LC50 (fed) LC50 (fed) Threshold LC50	6,037 4,453 4,442	Adelman and Smith 1976a,b Adelman et al. 1976
Shiners, *Notropis* sp.	Sodium chloride	-	5 days	Reduced survival	1,525	Van Horn et al. 1949
Fathead minnow (11 wk), *Pimephales promelas*	Sodium chloride	-	24 hr 96 hr -	LC50 (fed) LC50 (fed) Threshold LC50	4,798 4,640 4,640	Adelman and Smith 1976a b Adelman et al. 1976
Channel catfish, *Ictalurus punctatus*	Sodium chloride	412	24 hr 14 days	LC50 (fed)	8,000 8,000	Reed and Evans 1981
Mosquitofish, *Gambusia affinis*	Potassium chloride	-	24 hr 96 hr	LC50[d]	4,800 442	Wallen et al. 1957
Mosquitofish, *Gambusia affinis*	Calcium chloride	-	24 hr 96 hr	LC50[d]	8,576 8,576	Wallen et al. 1957
Mosquitofish, *Gambusia affinis*	Magnesium chloride	-	24 hr 96 hr	LC50[d]	14,060 12,370	Wallen et al. 1957

Table 5. (continued)

Species	Chemical	Hardness (mg/L as $CaCO_3$)	Duration	Effect	Concentration (mg/L)[a]	Reference
Mosquitofish, *Gambusia affinis*	Sodium chloride	-	24 hr 96 hr	LC50[d]	11,040 10,710	Wallen et al. 1957
Bluegill, *Lepomis macrochirus*	Sodium chloride	412	24 hr 14 days	LC50 (fed)	8,000 8,000	Reed and Evans 1981
Largemouth bass (juvenile), *Micropterus salmoides*	Sodium chloride	412	24 hr 14 days	LC50 (fed)	8,500 8,500	Reed and Evans 1981

[a] Concentration of chloride, not the chemical.

[b] This value was derived from the published graph.

[c] Concentrations not measured in test solutions.

[d] Turbidity = <25 to 320 mg/L.

REFERENCES

Academy of Natural Sciences. 1960. The sensitivity of aquatic life to certain chemicals commonly found in industrial wastes. Philadelphia, PA.

Adelman, I.R. and L.L. Smith, Jr. 1976a. Fathead minnows (Pimephales promelas) and goldfish (Carassius auratus) as standard fish in bioassays and their reaction to potential reference toxicants. J. Fish. Res. Board Can. 33:209-214.

Adelman, I.R. and L.L. Smith, Jr. 1976b. Standard test fish development. Part I. Fathead minnows (Pimephales promelas) and goldfish (Carassius auratus) as standard fish in bioassays and their reaction to potential reference toxicants. EPA-600/3-76-061a. National Technical Information Service, Springfield, VA.

Adelman, I.R., L.L. Smith, Jr. and G.D. Siesennop. 1976. Acute toxicity of sodium chloride, pentachlorophenol, Guthion, and hexavalent chromium to fathead minnows (Pimephales promelas) and goldfish (Carassius auratus). J. Fish. Res. Board Can. 33:203-208.

Anderson, B.G. 1944. The toxicity thresholds of various substances found in industrial wastes as determined by the use of Daphnia magna. Sewage Works J. 16:1156-1165.

Anderson, B.G. 1946. The toxicity thresholds of various sodium salts determined by the use of Daphnia magna. Sewage Works J. 18:82-87.

Anderson, B.G. 1948. The apparent thresholds of toxicity to Daphnia magna for chlorides of various metals when added to Lake Erie water. Trans. Am. Fish. Soc. 78:96-113.

Anderson, K.B. 1977. Musculium transversum in the Illinois River and an acute potassium bioassay method for the species. PB-288088. National Technical Information Service, Springfield, VA.

Arnold, D. 1974. Comparative study of the effects of copper sulfate and sodium chloride upon the growing habits of planktonic algae cultures. J. Tenn. Acad. Sci. 46:14.

Batterton, J.C., Jr. and C. Van Baalen. 1971. Growth responses of blue-green algae to sodium chloride concentration. Arch. Mikrobiol. 76:151-165.

Batterton, J.C., G.M. Boush and F. Matsumura. 1972. DDT: Inhibition of sodium chloride tolerance by the blue-green alga Anacystis nidulans. Science 176:1141-1143.

Beeton, A.M. 1965. Eutrophication of the St. Lawrence Great Lakes. Limnol. Oceanogr. 10:240-254.

Biesinger, K.E. and G.M. Christensen. 1972. Effects of various metals on survival, growth, reproduction, and metabolism of Daphnia magna. J. Fish. Res. Board Can. 29:1691-1700.

Birge, W.J., J.A. Black, A.G. Westerman, T.M. Short, S.B. Taylor, D.M. Bruser and E.D. Wallingford. 1985. Recommendations on numerical values for regulating

iron and chloride concentrations for the purpose of protecting warmwater species of aquatic life in the commonwealth of Kentucky. University of Kentucky, Lexington, KY.

Cairns, J., Jr. and A. Scheier. 1959. The relationship of bluegill sunfish body size to tolerance for some common chemicals. Proc. Ind. Waste Conf. Purdue Univ. 13:243-252.

Carrasquer, G., D. Kissel, W.S. Rehm and M. Schwartz. 1983. Anomalous potential difference responses to changes in sodium concentration in the antrum of frog stomach. Am. J. Physiol. 245:554-561.

Castille, F.L., Jr. and A.L. Lawrence. 1981. The effect of salinity on the osmotic, sodium, and chloride concentrations in the hemolymph of the freshwater shrimps, Macrobrachium ohione Smith and Macrobrachium rosenbergii De Man. Comp. Biochem. Physicl. 70A:47-52.

Christensen, G.M. 1971/72. Effects of metal cations and other chemicals upon the in vitro activity of two enzymes in the blood plasma of the white sucker. Catostomus commersoni (Lacepede). Chem.-Biol. Interact. 4:351-361.

Christensen, G.M. and J.H. Tucker. 1976. Effects of selected water toxicants on the in vitro activity of fish carbonic anhydrase. Chem.-Biol. Interact. 13:181-192.

Coetzee, N. and J. Hattingh. 1977. Effects of sodium chloride on the freshwater fish Labeo capensis during and after transportation. Zool. Afr. 12:244-247.

Cronkite, D.L., A.N. Gustafson and B.F. Bauer. 1985. Role of protein systhesis and ninhydrin-positive substances in acclimation of Paramecium tetraurelia to high NaCl. J. Exp. Zool. 233:21-28.

Das, S. and G.J. Srivastava. 1978. Responses of gill to various changes in salinity in fresh water teleost Colisa fasciatus (Bl. and Schn.). Z. Mikrosk. Anat. Forsch. (Leipz.) 92:770-780.

Davis, K.B., C.P. Schuier and B.A. Simco. 1972. The effect of short and long term exposure to salinity on plasma sodium and chloride concentrations of channel catfish. Am. Soc. Zool. 13:680.

De Jong, L.E.D. 1965. Tolerance of Chlorella vulgaris for metallic and non-metallic ions. Antonie Leeuwenhoek J. Microbiol. 31:301-313.

De Renzis, G. and J. Maetz. 1973. Studies on the mechanism of chloride absorption by the goldfish gill: Relation with acid-base regulation. J. Exp Biol. 59:339-358.

Dickman, M.D. and M.B. Gochnauer. 1978. Impact of sodium chloride on the microbiota of a small stream. Environ. Pollut. 17:109-126.

Dowden, B.F. 1961. Cumulative toxicities of some inorganic salts to Daphnia magna as determined by median tolerance limits. Proc. La. Acad. Sci. 23:77-85.

Dowden, B.F. and H.J. Bennett. 1965. Toxicity of selected chemicals to certain animals. J. Water Pollut. Control Fed. 37:1308-1316.

Edmister, J.O. and J.W. Gray. 1948. The toxicity thresholds for three chlorides and three acids to the fry of whitefish (Coregonus clupeaformis) and yellow pickerel (Stizostedion v. vitreum). Prog. Fish-Cult. 10:105-106.

Ellis, M.M. 1937. Detection and measurement of stream pollution. Bull. Bureau Fish. 48:365-437.

Eyster, C. 1962. Requirements and functions of micronutrients by green plants with respect to photosynthesis. In: Biologistics for space systems symposium. AMRL-TDR-62-116 or AD-292713. National Technical Information Service, Springfield, VA. pp. 199-209.

Ferri, S. and A. Sesso. 1982. Cell response associated to NaCl effect in a freshwater teleost epidermis. Zentralbl. Veterinaermed. Reihe C. 11:307-314.

Frahm, J. 1975. Toxicity tolerance studies utilizing periphyton. Gewasser Abwasser 57/58:59-66.

Greenway, H. and T.L. Setter. 1979a. Accumulation of proline and sucrose during the first hours after transfer of Chlorella emersonii to high NaCl. Aust. J. Plant Physiol. 6:69-79.

Greenway, H. and T.L. Setter. 1979b. Na^+, Cl^- and K^+ concentrations in Chlorella emersonii exposed to 100 and 335 mM NaCl. Aust. J. Plant Physiol. 6:61-67.

Hamilton, R.W., J.K. Buttner and R.G. Brunetti. 1975. Lethal levels of sodium chloride and potassium chloride for an oligochaete, a chironomid midge, and a caddisfly of Lake Michigan. Environ. Entomol. 4:1003-1006.

Hasan, M.R. and D.J. Macintosh. 1986. Effect of chloride concentration on the acute toxicity of nitrite to common carp, Cyprinus carpio L., fry. Aquacult. Fish. Manage. 17:19-30.

Hinkle, M., P. Heller and W. Van Der Kloot. 1971. The influence of potassium and chloride ions on the membrane potential of single muscle fibers of the crayfish. Comp. Biochem. Physiol. 40A:181-201.

Hinton, M.J. and A.G. Eversole. 1978. Toxicity of ten commonly used chemicals to American eels. Proc. Annu. Conf. Southeast. Assoc. Fish Wildl. Agencies 32:599-604.

Hinton, M.J. and A.G. Eversole. 1979. Toxicity of ten chemicals commonly used in aquaculture to the black eel stage of the American eel. In: Proceedings of the tenth annual meeting of the World Mariculture Society. Avault, J.W., Jr. (Ed). Louisiana State University, Baton Rouge, LA. pp. 554-560.

Hosiaisluoma, V. 1976. Effect of HCl and NaCl on the growth of Netrium digitus (Desmidiales). Ann. Bot. Fenn. 13:107-113.

Hughes, J.S. 1968. Toxicity of some chemicals to striped bass (Roccus saxatilis). Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 22:230-234.

Hughes, J.S. 1973. Acute toxicity of thirty chemicals to striped bass (Morone saxatilis). Presented at the Western Association of State Game and Fish Commissioners in Salt Lake City, UT.

Jennings, D.H. 1976. The effects of sodium chloride on higher plants. Biol. Rev. Camb. Philos. Soc. 51:453-486.

Kalinkina, L.G. 1979. Growth and biomass accumulation in marine and freshwater algae of the genus Chlorella as a function of NaCl concentration in the medium. Plant Physiol. (Engl. Transl. Fiziol. Rast.) 26:320-325.

Kalinkina, L.G. and B.P. Strogonov. 1980. Excretion of glycolic acid by marine and freshwater algae under the influence of different NaCl concentrations. Plant Physiol. (Engl. Transl. Fiziol. Rast.) 27:44-50.

Kalinkina, L.G., K.S. Spektorov and V.O. Bogoslovskaya. 1978. Effects of different concentrations of NaCl on growth and development of Chlorella pyrenoidosa. Plant Physiol. (Engl. Transl. Fiziol. Rast.) 25:16-20.

Kardatzke, J.T. 1980. Effect of sodium chloride on larval snow-melt Aedes (Diptera: Culicidae). Mosq. News 40:153-160.

Kardatzke, J.T. 1981. Effect of addition of calcium chloride to larval medium on survival of immature snow-melt Aedes (Diptera: Culicidae). Mosq. News 41:11-12.

Katz, U. and Y. Ben-Sasson. 1984. A possible role of the kidney and urinary bladder in urea conservation of Bufo viridis under high salt acclimation. J. Exp. Biol. 109:373-377.

Kessler, E. 1974. Physiological and biochemical contributions to the taxonomy of the genus Chlorella. IX. Salt tolerance as a taxonomic character. Arch. Microbiol. 100:51-56.

Konovalov, Y.D. 1984. Binding of dyes by carp embryonic cells under the effect of sulphates and chlorides. Hydrobiol. J. (Engl. Transl. Gidrobiol. Zh). 20(4):47-53.

Kostecki, P.T. and J.J. Jones. 1983. The effect of osmotic and ion-osmotic stresses on the mortality of rainbow trout (Salmo gairdneri). Comp. Biochem. Physiol. 74A:773-775.

Kumar, S. and G.J. Srivastava. 1981. The effect of sodium chloride on kidney and corpuscles of stannis of Channa punctatus (Bloch). Zool. Beitr. 26:13-16.

Leblanc, G.A. and D.C. Surprenant. 1984. The influence of mineral salts on fecundity of the water flea (Daphnia magna) and the implications on toxicity testing of industrial wastewater. Hydrobiologia 108:25-31.

Lee, F.C. 1973. Effect of various sodium chloride concentrations on the development of the mosquito Culiset a incidens (Thomson) (Diptera: Culicidae). Mosq. News 33:78-83.

Lewis, S.D. 1971. Effect of selected concentrations of sodium chloride on the growth of channel catfish. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 25:459-466.

Mahajan, C.L., S.D. Sharma and S.P. Sharma. 1979. Tolerance of aquatic organisms to chloride salts. Indian J. Exp. Biol. 17:1244-1245.

McCormick, S.D. and R.J. Naiman. 1984. Osmoregulation in the brook trout, Salvelinus fontinalis - II. Effects of size, age and photoperiod on seawater survival and ionic regulation. Comp. Biochem. Physiol. 79A:17-28.

Meech, R.W. and R.C. Thomas. 1980. Effect of measured calcium chloride injections on the membrane potential and internal pH of snail neurones. J. Physiol. 298:111-129.

Mushak, P.A. 1968. Content and state of nucleic acids in the alga Dunaliella salina Teod. depending upon NaCl concentration. Ukr. Bot. Zh. 25:91-95.

Ooshima, Y. and M. Oguri. 1974. Osmotic pressure, and sodium chloride concentrations in the blood plasma of "Cobalt" variant of rainbow trout. Bull. Jpn. Soc. Sci. Fish. 40:1307.

Palmer, C.M. and T.E. Maloney. 1955. Preliminary screening for potential algicides. Ohio J. Sci. 55:1-8.

Pappas, L.G. and C.D. Pappas. 1983. Laboratory studies on the significance of NaCl as an oviposition deterrent in Culiseta inornata. Mosq. News 43:153-155.

Patrick, R., J. Cairns, Jr. and A. Scheier. 1968. The relative sensitivity of diatoms, snails, and fish to twenty common constituents of industrial wastes. Prog. Fish-Cult. 30:137-140.

Perry, S.F., P. Payan and J.P. Girard. 1984. Effects of perfusate HCO_3 and pCO_2 on chloride uptake in perfused gills of rainbow trout (Salmo gairdneri). Can. J. Fish. Aquat. Sci. 41:1768-1773.

Phillips, A.M., Jr. 1944. The physiological effect of sodium chloride upon brook trout. Trans. Am. Fish. Soc. 74:297-309.

Reed, P. and R. Evans. 1981. Acute toxicity of chlorides, sulfates and total dissolved solids to some fishes in Illinois. Contract Report 283. State Water Survey Division, Peoria, IL.

Reynoso, G.T., B.A. de Gamboa and S.R. Mendoza. 1982. Induction of resistance to salinity in the freshwater alga Chlamydomonas reinhardtii. Environ. Sci. Res. 23:531-534.

Schiewer, U. 1974. Salt tolerance and the influence of increasing NaCl-concentrations on the contents of nitrogen, carbohydrates, pigments and the production of extracellular carbohydrates in some freshwater blue-green algae. Arch. Hydrobiol. Suppl. 46:171-184.

Schiewer, U. 1976. Ash content and ATPase activity of limnic blue green algae under sodium chloride loads. Wiss. Z. Univ. Rostock Math. Naturwiss. Reihe 25:287-294.

Schiewer, U. 1984. The ecophysiology of salt adaptation in freshwater blue-green algae. Limnologica 15:555-558.

Setter, T.L., H. Greenway and J. Kuo. 1982. Inhibition of cell division by high external NaCl concentrations in synchronized cultures of Chlorella emersonii. Aust. J. Plant Physiol. 9:179-196.

Shaw, H.M., R.L. Saunders, H.C. Hall and E.B. Henderson. 1975. Effect of dietary sodium chloride on growth of Atlantic salmon (Salmo salar). J. Fish. Res. Board Can. 32:1813-1819.

Shitole, M.G. and G.V. Joshi. 1984. Effect of sodium chloride on the balance between C_3 and C_4 carbon fixation pathways and growth. Photosynthetica 18:377-384.

Shomer-Ilan, A. and Y. Waisel. 1976. Further comments on the effects of NaCl on photosynthesis in Aeluropus litoralis. Z. Pflanzenphysiol. 77:272-273.

Sonzogni, W.C., W. Richardson, P. Rodgers and T.J. Monteith. 1983. Chloride pollution of the Great Lakes. J. Water Pollut. Control Fed. 55:513-521.

Spehar, R.L. 1987. U.S. EPA, Duluth, MN. (Memorandum to C. Stephan. U.S. EPA, Duluth, MN. June 24).

Sreenivasan, A., R. Ananthanarayanan and N. Kalaimani. 1979. Relationship between high chloride and hardness with rotifers. Indian J. Environ. Health 21:287-288.

Stamper, W.R. 1969. The determination of the optimal combination of sodium, potassium, calcium and magnesium chlorides for the survival of Daphnia pulex. Ph.D. thesis. Pennsylvania State University, University Park, PA. Available from: University Microfilms, Ann Arbor, MI. Order No. 70-19,471.

Stangenberg, M. 1975. The influence of the chemical composition of water on the pike perch (Lucioperca lucioperca L.) fry from the Lake Goplo. Limnologica 9:421-426.

Stanley, R.A. 1974. Toxicity of heavy metals and salts to Eurasian watermilfoil (Myriophyllum spicatum L). Arch. Environ. Contam. Toxicol. 2:331-341.

Stephan, C.E., D.I. Mount, D.J. Hansen, J.H. Gentile, G.A. Chapman and W.A. Brungs. 1985. Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses. PB85-227049. National Technical Information Service, Springfield, VA.

Sullivan, L.P., D.J. Welling and L.A. Rome. 1981. Effects of sodium and chloride on potassium transport by the bullfrog kidney. Am. J. Physiol. 240:127-137.

Teeter, J.W. 1965. Effects of sodium chloride on the sago pondweed. J. Wildl. Manage. 29:838-845.

Thornton, K.W. and J.R. Sauer. 1972. Physiological effects of NaCl on Chironomus attenuatus (Diptera: Chironomidae). Ann. Entomol. Soc. Am. 65:872-875.

Thornton, K. and J. Wilhm. 1974. The effects of pH, phenol, and sodium chloride on survival and caloric, lipid, and nitrogen content of a laboratory population of Chironomus attenuatus. Hydrobiologia 45:261-280.

Thornton, K.W. and J.L. Wilhm. 1975. The use of life tables in demonstrating the effects of pH, phenol, and NaCl on Chironomus attenuatus populations. Environ. Entomol. 4:325-328.

Threader, R.W. and A.H. Houston. 1983. Use of NaCl as a reference toxicant for goldfish, Carassius auratus. Can. J. Fish. Aquat. Sci. 40:89-92.

Ticku, M.K. and R.W. Olsen. 1977. Aminobutyric acid-stimulated chloride permeability in crayfish muscle. Biochim. Biophys. Acta 464:519-529.

Tomasso, J.R., M.I. Wright, B.A. Simco and K.B. Davis. 1980. Inhibition of nitrite-induced toxicity in channel catfish by calcium chloride and sodium chloride. Prog. Fish-Cult. 42:144-146.

Trama, F.B. 1954. The acute toxicity of some common salts of sodium, potassium and calcium to the common bluegill (Lepomis macrochirus Rafinesque). Proc. Acad. Nat. Sci. 106:185-205.

Tuchman, M.L. and E.F. Stoermer. Manuscript a. The effects of increased NaCl and KCl concentrations on a natural phytoplankton assemblage from Lake Superior. U.S. EPA, Chicago, IL.

Tuchman, M.L. and E.F. Stoermer. Manuscript b. The effects of NaCl and KCl additions on the competitive interactions between a diatom and a blue-green alga. U.S. EPA, Chicago, IL.

Turoboyski, L. 1960. Influence of high concentrations of some chemical compounds upon carp fry. Rocz. Nauk. Roln. 75B:401-445.

U.S. EPA. 1983a. Water quality standards regulation. Federal Regist. 48:51400-51413. November 8.

U.S. EPA. 1983b. Water quality standards handbook. Office of Water Regulations and Standards, Washington, DC.

U.S. EPA. 1985a. Appendix B - Response to public comments on "Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses." Federal Regist. 50:30793-30796. July 29.

U.S. EPA. 1985b. Technical support document for water quality-based toxics control. EPA-440/4-85-032 or PB86-150067. National Technical Information Service, Springfield, VA.

U.S. EPA. 1986. Chapter 1 - Stream design flow for steady-state modeling. In: Book VI - Design conditions. In: Technical guidance manual for performing waste load allocation. Office of Water, Washington, DC. August.

U.S. EPA. 1987. Permit writer's guide to water quality-based permitting for toxic pollutants. EPA-440/4-87-005. Office of Water, Washington, DC.

Vaidya, D.P. and R. Nagabhushanam. 1979. Influence of salt concentrations on survival, body weight and blood chloride of the freshwater snail, Indoplanorbis exustus (Deshyes) Hydrobiologia 63:195-198.

Van Horn, W.M., J.B. Anderson and M. Katz. 1949. The effect of Kraft pulp mill wastes on some aquatic organisms. Trans. Am. Fish. Soc. 79:55-63.

Vosjan, J.H. and R.J. Siezen. 1968. Relation between primary production and salinity of algal cultures. Neth. J. Sea Res. 4:11-20.

Wallen, I.E., W.C. Greer and R. Lasater. 1957. Toxicity to Gambusia affinis of certain pure chemicals in turbid waters. Sewage Ind. Wastes 29:695-711.

Zaim, M. and H.D. Newson. 1979. Larval development and oviposition behavior of Aedes triseriatus (Diptera: Culicidae) as affected by varying concentrations of sodium chloride and calcium nitrate in the water. Environ. Entomol. 8:326-329.

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION 6
DALLAS, TEXAS

In the Matter of:	)	
	)	
Altec Petroleum Groups. Inc.	)	CWA-06-2008-1832
	)	
Respondent.	)	

COMPLAINANT'S RESPONSE TO THE MAY 24, 2011, COURT ORDER FOR MORE DEFINITE STATEMENT

COMES NOW, the Complainant, the Director of the Compliance Assurance and Enforcement Division, through his attorney, Lorraine Dixon, in accordance with the Consolidated Rules of Practice Governing the Administrative Assessment of Civil Penalties and the Revocation/Termination or Suspension of Permits (the Consolidated Rules), 40 C.F.R. § 22.1 *et seq*., and files its Response to this Court's May 24, 2011, Order For More Definite Statement.

I. ADMINISTRATIVE PROCEDURES TO DATE

1. On May 20, 2008, Complainant issued an Administrative Complaint to the Respondent, Altec Petroleum Group, Inc. ("Respondent") pursuant to Section 309(g) of the Clean Water Act ("CWA").

2. Complainant filed a request for a hearing with the Regional Hearing Clerk on June 26, 2008.[1]

3. On June 30, 2008, the Presiding Officer issued a Scheduling Order, ordering the following:

· The parties to discuss settlement on or before July 23, 2008;

· the parties to file a status report of settlement negotiations;[2]

[1] Complainant alleges that the request did not comply with 40 C.F.R. § 22.15 as it did not clearly admit, deny or explain each of the factual allegations contained in the Original or the Amended Complaint.

· Respondent to file an answer to the Complaint as described in 40 C.F.R. § 22.15;[3]

· for both parties to submit a prehearing exchange no later than August 26, 2008;

· to file a response to the prehearing exchange by September 12, 2008; and

· the parties to participate in a prehearing conference with the Presiding Officer on September 23, 2008.

4. On July 31, 2008, the Presiding Officer issued its First Amended Scheduling Order granting both parties request for an extension to file their Prehearing exchanges and set a September 26, 2008 date for both parties to file its prehearing exchange.

5. On September 26, 2008, Complainant filed its PreHearing Exchange.

6. To date, Respondent has not filed its PreHearing exchange.

7. On October 28, 2008, Complainant filed a Motion to Amend the Complaint.

8. On June 9, 2009, the Presiding Officer granted Complainant's Motion to Amend the Complaint.

9. On July 13, 2009, Complainant filed a Motion for Extension of Time to file its Amended Complaint.

10. On July 15, 2009, Complainant filed its Amended Complaint.

11. Respondent did not file an Answer to the Amended Complaint.

12. On December 22, 2009 the Complainant filed a Motion for Accelerated Decision as to both Liability and Penalty seeking an Order granting full judgment against Respondent,

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[2] A Joint Status report was filed on July 23, 2008. In the Joint Status report both parties requested a thirty day extension to file their prehearing exchange.

[3] The Presiding Officer Ordered that the Respondent "… respond paragraph by paragraph to the Complaint, clearly and directly admitting, denying, or explaining each of the factual allegations in the Complaint with regard to which the Respondent has any knowledge. Where Respondent has no knowledge of a particular factual allegation and so states, the allegation will be deemed to be denied. The answer shall also set out the circumstances or arguments which are alleged to constitute the grounds of any defense. Failure of respondent to admit, denies, or explain and material factual allegation continued in the Complaint will be deemed an admission of the allegation.

Altec Petroleum Group, Inc., in this matter and assessing a civil penalty in the amount of $19,500. To date, Respondent has filed no response to this Motion.

13. On May 24, 2011, the Court filed an Order for More Definite Statement ("May 24, 2011 Order"). The May 24, 2011 Order requires Complainant's witness, Matthew Rudolph, to file a declaration describing his actions in the Altec Petroleum Group, Inc, matter, including his observations at the well site and all other facts on which Complainant has based its conclusion on that demonstrates that Respondent discharged pollutants without authorization. The Order also establishes that if Complainant relies on photographic evidence, the declaration shall describe the content of each photograph and its relevance to those conclusions.

14. Complainant hereby responds by filing Mr. Matthew Rudolph's Declaration and Complainant's evidence in support thereof consistent with this Court's May 24, 2011 Order.

II. DECLARATION OF MATTHEW RUDOLPH

I, MATTHEW RUDOLPH, make the following statements truthfully and sound fully from personal knowledge. I, Matthew Rudolph, work as an Environmental Engineer employed in the Water Enforcement Branch of the Compliance Assurance Enforcement Division of the United States Environmental Protection Agency, Region 6 ("EPA"). I joined the EPA and the Water Enforcement Branch in May 2003. My job duties are that of an enforcement officer and inspector. As such, I have the authority and credentials to conduct inspections at facilities and issue enforcement actions against facilities which are in violation of the Clean Water Act (CWA).

On September 13, 2007, I spoke with John Rempe, a biologist with the Oklahoma Department of Wildlife Conservation. Mr. Rempe had concerns about a drilling location (facility) located on the Osage County Western Wall Wildlife Management Area (the "WMA") and the water

pollution associated with this facility. Specifically, he had concerns about an earthen pit located at the facility which appeared to be contaminating a creek located adjacent to the facility and also located in the WMA. This facility was identified as Altec Petroleum Group, Inc.

On September 17, 2007, I was forwarded an e-mail from Renea Ryland describing operations at the Altec facility. Attached to the e-mail were two pictures: one of an unlined earthen pit with drilling fluids located on the facility; and the other was of an impacted creek. **(See Photo Exhibits 1 and 2)**[4]

On September 19, 2007, I was forwarded another e-mail from Renea Ryland. In the e-mail as an attachment was a letter from the OAG dated September 19, 2007. **(See Exhibit 1)** The letter indicates that the OAG took an action against the Defendant prohibiting the Defendant and its employees from entering the WMA and to cease and desist all present and future operations at the WMA.

On September 20, 2007, I was forwarded another e-mail from Renea Ryland. In the e-mail as an attachment was a copy of a letter from the OAG dated September 20, 2007. **(See Exhibit 2)** The letter outlines the expectations of the OAG regarding the cleanup work and the proper close out of the oil well located at the site.

On September 21, 2007, Kent Sanborn of the EPA conducted an inspection at the facility. Mr. Sanborn wrote an inspection report outlining his findings. **(See Exhibit 3)**[5]

On October 2, 2007, I received the inspection report via e-mail from Kent Sanborn. In the inspection report, Mr. Sanborn identified as areas of concerns two unlined earthen drilling pits

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[4] From my observations as an Environmental Engineer, photo exhibit 1 is of a flowing creek. I determined that this is the creek located directly adjacent to the facility. Additionally, photo exhibit 2 clearly shows fluids located in an unlined earthen pit at the facility and adjacent to the creek. Photo 2 also demonstrates that the pit is unlined and the soil in the pit is sandy. Based upon my knowledge as an Environmental Engineer sandy soil is highly permeable which would allow brine and other fluids to seep or flow through it.

[5] From the inspection report I determined that the facility had an unauthorized discharge of brine to a water body. In the inspection report the water body was identified as a tributary of Rock Creek but upon further investigation the water body was changed to a tributary of the South Fork of Pond Creek.

located at the northwest corner of the facility had been backfilled in. Mr. Sanborn observed evidence of where the backfilled pits had discharged brine into drainage located approximately 10 feet west and down-gradient of the pit. The discharge traveled approximately 470 feet to where the drainage empties into a creek which appeared to have relative permanent flow. The inspection report also identified an impacted creek which was determined to be a tributary of the South Fork of Pond Creek. Along with the inspection report there were photos which showed the facility and the impacted creek. **(See Photo Exhibits 3-12)**. Based upon my experience and knowledge as an Environmental Engineer it is my opinion, that the photos and evidence collected demonstrated that the impacted creek appeared to have a well defined bed and bank with water located in it. The creek appeared to be three to five feet wide and one foot deep, thus, I drew the conclusion that the impacted creek is a relative permanent flowing water body.

On October 3, 2007, I contacted Altec Petroleum Group, Inc. and spoke with the President of the company, Patrick Adams. I informed Mr. Adams that the EPA cited a violation to the CWA at his facility and an Administrative Order for Compliance would be issued by the EPA to Altec. I informed him that the AO was going to require Altec to perform the following: (1) cease all discharges of pollutants from the facility; (2) remove the brine from the creek; (3) install a catchment structure to catch all the contaminated run-off from the site; and (4) neutralize or extract the contaminated soils from the site. On November 16, 2007, Administrative Order Docket Number CWA-06-2008-1737 was issued to Altec Testing and Engineering, Inc. for a violation of the Clean Water Act referencing the September 21, 2007, inspection findings. The AO required Altec to perform the following: (1) cease all discharges of pollutants from the facility; (2) remove the brine from the creek; (3) install a catchment structure to catch all the

contaminated run-off from the site; and (4) neutralize or extract the contaminated soils from the site. **(See Exhibit 4)**

On November 15, 2007, I received a fax from Kent Sanborn of the sample results which were sent in to him from John Rempe. The samples were taken by Mr. Rempe in September 2007, and are both water and soil samples. The water samples showed high salt concentrations in the tributary of the South Fork of Pond Creek downstream of the facility and even higher salt concentrations at the discharge point of entry where the seep from the drilling pit was entering into the tributary of the South Fork of Pond Creek. The soil samples showed high salts in the soil at the drilling pit location after it was back filled in meaning the brine continued to seep from the old drilling pit through the soil and into the tributary of the South Fork of Pond Creek. **(See Exhibit 9)**

On March 10, 2008, EPA inspector Kent Sanborn conducted a second inspection at the site. **(See Exhibit 5)** During the second inspection EPA found evidence of yet another discharge from the site to the same tributary of the South Fork of Pond Creek. On March 12, 2008, I contacted Mr. Adams to let him know of the EPA's inspection findings from March 10, 2008, and that the probability of EPA pursuing a penalty for the alleged violations was likely.

On March 26, 2008, I received the March 10, 2008, inspection report via e-mail from Kent Sanborn. In the inspection report, Mr. Sanborn observed that no dam was ever built to contain the brine. He observed that on the drainage to the creek salinity measured 3,700 ppm to 6,700 ppm TSS and salinity downstream in the creek measured 1,200 ppm to 2,200 ppm TSS. **(See Photos Exhibits 13-16)**[6] Based upon my experience and knowledge as an Environmental Engineer I determined that the inspection reports and the photo evidence warranted a penalty for the alleged violations.

[6] Photo exhibit 15 showed the impacted creek next to the facility to be flowing with a high salt content.

On May 20, 2008, the EPA issued an Administrative Complaint Docket No. CWA-06-2008-1832. **(See Exhibit 6).**

On June 23, 2008, the Defendant submitted a letter to the EPA addressing it to Mr. John Blevins, Director of the Compliance Assurance and Enforcement Division, requesting a hearing on this matter. **(See Exhibit 7)**

On July 2, 2008, I contacted Mr. Adams to discuss setting up a settlement meeting.

On July 17, 2008, Lorraine Dixon, Regional Attorney, and I had a conference call with Mr. Adams to discuss settlement. No settlement was reached.

On September 9, 2008, I contacted John Rempe to ask him if he would appear as an eye witness for this case. Mr. Rempe informed me that he could appear as a witness in this case.

On September 11, 2008, I contacted John Rempe in regards to information about the tributary of the South Fork of Pond Creek. Mr. Rempe informed me that the creek flows approximately 6 to 8 months out the year.

On September 18, 2008, Kent Sanborn re-inspected the facility and the tributary of the South Fork of Pond Creek.

Based upon my discussions with Mr. Sanborn, observations of the photographs and review of maps, I determined that the wrong water body had been identified in the Original Complaint.

On October 28, 2008, Complainant filed a Motion to Amend the Complaint.

On July 15, 2009, EPA filed its Amended Complaint to include the correct water body. **(See Exhibit 8)**

On November 6, 2008, I inspected Pond Creek downstream of where the discharge entered into the tributary of the South Fork of Pond Creek. I was unable to inspect the facility and the tributary of the South Fork of Pond Creek due to car trouble. Based upon my experience and

knowledge as an Environmental Engineer, in addition to, my inspection and the inspection of Mr. Kent Sanborn, the photos of Pond Creek and my review of maps I determined that the evidence supported the finding that Pond Creek is a navigable in-fact water body. **(See Photos Exhibits 17-22)**[7]

Thus, based upon all of the above mentioned evidence it is my opinion that Altec Petroleum Group is in violation of the Clean Water Act (CWA), 33 U.S.C. § 1251 *et seq.,* for discharges of pollutants to waters of the United States and that the penalty was calculated in accordance with the statutory factors of Section 309(g) (3) of the CWA. (See Exhibits 10 and 11)

III. PRAYER FOR RELIEF

WHEREFORE, Complainant respectfully prays the Court will issue the following order: Respondent, Altec Petroleum Group, Inc., is found to be in violation of Section 301 of the CWA for the unlawful discharge of pollutants to waters of the United States and a civil penalty in the amount of $19,500 is assessed against the Respondent.

Respectfully submitted,

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[7] These photos show the South Fork of Pond Creek and Pond Creek further downstream from the discharge point of entry. Photo exhibit 21 shows Pond Creek and clearly here Pond Creek is navigable in-fact.

CERTIFICATE OF SERVICE

I hereby certify that on the 12 day of July 2011, the original of the foregoing Response to the May 24, 2011, Court Order for More Definite Statement was hand delivered to the Regional Hearing Clerk and the Regional Judicial Officer, U.S. EPA, Region 6, 1445 Ross Avenue, Dallas, Texas 75202-2733, and that true and correct copies were placed in the United States Mail, postage prepaid, addressed to the following:

Mr. Patrick Adams
President
Altec Petroleum Group
3232 County Road 3460
Pawhuska, OK 74056

and

Mr. Patrick Adams
President
Altec Petroleum Group
6035 Fremont St.
Riverside, CA 92504-1114

Jackie Allen
Paralegal